## Taipei Mobility: Gone in Less than 300 Seconds Mixed Modality Transportation System in Dense Mixed-use Urban Fabric, Take Taipei City for Example.

by Chih-Chao Chuang

Bachelor of Architecture (2001) Tamkang University

Submitted to the Department of Architecture in Partial Fulfillment of the Requirements for the Degree of Master of Science in Architectural Studies

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#### Abstract

Urban designers and planners always try to tackle the urban issues from spatial, cultural and economical point of views; However, sometimes these issues were limited or, even more, created by current transportation system. The thesis will discuss about the relations of urban mobility and urban space and try to redesign urban space from transportation point of views. According to United Nation Population Division Report, half world's people will live in urban area by the end of 2008. The urban population will rise from 6.7 billion in 2007 to 9.2 billion in 2050. Right now, A lot of cities already suffered the traffic congestion, air pollution which caused by current transportation system and also create low quality of life, we can expect the life quality in urban area will deteriorate more in the future because of population growth. We need new types of thinking to solve these problems. This thesis will introduce a new type of Mobility-On-Demand System to Taipei City, which is the case study city because of its density and mixed-use characteristics. This system will supplement the current transportation system to make public transportation more efficient and private transportation faster. The Mobility-On-Demand System is composed by City Car and Roboscooter, which were developed by Smart Cities, MIT Media Lab. They are electric, small footprint, foldable and most important of all, they are private and also public. This thesis will talk about how can a city be transformed and people's life quality be improved with the help of the new mobility Mobility-On-Demand System.

Thesis Supervisor: William J. Mitchell Title: Professor of Architecture and Media Arts and Sciences

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# **1.0 INTRODUCTION**

# "Are you tired of waking up early in the morning just to avoid traffic jam?"

"Are you tired of no matter what you do, you still stuck in traffic somehow?"

> GEORGE BRAZIL Plumbing-Heating Air Conditioning

TRANSPORT INTERNATIONAL

•

**MP** 

Figure 2.



"Are you tired of the traffic noise 24 hours a day which drives you crazy?"

Figure 4.

"Are you tired of digging your empty wallet for the surging gas price?"

Regular Self

Plus Self

Ultra 93

9

TEL

"Are you tired of worrying about " The Day After Tomorrow" scenario will happen one day?"

15

Yes, We Could Have Other Options.

# Taipei Mobility: Gone in Less than 300 Seconds Mixed Modality Transportation System in Dense Mixed-use Urban Fabric, Take Taipei City for Example.

#### **1.1 Introduction**

According to United Nation Population Division Report, half world's people will live in urban area by the end of 2008<sup>1</sup>. The urban population will rise from 6.7 billion in 2007 to 9.2 billion in 2050<sup>2</sup> Right now, a lot of cities already suffered from traffic congestion which wasted a lot of fuel and money to air pollution, these were caused by current transportation and road systems and high population density. These also create low quality of life for their habitants. Take U.S. cities for example, which its developing pattern was followed by a lot of giant developing countries, such as India and China. From 1982 to1999, in 75 metropolitan areas, the average percentage of daily traffic congestion, rising from 17% to 33%, nearly doubled during 17 years.<sup>3</sup> The Texas Transportation Institute of so state's in its annual traffic congestion analysis in 19999 that the average traffic congestion time, rose from two to three hours a day in 1982, to five to six hours a day in 1999. These traffic congestion patterns not only happened in U.S., but also in any other metropolitan area all over the world. Especially the population densities of United States metropolitan areas are not very high compare to Asia or South American cities. It is not too hard to imagine what will these metropolitan areas be when they are following the United States lead and become developed countries. This is a reasonable assumption that the quality of life in urban areas will deteriorate more in the future because of population growth and if there's no major improvement to the current transportation system and planning policies. Since a lot of these urban problems more caused by the current transportation systems and policies and can not be solved by traditional of urban design or planning methods, as urban designers and planners, we need to tackle these problems from the transportation point of views.

Urban development always has a close relation with transportation. How to move is an urban issue. The invention of steam engine train expanded the urbanized area boundaries and people's perception towards time and space. Cities can be more expanded and concentrated at the same time, because the resources and labors can move in and out very fast. The elevators enabled the later invention of skyscrapers. The escalators encouraged the ground floor retail stores transformed into multi-stories department stores. Not to mention the later inventions of gasoline cars and highways, they created the urban sprawl all over the world. The minimum street width is also determined by the width of a fire truck. Transportation always plays an important role in urban form and leads urban development in new directions. Although transportation and urbanism have close relationships, most of transportation issues were only discussed among specialists of transportation professions, urban designers and planners just took their conclusions to form the urban design theories and policies. However, urban designers and planners can not deal with a lot of urban problems which caused low quality of urban life because the causes of these problems were not discussed in their fields. For instance, more population means more cars and more highways. If traffic jams still happened, there will be more highways or more lanes in construction. These endless highways can not stop the endless time people spend on traffic delays and commute. They also create a never ending suburbia. More people need to drive their cars to works, more space will become parking lots to accommodate parking needs. It makes the urban fabrics and activities disconnected and scattered. A lot of transportation problems were solved from technical or economical point of views,

