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MANAGING MEGA-CITY TRANSPORTATION PLANNING SYSTEMS: CASES OF NEW YORK AND SHANGHAI

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Abstract
This paper conducts a comparative analysis on the megacity transportation planning systems between New York and Shanghai. This case study examines the seven lessons learned from New York's public transportation development: building political partnership; ensuring economical reasonableness; optimizing transit project development process; ensuring multimodal connection; integrating land use and transportation; achieving sustainable development; and synchronizing transit system expansion with travel demand increase. Based on this empirical study, the paper makes preliminary recommendations on how to apply these seven lessons to Shanghai.
Keywords: New York; Shanghai; Public Transportation; Subway; Lessons.

1. Introduction

The research on megaregions is recently surging because many pressing planning issues are megapolitan in nature, transcending individual city, county, or even metropolitan boundaries (Carbonell and Yaro, 2005; Lang and Dhavale, 2005; Regional Plan Association, 2007; Ross, 2009). It is expected that by 2030, for the first time in history, two out of three people will live in urban areas, especially in the megaregions (Amekudzi, Thomas-Mobley and Ross, 2007). Global cities or world cities are all interconnected and located in megaregions, forming integral components of the so-called network society (Castells, 1996; Taylor, Catalano and Walker, 2002; Taylor and Lang, 2005).

To effectively study megaregions requires a clear and deep understanding about their central megacities. These central megacities and their supporting areas have multi-faceted, synergistic and symbiotic relations, which are forged by transportation and other means. Therefore, it is important to conduct a thorough study on the megacity transportation planning process, which not only impacts megacities themselves, but also the entire megaregions.

This paper chooses New York and Shanghai, both of which are globally important central megacities, as case examples to unfold this research. New York is the most important and the largest city in the U.S. The New York-centered Northeast Megaregion, which geographically spans from the north of Boston to the south of Washington, D.C., is widely regarded as the most established and well-known "megalopolis" or "liquid city" in

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the world (Gottmann, 1961; Short, 2007; University of Pennsylvania, 2005). Likewise, Shanghai is the economic capital of China. The Yangtze River Delta (YRD) Megaregion, with Shanghai as its dominant anchor city, is emerging as the most important megaregion in China with a global influence.

Following this introduction, the paper first describes the geographic settings, transportation systems, and planning institutions of New York and Shanghai. Afterwards, it highlights the lessons learned from New York's public transportation development, based on which a series of recommendations are made for Shanghai. Finally, it summarizes research findings and draws conclusions.

2. NEW YORK AND SHANGHAI: FACTS AT A GLANCE

This section takes glance at the most relevant facts about New York and Shanghai.

2.1. Geographic Settings

New York can be defined at two geographic levels: metropolitan statistical area (MSA) level and central city level. Situated along the northeastern seaboard, the New York Tri-State MSA is defined by the U.S. Office of Management and Budget as the New York-Northern New Jersey-Long Island, New York-New Jersey-Pennsylvania Metropolitan Statistical Area, which includes 23 counties with about 19 million residents, as illustrated in Figure 1.

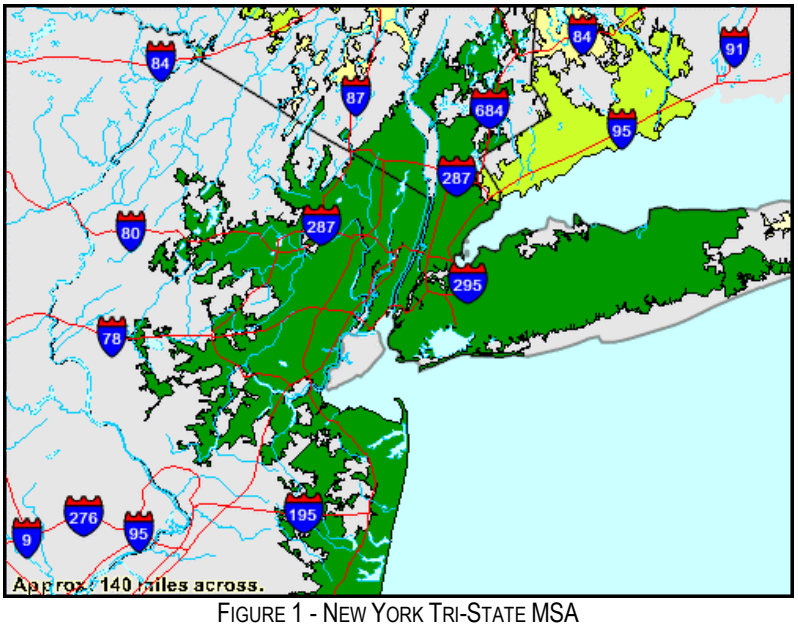

FIGURE 1 - NEW YORK TRI-STATE MSA

As New York Tri-State MSA's central anchor city, New York City includes 5 county-equivalent boroughs: Manhattan, Brooklyn, Queens, Bronx, and Staten Island. See Figure 2 for details. This paper concentrates on New York City because this is where the most subway operations take place.

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FIGURE 2 - NEW YORK CITY BOROUGHS

Sitting on the Yangtze River Delta on China's eastern coast, Shanghai is bordered on the north and west by Jiangsu Province, on the south by Zhejiang Province, and on the east by the East China Sea (Yang, 2009). Shanghai's administrative system is different from New York's. As a province-equivalent municipality, Shanghai Municipality currently includes 17 districts and 1 county (Chongming). See Figure 3 for the latest Shanghai Municipality Map. Since Shanghai Municipality includes both city proper (can be regarded as central city) and the surrounding districts (most of them are former rural counties), it is essentially the Shanghai MSA equivalent to the New York Tri-State MSA. The Yangtze River Delta Megaregion corresponds to the Northeast Megaregion.

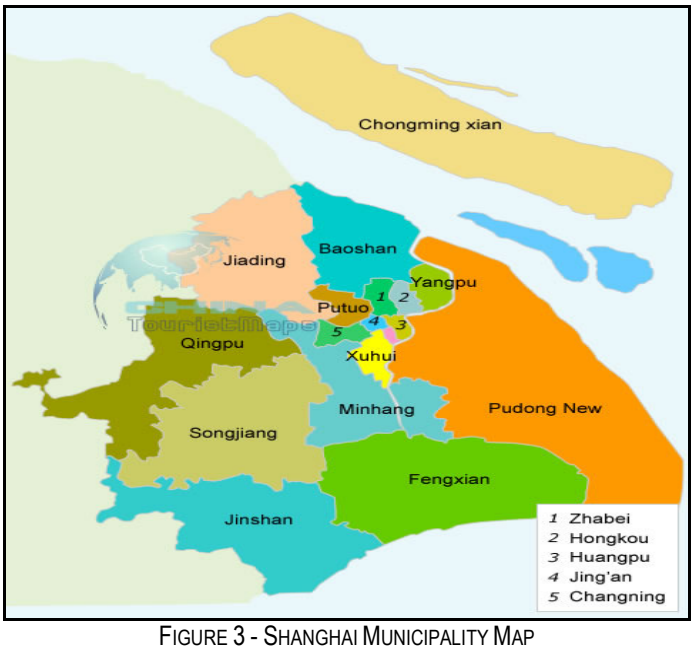

FIGURE 3 - SHANGHAI MUNICIPALITY MAP

ISSN
2067- 2462

As shown in Figure 4, Shanghai's central city, i.e., the Shanghai Proper, includes 9 core districts (Huangpu, Luwan, Xuhui, Changning, Jing'an, Putuo, Zhabei, Hongkou, and Yangpu). Nanshi District was merged into new Huangpu District in 2000.

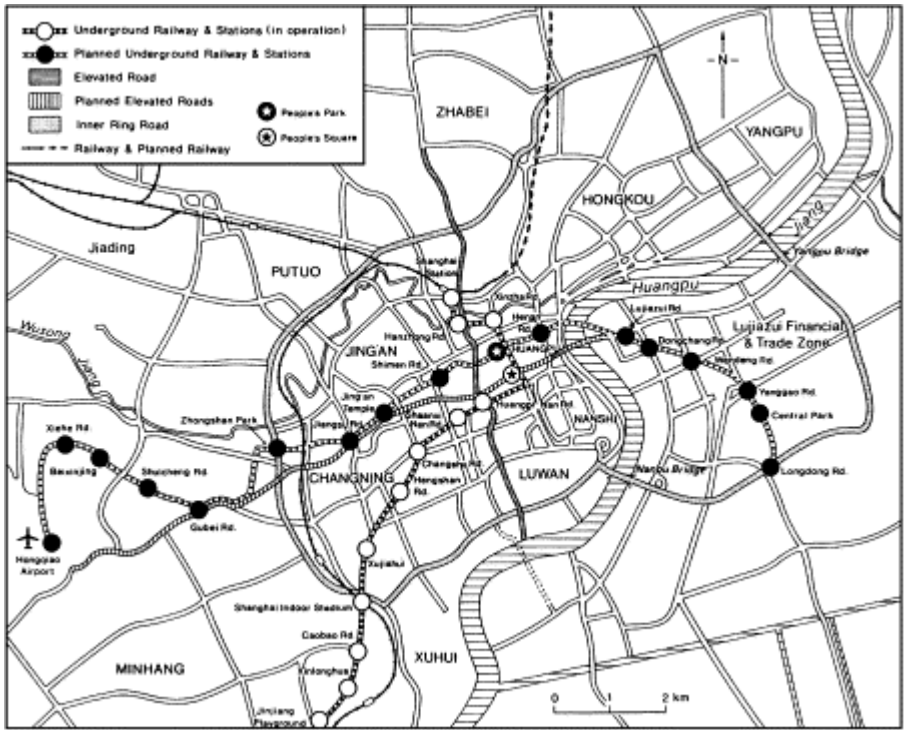

FIGURE 4 - SHANGHAI PROPER MAP

Using the above geographic definitions, the area and population of New York and Shanghai are compared in Table 1.