not design or cultural oriented. Sometimes it creates urban fabric separation and low quality streets and needs a project like Big Dig spent millions of dollars in years to fix it. Cities are for people to live in and enjoy their urban life. Urban designers and planners like to depict an imagined urban life from a person walking experience perspective. Ironically, people tend to spend more time experiencing urban space in their cars than on their feet. The most popular public spaces are highways and roads. The purpose of these most popular "Public Spaces" are to pass by not to stay. To serve this purpose, a lot of time urban designers would sacrifice to real urban public space for these "Public Spaces." If the current transportation planning logic does not change, a lot of urban planners and designers' efforts are still in vain. If a lot of urban space problems were caused by transportation, maybe urban designers need to address the urban issues from transportation point of view rather than urban design point of view.

The current transportation energy consumption is 34% of total energy consumption of the world<sup>5</sup> The gasoline vehicles contribute the major part of the total transportation energy consumption. Even though after a century technological revolution, the fuel efficiency of gasoline vehicles still has a lot of room to improve. 80% of energy was lost and wasted in the internal combustion engine when is running. Only 20% of energy contributes to vehicle's movement. Moreover, in this 20%, 19% of the energy is to move the vehicle's own weight, only 1% of the total energy is to move passengers and drivers' body weight<sup>6</sup> For example, the gas price skyrocketed in these days. If 1 gallon of gas is \$4 U.S. dollars, 1% of the total energy is to move your body weight means only 20 cents contribute to your body moving. The amount of energy waste is tremendous. The average percentage of car using time in United States is 4% of the total time. It means 96% of the time these vehicles were parked in some parking spaces? Therefore, cities need to build a lot of parking lots for these vehicles when they are not in use. People also spend money to pay parking fees, buy or rent parking spaces, or build garages for them. These vehicles are not only inefficient, regarding only 4% of that using time, occupying valuable urban spaces, and spending people's money, but also affecting the whole urban form and development.

This thesis will address urban design issues from transportation point of view. It will take Taipei city for case study to research the viability of introducing a new transportation system, Mobility-On-Demand System, intense and mixed-use urban fabrics. This M.O.D. System This system will supplement the current transportation system to make public transportation more efficient and private transportation faster. It will also address the energy and environmental issues by using all electric vehicles as its fleets. They are electric, small footprint, foldable and they are both private and public. This thesis will talk about how can a city be transformed and people's life quality can be improved with the help of the new mobility Mobility-On-Demand System.

# 2.0 SITE ANAYSIS

# **Taipei City**

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Taipei city is the capital city of Taiwan. It is also the social, economical center of the country. It is located in the northern part of Taiwan and surrounded by Taipei County, Taiyuan City and Keelung City. Taipei City, Taipei County and Keelung City is the so-called Greater Taipei Area. Most parts of Taipei city and Taipei County are situated in the Taipei basin and surround by hills and mountains.



#### 2.1 Introduction of Taipei City

Taipei City is located in the northern part of Taiwan, which is situated in the bottom of Taipei basin and surrounded by hills and mountains. Taipei City is the capital city and social, economic and political center of Taiwan. Taipei City has 2,630,515 residents and relation density is 9,678 people per square kilometers,<sup>8</sup> ranked the seventh highest population density city in the word.<sup>9</sup> Combine with Taipei County, together they have 6,409,734 residents in Greater Taipei Area. Taipei City is the typical East Asia city, so does the Taipei County. That land use zoning system is not monotonic or single-purpose, it'd always multipurpose. Everywhere is mixed-used. Commercial and residential areas can easily be seen mixed together in the same street or in the same block. Because of the mixed-used characteristics and high density, it creates may be the most convenient city in the world. People can buy or do basically anything within three to five minutes driving distance in Taipei urban area. A lot of stores are

Figure 8. Taipei City Bird Eye View

running 24-7 and convenience stores are everywhere. Sometimes people can see the same brand convenience stores open across the street and face each other. Taipei City also faces a lot of traffic problems. Every 1000 people have 218 cars and 406 motorcycles in Taipei City;10222 cars and 570 motorcycles in Taipei County.<sup>11</sup> Taipei city ranked the second most congested city in Asia.<sup>12</sup> What makes things worse is that motorcycles pollute more than cars. It am not hard to imagine that people almost choked in traffic congestion with a lot of smoke. The traffic issue needs to be addressed in order to improve the living guality in Taipei City.