TABLE 1 - AREA AND POPULATION OF NEW YORK AND SHANGHAI

Indicators	MSA Level		Central City Level	
	New York Tri-State MSA	Shanghai Municipality	New York City (5 boroughs)	Shanghai Proper (9 Districts)
2007 Population	18,810,000 persons	18,580,800 persons	8,274,527 persons	6,210,000 persons
Land Area	17,405 km^2	6,340.5 km^2	785.21 km^2	288.33 km^2
2007 Population Density	1,081 persons/km^2	2,930 persons/km^2	10,538 persons/km^2	21,538 persons/km^2

Table 1 indicates that even though New York Tri-State MSA and Shanghai Municipality has a comparable population size (about 19 million population), the population density of Shanghai is more than double that of New York at both MSA level and central city level.

Table 2 takes a closer look at the borough-level population density in New York City. Manhattan borough has the smallest land area, yet has the population density much higher than those of other boroughs. Therefore, Manhattan borough is the single and dominant central business district (CBD) of New York City.

ISSN
2067- 2462

TABLE 2 - NEW YORK CITY AREA AND POPULATION IN 2000

Area	Total Population	Land Area (km^2)	Density (Population / km^2)
New York City	8,008,278	785.21	10,198.93
- Bronx borough	1,332,650	108.73	12,256.17
- Brooklyn borough	2,465,326	182.77	13,488.31
- Manhattan borough	1,537,195	59.54	25,816.01
- Queens borough	2,229,379	282.71	7,885.86
- Staten Island borough	443,728	151.45	2,929.87

Source: U.S. Census Bureau. (2000). County and City Data Book. Washington, D.C.: U.S. Census Bureau.

Table 3 shows the Shanghai Proper area and population in 2007. Unlike New York City, which has a single and dominant CBD, Shanghai seems to have three roughly comparable CBDs: Huangpu, Jing'an, and Luwan Districts. While Huangpu District has the highest population density, Jing'an District and Luwan District also have similarly high population densities.

TABLE 3 - SHANGHAI PROPER AREA AND POPULATION IN 2007

Area	Registered Population	Land Area (km^2)	Population Density (Population/km^2)
Shanghai Proper	6,154,779	288.33	21,346.30
- Huangpu District	605,579	12.41	48,797.66
- Luwan District	311,500	8.05	38,695.65
- Xuhui District	891,800	54.76	16,285.61
- Changning	611,300	37.19	16,437.21
- Jing'an District	309,900	7.62	40,669.29
- Putuo District	862,900	54.83	15,737.73
- Zhabei District	695,100	29.26	23,755.98
- Hongkou District	789,600	23.48	33,628.62
- Yangpu District	1,077,100	60.73	17,735.88

Source: http://www.stats-sh.gov.cn/2003shtj/tjnj/nj08.htm?d1=2008tjnj/C0305.htm.

2.2. Transportation Systems

This section describes the transportation systems of New York and Shanghai from both demand (focusing on trip making) and supply (focusing on subway) perspectives.

1) Trip Distribution

According to New York Metropolitan Transportation Council (2010), Manhattan, Brooklyn and Queens produce and attract similarly numbers of auto trips, much higher than those of Bronx and Staten Island.

TABLE 4 - 2010 DAILY BOROUGH-TO-BOROUGH TRIPS BY AUTO

Boroughs	Bronx	Brooklyn	Manhattan	Queens	Staten Island	Total
Bronx	768,162	8,725	132,375	21,022	908	931,192
Brooklyn	8,668	1,475,150	158,725	133,233	52,978	1,828,754
Manhattan	131,695	157,443	1,424,080	200,525	13,505	1,927,248
Queens	20,447	132,731	199,850	1,397,525	4,000	1,754,553
Staten Island	1,062	54,297	12,814	3,773	742,252	814,198
Total	**930,034**	**1,828,346**	**1,927,844**	**1,756,078**	**813,643**	**7,255,945**

Source: New York Metropolitan Transportation Council. (2010). 2035 Regional Transportation Plan: A shared Vision for a Shared Future. New York, NY: New York Metropolitan Transportation Council.

ISSN
2067- 2462

For transit trips, the situation is totally different. Manhattan is an overwhelmingly dominant transit hub in New York. The transit trips generated by Manhattan are nearly half of New York City' total transit trips because of its large employment base.

TABLE 5 - 2010 DAILY BOROUGH-TO-BOROUGH TRIPS BY TRANSIT

Boroughs	Bronx	Brooklyn	Manhattan	Queens	Staten Island	Total
Bronx	556,315	10,248	197,801	15,546	581	780,491
Brooklyn	9,606	1,136,940	515,106	67,808	13,965	1,743,425
Manhattan	197,590	511,467	2,778,938	569,452	16,700	4,074,147
Queens	14,614	68,121	571,774	634,628	1,167	1,290,304
Staten Island	567	14,607	16,102	1,276	176,478	209,030
Total	778,692	1,741,383	4,079,721	1,288,710	208,891	8,097,397

Source: New York Metropolitan Transportation Council. (2010).. 2035 Regional Transportation Plan: A shared Vision for a Shared Future. New York, NY: New York Metropolitan Transportation Council.

2) Commuting Mode Split

As shown in Table 6, of the total journey-to-work commuting trips in New York, 54% were transit trips (over 59% of these transit trips were subway trips) and 31% were auto trips (over 80% of these auto trips were drive-alone trips). Walking, taxi, bicycling, ferry and others accounted for the remaining 15% of commuting trips.

TABLE 6 - NEW YORK CITY'S COMMUTING MODE SPLIT IN 2004

Modes	Percentages
Subway	32%
Bus	14%
Commuter rail	8%
Transit subtotal	*54%*
Drive alone	25%
Carpool	6%
Auto subtotal	*31%*
Walking	8%
Taxi	1%
Bicycling	0.4%
Ferry	0.4%
Others	5.2%
Total	**100%**

Source: U.S. Census Bureau (2004) American Community Survey. Washington, D.C.: U.S. Census Bureau.

Compared to New York City, Shanghai's transit modal share (37.3%) was much lower due to its much higher bicycling and walking modal shares. See Table 7 for details. This is also partly due to China's relatively low auto ownership. The per-capita auto ownership ratio in China is around 40 autos for every 1,000 citizens this year. By contrast, the U.S. already had 765 autos per 1,000 citizens in 2002 (Source: http://www.greencarcongress.com/2006/05/percapita_car_o.html). According to the survey of Shanghai Comprehensive Urban Transportation Planning Institute (1992), Shanghai's walking modal share has been in

ISSN
2067- 2462

decline over the years due to its switch to other motorized modes. Shanghai is undergoing a rapid motorization process.

TABLE 7 - SHANGHAI'S COMMUTING MODE SPLIT IN 1991

Modes	Percentages
Transit	37.3%
Bicycling	28.5%
Walking	26.1%
Others	8.1%

Source: Shen (1997) Urban Transportation in Shanghai, China: Problems and Planning Implications. International Journal of Urban and Regional Research 21 (4): 589 - 606.

3) Subway System

Globally, the New York City's subway is the largest rapid transit system in terms of track mileage and the fourth largest one in terms of annual ridership, trailing Tokyo, Moscow, and Seoul, as shown in Table 8.

TABLE 8 - LIST OF THE LARGEST SUBWAY SYSTEMS IN THE WORLD IN 2007

City	Annual Subway Ridership
1. Tokyo	3.011 billion
2. Moscow	2.529 billion
3. Seoul	1.655 billion
4. New York City	**1.563 billion**
5. Mexico City	1.417 billion
6. Paris	1.410 billion
7. London	1.015 billion
8. Osaka	878 million
9. Hong Kong	867 million
10. St. Petersburg	828 million

Source: http://www.mta.info/nyct/facts/ffsubway.htm.

Table 9 shows New York City subway statistics provided by the Metropolitan Transportation Authority (MTA).

TABLE 9 - NEW YORK CITY SUBWAY STATISTICS IN 2009

Indicators	Numbers
Average weekday passengers	5,225,675
Subway lines	26
Subway cars	6,290
Subway Route Miles (Kilometers)	229 Miles (369 Kilometers)
Revenue Track Miles (Kilometers)	656 Miles (1,056 Kilometers)
Subway stations	468

Source: http://www.mta.info/mta/network.htm. Note: Subway in four boroughs excluding Staten Island Railway.

Figure 5 shows the New York City Subway Route Map. Manhattan has the densest subway routes, which are interconnected with those in Brooklyn, Queens, and Bronx. Staten Island has its own, independent rail system.

ISSN
2067- 2462

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Management Research and Practice
Volume 3, Issue 4 / December 2011

FIGURE 5 - NEW YORK CITY SUBWAY ROUTE MAP

FIGURE 6. SHANGHAI SUBWAY ROUTE MAP

ISSN
2067- 2462

The Shanghai's subway system, or Metro, is among the most rapidly expanding ones in the world. After the first line opened only in 1995 as a north-south axis from the Central Station to the southern suburbs, the Shanghai Metro system has reached a total length of over 420 km in 2010, comprising 12 lines, as illustrated in Figure 6.