#### 2.2 Pilot Program of Mobility-On-Demand

Taipei City will be a good candidate city to test out the pilot program of Mobility-On-Demand transportation system. It will not only solve the traffic problems but also can integrate the existing transportation system and make it work more efficiently. It could also deal with the environmental issue. Most often Taipei City residents have high incomes and always open to new technologies, new ideas and new services. They will be interested in this service if it can save more time and money. Also because of the mix-used urban fabrics, it will make Mobility-On-Demand fleet management easier. The traffic of Taipei City already used to cars and scooters mixed together roaming down the same street and the same land, it will not be a problem to introduce the mixed modality Mobility-On-Demand service to Taipei City.



Figure 9. Street View of Taipei City



# 2.3 Location and Geography

Taipei City is located almost at the northern tip of Taiwan and surrounded by Taipei County, keelung City, and Taoyuan County. The Greater Taipei Area often refers to Taipei City and Taipei County together. The metropolitan area of Taipei includes Taipei City, Taipei County, Keelung City, Taoyuan County, Hsinchu City, Hsinchu County, and Yilan County. Taipei City and Taipei County are located in the alluvial plain of Taipei basin. The perimeter of basin is about 70 square kilometers in length and the slope is pretty steep so it is not suitable for any kind of construction. Within Taipei basin, there are 243 square kilometers in area under 20 meters height above sea level, 19 square kilometers are water area.<sup>13</sup> Tamsui River is running through the middle of the basin and cut it into two half. The left one is Taipei County and the right side is Taipei City. Taipei City has 272 hectares and Taipei County has 2053 hectares. The 55 % of Taipei City are hills and mountains, only 45% are plains. Taipei County only has 11.65% plains, the others are

hills and mountains. The urban development is basically within the plains of the Taipei basin.



Figure 11. View of Taipei Basin

Aerial Photos of Greater Taipei Area

Figure 12.

#### 2.4 Administrative Zones

Taipei City has 12 districts and Taipei County has 10 township-level cities, 4 urban townships and 15 rural township, total 29 cities and townships. The Taipei County actually surrounds and encloses Taipei City entirely.



Table	1 Are	a of	Each	Die	triot
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Name	Area	Name	Area
Taipei City	271.80	Sijhih City	71.24
Shihlin District	62.37	Rueifang Township	70.73
Beitou District	56.82	Danshuei Township	70.66
Neihu District	31.58	Sanjhih Township	65.99
Wunshan District	31.51	Wanli Township	63.38
Nangang District	21.84	Linkou Township	54.15
Jhongshan District	13.68	Shihmen Township	51.26
Daan District	11.36	Jinshan Township	49.21
Sinyi District	11.21	Bali Township	39.49
Songshan District	9.29	Wugu Township	34.86
Wanhua District	8.85	Shulin City	33.13
Jhongjheng District	7.61	Tucheng City	29.56
Datong District	5.68	Banciao City	23.14
Taipei County	2,052.57	Yingge Township	21.12
Wulai Township	321.13	Shenkeng Township	20.58
Sansia Township	191.45	Jhonghe City	20.14
Pinglin Township	170.84	Sinjhuang City	19.74
Shuangsi Township	146.25	Taishan Township	19.16
Shihding Township	144.35	Sanchong City	16.32
Sindian City	120.23	Lujhou City	7.44
Gongliao Township	99.97	Yonghe City	5.71
Pingsi Township	71.34		

#### 2.5 Population and Density

Greater Taipei urbanized area ranked the seventh highest population density city in the world, about 15,200 people per square kilometer in urban area<sup>14</sup> Within the Taipei City and Taipei County boundaries, Taipei City population density is 9,682 people per square kilometer and Taipei County population density is 1,854 people per square kilometer. However, because the most urbanized areas of Greater Taipei are located in the alluvial plain of Taipei basin, the population densities in urbanized areas are actually much higher than the statistics showed. There is one district the population density is higher than the most highest population density city; there are two districts higher than the second place city, but lower than the top one; they are nine districts higher than the third place city, but lower than the second place one. The aerial photos below show the same scale comparison between Manhattan and Taipei. Manhattan has 87.5 square kilometer in area, 1,620,867 residents and population density is 27,256 people per square kilometer. Although Greater Taipei Area doesn't have so many skyscrapers like Manhattan, but the population density of many districts are close to this number. The population density is very high in Greater Taipei Area.

					the set of start to reach the set
Name	Population	Density	Name	Population	Density
Taipei City	2,631,605	9,682	Yingge Township	85,891	4,066
Daan District	315,511	27,770	Taishan Township	74,670	3,897
Songshan District	211,540	22,776	Sijhih City	181,195	2,544
Datong District	126,201	22,213	Sindian City	290,868	2,419
Wanhua District	192,040	21,694	Wugu Township	77,456	2,222
Jhongjheng District	159,829	21,011	Danshuei Township	132,804	1,880
Sinyi District	228,935	20,427	Linkou Township	68,296	1,261
Jhongshan District	218,705	15,985	Shenkeng Township	22,509	1,094
Neihu District	265,894	8,420	Bali Township	32,773	830
Wunshan District	261,915	8,312	Rueifang Township	43,434	614
Nangang District	113,726	5,207	Sansia Township	95,617	499
Shihlin District	287,177	4,605	Jinshan Township	22,249	452
Beitou District	250,132	4,402	Sanjhih Township	23,579	357
Taipei County	3,804,969	1,854	Wanli Township	20,732	327
Yonghe City	236,927	41,466	Shihmen Township	11,875	232
Lujhou City	192,515	25,893	Gongliao Township	14,020	140
Banciao City	548,816	23,720	Pingsi Township	5,602	79
Sanchong City	383,749	23,518	Shuangsi Township	9,937	68
Jhonghe City	409,846	20,346	Shihding Township	7,862	54
Sinjhuang City	396,762	20,101	Pinglin Township	6,582	39
Tucheng City	237,643	8,040	Wulai Township	5,427	17
Shulin City	165.333	4.991			

#### Table 2. Population and Population Density in Each District (People/km2)

Figure 14. Taipei Bird's Eye View



Figure 15. New York City Bird's Eye View



Figure 16.

# Table 3. Top Cities of Population Density (People/km2)

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Name	Country	Population	Density
Mumbai	India	14,350,000	29,650
Kolkata	India	12,700,000	23,900
Karachi	Pakistan	9,800,000	18,900
Lagos	Nigeria	13,400,000	- 18,150
Shenzhen	China	8.000,000	17,150
Saoul	South Korea	17,500,000	16,700
Taipei	Taiwan	5 700 000	15 200



#### 2.6 Urbanized Area of Greater Taipei

Because Greater Taipei is situated in the bottom of the Taipei Basin, the mountains and hills in the perimeter of basin become the physical boundary of urban development. Within the boundary, nearly all the areas are occupied by buildings and infrastructure. Based on different urban fabrics and development patterns, Greater Taipei can be divided into 7 zones. Each zone's urban fabric and public transportation accessibility is different.



Zone 1: Core Commecial Area Public Transportation: Dense Urban Fabric: Dense

The central business district of Taipei City. A lot of Tall office buildings situated along avenues and boulevards. Top 4 busiest MRT stations are located in this area. A

lot of people come here for works more than the people who live here.



Figure 19.

1000		
		and and the

Zone 2: Second Commecial Area Public Transportation: Even Urban Fabric: Dense

The residential and commercial areas are totally mix-used. Not as crowded as CBD and streets have more space for parking.

Figure 21.

## Zone 3: Newly Developed Area Public Transportation: Even Urban Fabric: Dense

One block equal one mega building. Most of the buildings are headquarter for international corporations. There are also a lot of department

stores here. Taipei Clty Gov. is here, too.



Figure 23.





Zone 4: Old City Area Public Transportation: Even Urban Fabric: Dense

The earliest developed area in Taipei, famous for its small alleys and organic growth pattern. There are a lot of ancient build-

ings, markets and temples in this area. A lot of traditional row-houses were also preserved.



Figure 25.

#### Zone 5: Residential Area inside City Public Transportation: Even Urban Fabric: Even

It's situated around core com. and second com. areas. Mostly residential neighborhood, but commercial areas are also in-

cluded. Most of them are 5-7stories high buildings.







Figure 27.

Zone 6: Outskirt Residential Area Public Transportation: Even Urban Fabric: Even

It's situated between the central city and mountains of Taipei Basin. Most of them are 5-7stories high buildings, but tall resi-

dential towers are also common.



Figure 29.

## Zone 7: Organic Mix-Use Fabric Area Public Transportation: Loose Urban Fabric: Dense

The Taipei County is belong to this area. It is very dense and famous for its organic grownth pattern and green-less space.

Most of the streets are very sinuous and hard to recognize.



Figure 31.








#### 2.7 Road System

The red dotted line represents Taiwan High Speed Rail, the top speed is 300 kilometers per hour. It connects Taipei City and Kaohsiung City in 90 minutes. The total route length is 345 kilometers. They are total eight stations in service right now and two of them are in Greater Taipei Area. The black dotted line represents Taiwan railroad, the ordinary train. Most of the routes overlap with Taipei High Speed Rail in city center. The orange solid lines represent highways. There are three major highways running across Taipei City. They cross over in the west side of the city. The solid color lines represent the current MRT system. It's connects the major urbanized parts of Taipei City. The yellow thicker solid lines represent expressway and there are 13 expressways in Greater Taipei Area. The vellow thinner solid lines represent main streets. They are denser inside the urban area.