Table 10 shows the Shanghai Subway Statistics. In terms of its subway route length, Shanghai (423.8 km) has surpassed New York (369 km), becoming the city with the longest rapid transit network in the world (Freemark, 2010). In terms of rail ridership, however, Shanghai Metro is still behind New York subway. By the year 2020, the Shanghai Metro System will comprise 22 lines and 877 km of length.

TABLE 10 - SHANGHAI SUBWAY STATISTICS IN 2009

Indicators	Numbers
Average weekday passengers	3.56 million
Subway lines	12
Subway Route Miles (Kilometers)	263.4 miles (423.8 km)
Subway stations	268

Source: http://www.urbanrail.net/as/shan/shanghai.htm.

2.3. Planning Institutions

New York has different levels of agencies involved in transportation planning, design, construction, and operation. Table 11 provides a list of major transportation-related agencies, along with their responsibilities and plans.

TABLE 11 - MAJOR TRANSPORTATION-RELATED AGENCIES IN NEW YORK

Geographic Level	Agencies	Responsibilities	Key Plans
City Level	New York City Department of City Planning (NYCDCP)	City's zoning and land use processes.	PlaNYC.
	New York City Department of Transportation (NYCDOT)	City's sidewalk inspection and management, permit management and construction control, ferries, bridges, traffic, roadway repair and maintenance.	
Metropolitan Level	Metropolitan Transportation Authority (MTA) New York City Transit	Subway and bus construction as well as operation for the New York City.	Unified mass transportation policy, subway and bus operations and scheduling plans.
	New York Metropolitan Transportation Council (NYMTC)	Regional transportation planning and project coordination for New York City, Long Island and Lower Hudson Valley counties.	Regional Transportation Plan (RTP), Transportation Improvement Program (TIP), Unified Work Programs (UPWP).
Megaregion Level	Regional Plan Association (RPA)	Recommend the improvement of the quality of life and economic competitiveness of the 31-county New York-New Jersey-Connecticut region.	Co-chairs the National Committee for America 2050 and generates influential publications on megaregion planning.

ISSN
2067- 2462

On the land use planning side, NYCDCP is the key player. It is directly responsible for the citywide transit-oriented rezoning and other land use decisions.

On the transportation planning side, NYCDOT and NYMTC play an important role in New York City and New York Metropolitan area, respectively.

However, as the largest transit operator in North America, the state-run MTA New York City Transit, also called the New York City Transit Authority (NYCTA), exerts a disproportionately dominant influence on New York's subway and bus operations.

The New York-based RPA is very influential in megaregion planning, in particular, the Northeast Megaregion. However, as a non-profit organization, RPA does not have "teeth" for actual implementation, which is totally different from MTA and other agencies.

In Shanghai, the transportation-related agencies are very different from those of New York. Table 12 lists the major transportation-related agencies in Shanghai.

TABLE 12 - MAJOR TRANSPORTATION-RELATED AGENCIES IN SHANGHAI

Geographic Level	Agencies	Responsibilities	Key Plans
City Proper Level	District Planning and Transportation Bureaus	District land use, zoning, transportation, and master plans.	District Master Plan.
Municipality Level	Shanghai Municipal City Planning Administration and Shanghai Urban Construction & Communications	Citywide land use, zoning, and master plans.	City Master Plan.
	Shanghai Shentong Metro Group Co., Ltd.	Operates and manages all subway lines.	Subway operations and scheduling plans.
Megaregional Level	State Council	Directly oversees Shanghai Municipality, Jiangsu and Zhejiang Provinces.	Yangtze River Delta Regional Plan.

At city proper level (i.e., Central City level), each district (e.g., Huangpu, Luwan Districts) has its planning and transportation bureau, responsible for district-level transportation planning affairs. If these district-level planning affairs have citywide significance, they are subject to the approval by the municipal government.

Shanghai Municipal City Planning Administration and Shanghai Urban Construction & Communications are responsible for citywide land use and transportation planning and decision-making.

On the transit operation side, four companies currently operate the Shanghai Metro network. Each of the following companies is a subdivision of Shanghai Shentong Metro Group Co., Ltd.:

- Shanghai No.1 Metro Operation Co., Ltd. manages Lines 1, 5, 9 and 10;
- Shanghai No.2 Metro Operation Co., Ltd. manages Lines 2, 11 and 13;

ISSN
2067- 2462

- Shanghai No.3 Metro Operation Co., Ltd. manages Lines 3, 4 and 7 and will also manage Line 21 in the future; and
- Shanghai No.4 Metro Operation Co., Ltd. manages Lines 6 and 8 and will also manage Line 12 in the future.

At the Yangtze River Delta regional level, the State Council directly steps in because there is no megaregion-level planning organization existing at present since the dissolution of the Shanghai Economic District Planning Office in 1988.

3. NEW YORK PUBLIC TRANSPORTATION DEVELOPMENT: LESSONS LEARNED

New York' public transportation development lessons can be summarized by using an acronym PROMISE: Partnership (political principle), Reasonableness (economical principle), Optimization (technical principle), Multimodalism (systems principle), Integration (systems principle), Sustainability (3 "E" principles), and Expansion (development principle).

3.1. Partnership

On the public-public partnership side, New York area has a very long, partnership-based regional planning tradition. For example, as an independent, non-profit organization of business, civic and community leaders founded in 1929, Regional Plan Association (RPA) has been active and instrumental in preparing and promoting the implementation of the Regional Plan for the Tri-State MSA. On a smaller regional scale, the New York Metropolitan Transportation Council (NYMTC) is the federally designated MPO largely for New York City, Long Island, and three outlying counties in the Lower Hudson Valley. NYMTC's 2035 Regional Transportation Plan: A Shared Vision for a Shared Future provides a regional blueprint guiding the New York area's transportation development.

At the city level, New York City needs to collaborate with MTA in implementing its ambitious transit capacity enhancement initiatives proposed in Mayor Bloomberg's 2007 PlaNYC. As a state-run entity, MTA's board membership reveals the collaboration and partnership relations among the State, the City, and other stakeholders.

On the public-private partnership side, New York City has been attempting to tap into private funding sources by imposing congestion pricing and promoting transit-oriented rezoning. In addition, citizen participation is also an important form of public-private partnership.

ISSN
2067- 2462

3.2. Reasonableness

In downtown Manhattan, subway lines are set underground to minimize potential conflicts with surface traffic. But outside of downtown Manhattan, like in the north of 96th Street, subway lines are made at grade or elevated to save construction costs.

Many New York subway stations are located directly underneath the department stores or supermarkets for the convenience of passengers to access. Many interconnected underground tunnels are constructed for the station transfer purpose. This kind of subway station design (entrance, exit, underground) embodies the transit-oriented development (TOD) design principles proposed by Peter Calthorpe (1993).

Since subway construction involves huge capital costs and has a profound implication for urban transportation planning (Pendakur, 1993), for those urban areas (e.g., urban fringe areas) unsuitable for subway construction, bus rapid transit (BRT) or light rail transit (LRT) technologies should be considered and possibly deployed.

3.3. Optimization

Optimization is multi-faceted, involving every step of transit project development process (e.g., planning, design, construction, operation, maintenance). Several key optimization measures in New York are enumerated below.

Optimizing travel demand forecasting model is an important step in improving quality of transportation analytical process. NYMTC has developed the state-of-the-practice, tour-based (rather than conventional trip-based) transportation model, Best Practice Model (BPM), to meet the federal requirements for long-range planning including conformity (air quality), sub-regional and corridor-level analyses.

New York has a three-tiered transit system, which optimizes network structure. Tier 1 is the backbone of the entire public transportation system, consisting of subway and commuter rail lines. Tier 2 consists of bus lines for inter-community connections and feeding rail stations. And Tier 3 provides local circulations. This approach is consistent with what was proposed for Shanghai in the White Paper of Shanghai Urban Transportation (Shanghai Municipal Government, 2002). In Shanghai, taxi plays an important role in fulfilling part of its Tier 3 functions.

Optimizing subway station location is also very important. New York City has 26 subway routes and 468 stations. These stations are so located that most passengers can access them within 5 minutes. Mode of arrival and mode of departure are adequately considered in New York public transportation planning process.

New York City Transit also optimizes subway operations and scheduling to better match its ridership demand. For example, the average headway is 3-5 minutes during peak periods, and becomes 10-12 minutes during

ISSN
2067- 2462

off-peak periods. From midnight to 5 am, the average headway is further increased to 20 minutes. Some routes provide skip-stop, express services to save passenger travel times. Since 1997, New York City Transit has issued MetroCards with stored values. With MetroCards, passengers can ride at lower costs.

3.4. Multimodalism

Multimodalism is an important design concept in New York's public transportation system. For example, as a major transit hub in midtown Manhattan, New York Penn Station serves commuters from Long Island and New Jersey as well as subway riders (Routes A, B, C, D, E, F, N, R, Q, V, W,V, 1 2, 3) in New York City. It also provides intercity services through Amtrak.

3.5. Integration

It is generally believed that land use impacts transportation through its change in activity patterns, whereas transportation impacts land use through its provision of accessibility (Giuliano, 2004). While land use alternative is regarded as an effective congestion relief tool (Cervero, 1991), opposing views also exist (Giuliano, 1995; Boarnet and Crane, 2001).