#### 2.8 Public Transportation

There are four different types of public transportation in Greater Taipei Area. They are public bus, Metropolitan Rapid Transit, known as MRT, Taiwan Railway, and taxi. Public bus and MRT are the most widely used public transportation systems in Taipei City. Public bus has average 1,687,960 passengers per day<sup>15</sup> and MRT has average 1,239,761 passengers per day<sup>16</sup> Even after MRT started to operate, buses passengers only 90,000 less after 10 years. A lot of people use railway to do intercity commute. There are 142,373 passengers per day in and out railway stations in Taipei City<sup>17</sup>. There are 57,764 taxis in Greater Taipei Area and share 62.5% of the total taxis in Taiwan. There are estimated 1,156,305 passengers per day use this service in Greater Taipei Area and each taxi serves 20 passengers per day<sup>18</sup>.





	MRT	BUS
1985	-	260
1986	-	254
1987	-	246
1988	-	238
1989	-	227
1990	-	216
1991	-	214
1992	-	211
1993	-	204
1994	-	190
1995	-	175
1996	4	178
1997	10	186
1998	17	192
1999	35	198
2000	73	186
2001	79	187
2002	89	177
2003	87	168
2004	97	171
2005	99	168
2006	105	169

Chart 1. Total Passngers of Public Transit in Each Year (10,000/year)



Figure 39. Distance on Foot

Table 5. Distance of Transfer Types Distance Walk 1,457 Bus 2.360

Scooter

Table 6. MRT Passengers **Transfer Types** 

2,565

	Arrive	Depart
Walk	56.7%	67.8%
Taxi	1.3%	1.3%
Bus	23.5%	26.2%
Car	2.3%	0.4%
Scooter	6.5%	1.4%
Bike	1.0%	0.6%
Othes	8.7%	2.3%

#### 2.9 Transfer Types

Public buses and MRT are the major two public transportation systems. Sometimes public buses have to assist MRT to solve the first mile and last mile problems. About 56.7% and 67.8% of the total MRT passengers arrived and left MRT stations on foot. It took them average 18.21 minutes to walk 1,457 meters in distance. About 23.5% and 26.2% of total MRT passengers who arrived and left MRT stations by bus. Only 6.5% and 1.4% of the passengers used scooters. However, scooters traveled the longest distance in shortest time. It took them 4.28 minutes to travel 2,565 meters in distance.19



Figure 40. Distance by Bus



Figure 41. Distance by Scooters

Figure 42. Traffic of Taipei in Rush Hours

40

and the se

Name	Cars	Scooters	Cars/1000 people	Scooters/ 1000 ppl.	Name	Cars	Scooters	Cars/1000 people	Scooters/ 1000 ppl.
Taipei City	574.560	1,067,407	218	406	Taishan Township	17,941	42,709	240	572
Wanhua District	31,816	106,027	166	552	Wugu Township	21,246	44,253	274	571
Datong District	26,819	69,611	213	552	Shuangsi Township	1,865	5,454	188	549
Nangang District	24,651	52,951	217	466	Gongliao Township	2,903	7,400	207	528
Jhongjheng District	35,311	68,442	221	428	Pingsi Township	1,143	2,838	204	507
Jhongshan District	60,516	93,287	3,287 277 427 Sansia Tov			23,328	47,458	244	496
Shihlin District	60,748	121,077 212 422 Yonghe C			Yonghe City	42,982	115,840	181	489
Beitou District	t 51,487 105,110 206 420 Rueit Town		Rueifang Township	8,714	20,914	201	482		
Sinyi District	45,413	88,596	198	387	Danshuei Township	31,914	62,982	240	474
Neihu District	trict 63,225 99,931 238 376		Wulai Township	1,076	2,553	198	470		
Wunshan District	54,937	98,038	210	374	Jinshan Township	5,253	10,175	236	457
Songshan District	50,011	72,871	236	344	Bali Township	9,144	14,909	279	455
Daan District	69,626	91,466	221	290	Sanjhih Township	6,601	10,502	280	445
Taipei County	843,016	2,167,353	222	570	Sindian City	69,075	128,513	237	442
Sanchong City	78,593	264,521	205	689	Pinglin Township	1,680	2,893	255	440
Sinjhuang City	86,877	250,401	219	631	Shihding Township	2,016	3,374	256	429
Banciao City	109,816	342,010	200	623	Sijhih City	49,473	77,584	273	428
Shulin City	40,790	102,281	247	619	Shihmen Township	2,912	5,026	245	423
Lujhou City	ujhou City 38,531 117,546 200 61		611	Wanli Township	4,411	8,694	213	419	
Tucheng City	50,822	143,665	214	605	Shenkeng Township	6,073	9,400	270	418
Jhonghe City	85,369	246,625	208	602	Linkou Township	19,178	25,965	281	380
Yingge Township	23,290	50,868	271	592					