New York is the first American city to enact comprehensive zoning ordinance as early as 1916 (Levy, 2003). Since 2002, New York City Department of City Planning (NYCDCP) has completed 101 rezonings covering more than 8,650 blocks for the city's long-term economic health while addressing local communities' needs today (Source: http://www.nyc.gov/html/dcp/home.html). In answer to Mayor Bloomberg's 2007 call for implementing PlaNYC, NYCDCP has specifically undertaken transit-oriented rezoning in order to boost development densities in the vicinity of transit stations. This initiative has yielded some positive results. Like any other plans, these rezoning practices still have deficiencies. For example, many of New York City's "transit oriented" rezonings actually encouraged automobile use by requiring most new developments to provide off-street parking (Paul, 2010).

3.6. Sustainability

New York's public transportation planning intends to build a sustainable transportation system embodying the three "E" principles: economic efficiency, social equity, and environmental protection.

Mayor Bloomberg's PlaNYC contains the list of goals and objectives as shown in Table 13. This transit-led plan is sustainable development-minded.

ISSN
2067- 2462

TABLE 13 - GOALS AND OBJECTIVES IN PLANYC

Goals	Objectives
Build and expand transit infrastructure	• Increase capacity on key congested routes • Provide new commuter rail access to Manhattan • Expand transit access to underserved areas
Improve transit service on existing infrastructure	• Improve and expand bus service • Improve local commuter rail service • Improve access to existing transit • Address congested areas around the city
Promote other sustainable modes	• Expand ferry service • Promote cycling
Improve traffic flow by reducing congestion	• Pilot congestion pricing • Manage roads more efficiently • Strengthen enforcement of traffic violations • Facilitate freight movements
Achieve a state of good repair on our roads and transit system	• Close the Metropolitan Transportation Authority's state of good repair gap • Reach a state of good repair
Develop new funding sources	• Establish a new regional transit financing authority

Source: City of New York (2007) PlaNYC: A Greener, Greater New York. New York, NY: City of New York.

3.7. Expansion

Expansion means that transit system needs to be constantly expanded to accommodate rising travel demand due to fast population and economic growth. Maintaining and renovating existing system alone is insufficient. New York has learned this lesson in a hard way.

For example, in New York, over 70% of all Long Islanders, who commute into Manhattan, take the Long Island Rail Road (LIRR), but the tunnels into the city have reached their capacity.

By 2030, nearly a million more residents, 750,000 new jobs, and millions of more visitors will put the City's transportation system under new pressures. The increasing congestion and the resulting economic costs will reverberate throughout the region (City of New York, 2007).

As its initial moves, New York City is planning to work with MTA to complete the following expansion projects as soon as possible:

- LIRR East Side Access;
- LIRR Main Line Third track;
- Full-length Second Avenue Subway; and
- 7 Line West Side Expansion.

New York City still has a $31 billion funding shortfall in achieving a full state of good repair on its transit and road networks. Many innovative measures have been proposed, such as congestion pricing, establishment of the Sustainable Mobility and Regional Transportation (SMART) Financing Authority, and others. Some

ISSN
2067- 2462

opposing views have been heard, however. For example, Gelinas (2007) argued that the while process is too cumbersome. She suggested the mayor and the governor to reform the MTA first.

4. RECOMMENDATION FOR SHANGHAI

Based on the above seven lessons learned from New York, this section makes preliminary recommendations for Shanghai's public transportation development.

4.1. Establish the Yangtze River Delta Megaregion Governing Council

This paper strongly recommends the Central government, in conjunction with Shanghai, Jiangsu, and Zhejiang, to establish the Yangtze River Delta Megaregion Governing Council. Similar to the Portland Metro and the Twin Cities Metropolitan Council in the U.S., this Governing Council shall have an expanded authority in setting multimodal transportation development policies, coordinating three-party transportation planning activities, reviewing and approving land use policies, managing a revenue-sharing program among three parties, engaging communities and the public in planning for future sustainable growth, and others. The reinstatement or reestablishment of this super megaregion planning organization requires the special authorization from the Central government. In the meantime, private sectors should also be encouraged to participate in the planning process through funding contribution, citizen participation, and others.

4.2. Build density-based, area specific multimodal transportation system

In the densest CBD areas, major transit mode should be underground subway, which links all major activity centers. Each subway station should have multiple entrances/exits for the convenience of passengers, and underground tunnels need to be constructed to facilitate transfers among different subway lines. All necessary amenities should be provided as much as possible at each station floor (surface, mezzanine, platform), such as elevators, escalators with hand rails, ticket vending machines, benches, trash receptacles, route maps, and possibly rest rooms. Any unnecessary and fanciful decorations can be avoided. Auto trips should be strictly restricted. Walking and bicycling are principal modes of arrival/departure. All location and directional signs need to be provided.