 Table 7. Cars and Scooters numbers in Greater Taipei Area

#### 2.10 Private Vehicles

Cars and motorcycles, most of them are scooters, are the major two types of private vehicles in Greater Taipei Area. They are total 1,417,576 cars and 3,234,760 scooters in Greater Taipei Area.<sup>20</sup>Nearly every 1000 people have average 220 cars and 503 scooters. The table on the left shows in Taipei County. the scooter ownership is 50% more than Taipei City scooter ownership. In places have denser urban fabrics and higher population densities, people tend to have more scooters, but not always less cars. 25% of the total residents in Greater Taipei Area commute by their cars, 36% by their scooters. Because traffic is too congested in Greater Taipei Area. scooters actually are the cheaper and faster solution in this condition, especially with their small vehicle footprint, they can in and out the traffic without any problem. About 54.4% of the total scooters used for daily commute, from home to work or to school<sup>21</sup>About 80.4 % of scooter users ride their scooters directly to their destination without transferring. About 64.8% of the scooter users are male. About 90.2% of scooter users in Greater City center and 88.9% of scooter users outside the city center will buy another scooter if the current one is broken.22



#### 2.11 Parking in Taipei City

Parking in Taipei City is always an issue. There are 2,114 cars and 3,927 scooters per every square kilometer in Taipei City. However, including public street parking spaces to private beauty and parking spaces, there are only 1,911 car parking spaces and 1,562 scooter parking spaces in every square kilometer.<sup>23</sup> The lower table shows the vehicle density and parking space density comparison in every district in Taipei City. Although in some districts, parking spaces are outnumber the numbers of vehicles. In reality, only a few people have their own private parking spaces and the rest have to pay for parking except street parking midnight. People tend to find any available free parking space all sides of this

Name	Car density	Car Parking Density	Available Parking Space	Scooter Density	Scooter Parking Density	Available Parking Space
Taipei City	2,114	1,911		3,927	1,562	
Jhongshan District	4,423	5,297	874	6,818	3,461	-3,358
Neihu District	2,002	2,808	806	3,165	2,825	-339
Jhongjheng District	4,642	5,367	725	8,997	5,117	-3,880
Nangang District	1,129	1,153	25	2,424	1,014	-1,411
Sinyi District	4,052	3,853	-199	7,905	3,087	-4,818
Wunshan District	1,744	1,450	-294	3,111	868	-2,243
Beitou District	906	580	-326	1,850	456	-1,394
Shihlin District	974	632	-342	1,941	560	-1,382
Songshan District	5,385	4,751	-634	7,846	2,901	-4,945
Daan District	6,128	4,678	-1,450	8,051	4,085	-3,965
Datong District	4,720	3,124	-1,596	12,252	2,371	-9,882
Wanhua District	3,594	1,813	-1,781	11,977	1,949	-10,029

Table 8	Cars and	Parking	Spaces	Density	/ in	Fach	District
Table 0.	ours unu	I GIRING	opuouo	DOMONY		Luon	Diotitot

parking system to avoid paying money. It creates that cars and scooters are actually parking everywhere throughout the city. Because of parking space shortage, a lot of people will not use their cars unless necessary. It will be very hard to find another parking space especially when people were already returned home from work. There are three types of street parking for cars. If there is a red line on the curb, its means no parking; a yellow line means

temporary parking; if there is no line means can park at any time. They are three different types of street parking for scooters. They are perpendicular curb parking, sidewalk parking, and scooter turn parking.

#### Figure 44. Sidewalk Parking











#### 2.12 Home versus Work Trips Matrix

This table shows the commute pattern from home to work of people who are over 15 years old with jobs. We can tell how many people live in which district and go to which district for works. The yellow represents the largest numbers of people live in this district go to that district for work. For example, there are 94,056 workers live in Songshan district. 57,471 of them stayed in Songshan District for works. It is 61.1% of the total workers live in this Songshan District. The grey represents the second largest numbers. For example, there are 6,422 workers live in Songshan District go to Jhongshan District for works. It is 6.8% of the total workers live in this Songshan District for works. It is 6.8% of the total workers live in this Songshan District for works. It is 6.8% of the total workers live in this Songshan District for works. It is 6.8% of the total workers live in this Songshan District for works. It is 6.8% of the total workers live in this Songshan District for works. It is 6.8% of the total workers live in the third. The red ones show the top 5 largest numbers of people whose homes in one district but go to another district for works, except home and work in the same district.

Table 9. Home versus Work Trips in Number between Districts

	1		松山區	信義區	大安區	中山區	中正區	大同區	萬華區	文山區	南港區	内湖區	士林區	北投區	板橋市	三重市	中和市	永和市	新莊市	新店市	樹林市
	1	Work	Songshan	Sinyyi	Da-an	Inongsnab	inongjneng	Datong	wannua	wunsnan	Nangang	Neinu	Shihlin	Beitou	Banciao	Sanchong	Jhonghe	Yonghe	Sinjhuang	Sindian	Shulin
Lot . Lotter	Home	Total	182,113	123,297	207,189	214,402	152,475	79,706	83,997	82,866	55,881	99,296	118,291	82,122	183,010	158,023	143,808	55,252	155,534	105,349	74,674
松山區	Songsnan	94,056	57,471	2,994	4,578	6,422	3,015	991	466	482	1,202	1,875	895	441	603	878	506	259	575	646	139
信義區	Sinyyi	110,337	8,098	57,978	9,215	5,911	4,555	992	604	894	2,567	2,269	968	442	932	830	838	389	646	1,083	220
大安區	Da-an	139,634	5,916	3,828	89,885	6,346	6,854	1,016	772	1,210	981	1,244	1,044	528	1,217	1,032	1,211	712	968	1,687	206
中山區	Jhongshan	102,696	4,147	1,486	3,095	71,814	2,814	1,334	480	400	527	1,584	1,675	527	778	1,338	611	301	786	579	174
中止區	Inongineng	71,202	2,481	1,757	4,662	3,779	41,218	903	1,583	776	446	841	771	404	1,085	843	1,119	742	619	964	165
大同區	Datong	57,134	1,312	673	1,107	2,914	1,265	39,355	415	160	231	552	1,035	378	483	1,590	327	162	612	246	126
周華區	wannua	89,465	2,794	1,766	3,314	3,871	4,644	1,248	52,905	598	456	678	855	394	2,397	1,454	2,456	610	1,008	882	347
又山區	wunshah	118,832	5,221	3,551	8,985	5,500	6,737	952	868	59,536	881	1,232	924	484	1,113	796	1,715	811	766	7,463	227
<b>南港</b> 區	Nangang	52,511	3,965	2,824	2,174	2,012	1,393	371	266	294	27,805	2,041	410	192	348	364	289	131	286	364	97
內湖區	Neinu	121,469	10,791	4,178	5,282	9,254	4,041	1,431	586	614	3,341	60,050	2,324	860	724	1,186	598	275	817	748	210
士林區	Shihlin	133,512	4,909	2,183	4,219	10,097	4,250	3,649	938	503	718	2,354	76,642	3,291	927	2,467	706	333	1,271	679	288
北投區	Beitou	113,534	3,765	2,073	3,269	7,971	3,726	2,512	773	443	625	1,785	7,785	60,779	768	1,745	576	278	972	591	207
<b>枚橋</b> 市	Banciao	240,556	6,613	3,725	6,731	8,754	8,759	2,905	5,813	1,358	1,007	1,617	1,786	828	130,492	4,066	9,360	1,467	7,390	1,982	7,028
三重市	Sanchong	182,303	5,541	2,738	4,567	9,979	5,452	4,815	2,414	721	791	1,539	2,952	1,160	2,031	107,682	1,130	446	5,545	751	848
中和市	Jhonghe	193,694	7,339	4,702	9,678	8,814	10,478	2,304	3,902	2,144	1,055	1,626	1,569	804	7,721	1,878	95,960	5,269	2,203	6,622	1,215
永和市	Yonghe	108,494	5,804	4,023	9,698	7,624	10,573	1,828	1,865	1,493	832	1,288	1,189	626	2,323	1,101	6,085	37,173	1,007	3,073	406
新壯市	Sinjhuang	178,716	3,282	1,986	3,263	4,756	4,001	1,961	1,523	629	557	1,016	1,262	575	4,088	7,891	1,787	460	107,674	688	5,485
新店市	Sindian	138,497	6,462	4,072	9,431	7,108	8,017	1,335	1,359	5,246	904	1,491	1,214	675	1,632	862	4,316	1,653	920	68,813	445
樹林市	Shulin	71,872	1,181	572	910	1,186	1,253	426	420	175	182	281	268	142	2,791	1,001	892	207	3,925	380	45,437
黨歌鎮	Yingge	37,597	412	187	274	374	352	114	89	81	75	100	135	53	475	143	266	53	298	138	878
三峽鎮	Sansia	38,231	376	261	374	449	462	151	211	101	55	102	117	54	1,189	269	548	153	433	339	1,744
淡水鎮	Danshuei	63,102	1,667	835	1,540	3,336	1,656	998	304	175	228	749	2,808	3,370	328	876	227	113	468	229	113
汐止市	Sijhih	95,073	9,230	4,113	4,656	4,965	2,420	987	485	604	5,127	5,582	974	444	507	672	510	220	429	622	170
瑞芳鎮	Rueifang	18,866	853	268	256	327	261	112	85	93	242	293	110	63	255	191	121	41	190	85	100
土城市	Tucheng	113,964	2,106	1,346	2,080	2,583	2,741	847	1,506	559	340	570	562	283	10,158	1,186	7,411	1,139	2,212	1,381	3,183
蘆洲市	Lujhou	77,205	2,129	969	1,508	3,752	1,665	1,791	748	240	300	729	2,449	821	760	7,384	424	156	2,315	263	313
五股鄉	Wugu	34,894	603	332	560	1,001	606	438	265	104	123	282	455	314	349	1,906	140	77	1,345	129	232
泰山鄉	Taishan	32,695	607	317	458	739	604	302	227	95	86	192	352	201	449	1,007	211	58	3,213	100	557
林口鄉	Linkou	24,843	632	278	486	682	437	235	121	50	85	134	220	89	232	352	134	52	614	80	155
深坑鄉	Shenkeng	11,252	463	391	766	537	342	117	75	823	119	144	72	39	81	80	137	38	66	573	24
石碇鄉	Shihding	3,125	59	47	93	69	52	16	22	192	40	33	33	11	48	63	57	29	25	194	8
坪林鄉	Pinglin	2,486	81	46	34	16	20	10	11	76	24	19	17	10	75	36	73	21	36	183	13
三芝鄉	Sanjhih	11,406	151	64	125	208	99	80	28	18	24	54	192	312	70	151	50	22	91	27	27
石門鄉	Shihmen	4,479	44	30	34	57	34	23	6	15	13	40	98	132	41	91	27	14	80	20	14
八里鄉	Bali	14,859	317	135	226	487	220	183	76	40	49	127	522	783	102	515	49	27	190	60	44
平溪鄉	Pingsi	2,133	97	37	25	26	20	18	13	68	36	35	9	3	97	51	56	18	66	50	31
雙溪鄉	Shuangsi	3,555	170	29	29	57	62	40	20	14	49	42	26	14	186	122	63	30	133	23	60
貢寮鄉	Gongliao	5,324	133	36	54	101	53	36	27	15	34	38	47	19	273	164	94	24	158	47	70
金山鄉	Jinshan	8,848	173	55	136	132	88	61	37	34	34	89	106	71	116	105	53	34	100	35	30
萬里鄉	Wanli	7,621	244	113	85	81	52	26	11	21	42	69	50	29	105	60	46	15	54	24	33
烏來鄉	Wulai	1,507	13	29	24	29	21	8	7	38	7	5	2	5	23	15	20	6	3	256	4
龜山鄉	Gueishan	61,174	519	223	321	464	340	166	106	76	74	115	179	91	359	371	160	72	1,337	108	1,143