In the urban fringe areas, bus rapid transit (BRT) lines should be built to serve inter-community travels. Subway lines can be made at grade or elevated to save construction costs. Both subway and BRT stations should provide park-and-ride lots, parking structures, or bicycle racks.

In the outlying areas, regular buses, paratransit (e.g., taxis, jitneys, shuttles, vans), and autos are allowed.

ISSN
2067- 2462

4.3. Build new tour-based travel demand forecasting models

Shanghai may need to build new tour-based travel demand forecasting models, based on detailed travel surveys. The enhanced modeling capacity is critically important to improve the accuracy of transportation analysis. This task is closely related to other tasks, such as land use forecasting, geographic information system.

4.4. Ensure multimodal connection

Due to Shanghai's central city status in the Yangtze River Delta Megaregion, the soon-opened high-speed rail lines will play a particularly important role in integrating Shanghai, Jiangsu, and Zhejiang together. These regional high-speed rail lines should be interconnected with Shanghai subway lines and other modes. Fortunately, Shanghai's Hongqiao Terminal has already taken multimodalism concept into its planning process, by connecting Beijing-Shanghai Express Railway (BSER), its subway (Routes 2, 5, 10 and others), and airport.

Intracity multimodal connection is critically important. Subway/bus, subway/commuter rail, subway/auto, subway/bicycling, subway/walking, and other connection nodes should be carefully designed and constructed to facilitate intermodal transfers. The timed transfer and hub-and-spoke concepts should be applied to reduce intermodal transfer times.

4.5. Municipal Government should play an active role in land use planning

Unlike Manhattan, which is the sole dominant CBD in New York, Shanghai seems to have three relatively comparable CBDs, which may have caused duplicative construction, lower efficiency, and unnecessary competition. By utilizing its land use and zoning tools, Shanghai is suggested to gradually build one dominant, Manhattan-like CBD to yield better agglomeration economies. From the perspective of Shen (1997), Shanghai's land use planning can be particularly effective because the locations of jobs, housing and services are largely determined by the municipal government through master plans and detailed land-use plans.

In addition, the Shanghai municipal planning and transportation agencies must work together to ensure the proper integration between land use and transportation, especially TOD development in the vicinity of subway stations, job/housing balance, urban sprawl containment, smart growth, and many others.

ISSN
2067- 2462

4.6. Promote sustainable development

As indicated earlier, Shanghai's public transportation system should be made optimal and more efficient. In addition to this efficiency goal, social equity and environmental protection are also important sustainable development goals.

On the social equity front, many efforts are suggested to be made. For example, subway stations should be so designed that they are more accessible to the handicapped or senior passengers. Low-income passengers should be subsidized when boarding trains or buses. Necessary paratransit services should be provided to pick up or drop off those handicapped or senior passengers at subway stations.

On the environmental protection side, Shanghai's public transportation system should be environmentally sustainable with high fuel efficiency, low emission, and energy conservation. Such a system is conducive to building a green infrastructure, including landscapes and other open spaces that conserve ecosystem values/functions and provide associated benefits to human populations.

4.7. Further expand the Metro system

Considering Shanghai's excessively high population density and great growth potential in the future, its Metro system needs to be expeditiously expanded. Of course, the expansion plan requires conducting rigorous technical analyses and environmental impact studies. The plan should be politically enforceable, technically sophisticated, financially constrained, and environmentally sound.

5. CONCLUSIONS

This paper conducts a comparative analysis on the megacity transportation planning systems between New York and Shanghai. Through this empirical study, it is concluded that the following seven public transportation development lessons learned from New York may be relevant to Shanghai.

First, Partnership requires all government agencies (Within Shanghai, and among Shanghai, Jiangsu, and Zhejiang) and private sectors to forge a strong partnership to facilitate cooperation, collaboration, and coordination. The Yangtze River Delta Megaregion Governing Council is strongly suggested to be established.

Second, Reasonableness means that the subway design and construction should follow the economical principle. For example, subway should be underground in the downtown area, but should be at grade outside of the downtown area in order to save construction costs. Likewise, money should not be expended on unnecessary and fanciful station decoration.

ISSN
2067- 2462

Third, Optimization calls for streamlining and optimizing planning, design, construction, operation, and maintenance processes.

Fourth, Multimodalism requires that all public transportation components must be

seamlessly connected to form an effective system.

Fifth, Integration of land use and transportation is essential.

Sixth, Sustainability is guided by the 3 "E" principles: economic efficiency, social equity, and environmental protection.

Seventh, Expansion of transit system should be synchronized with increasing population

and travel demand growth.

The above seven aspects are all interrelated. To what extent Shanghai can actually learn from New York requires a thorough and more detailed analysis.

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ISSN
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