			WORK	
		Taipei City	Taipei County	Taoyuan County
HOME	Total	1,481,635	1,409,659	814,996
Taipei City	1,204,382	1,018,002	121,429	26,147
Taipei County	1,727,197	396,979	1,227,097	56,910
Taoyuan County	816,345	32,189	37,304	719,697

### Table 10. Home versus Work Trips in Number between Cities

27,416	a second second second second second second	Dansnuel	Sijhih	Rueifang	Tucheng	Lujhou	Wugu	Taishan	Linkou	Shenkeng	Shihding	Pinglin	Sanihih	石門鄉 Shihmen	八里鄉 Bali	平溪鄉 Pingsi	雙溪鄉 Shuangsi		金山鄉	萬里鄉	烏來鄉	龜山鄉
	32,747	52,801	82,585	13,432	88,770	51,034	55,338	28.135	43.424	10.073	2.226	1 743	7 835	3 255	12 147	1.067	1 641	acre	7.450	wann	vvulai	Gueisnar
36	8 85	246	1,365	39	207	136	335	126	422	115	14	14	12	9,200	37	1,007	1,041	3,070	7,152	6,327	1,185	69,655
4	1 142	339	2,020	92	260	170	370	108	423	220	21	9	11	10	37	7	4	13	21	24	2	302
63	3 122	474	1,307	46	410	155	460	176	503	292	35	13	17	17	45	0	2	21	37	26	5	246
4!	5 81	338	725	23	211	274	464	166	406	68	15	9	19	5	53	3	3	20	43	25	9	330
32	2 89	262	463	17	373	108	301	139	260	86	19	3	6	7	30	4	4	0	15	1	4	230
22	2 49	209	274	27	133	344	440	85	268	29	3	7	12	,	12	2	4	8	15	9	6	159
50	) 145	251	448	32	580	192	545	163	367	74	5	6	8	1	44	2	0	3	4	2	5	107
41	207	355	1,106	48	509	165	369	162	369	1.119	96	16	10	21	46	24	4	0	12	1	3	177
20	58	151	2,936	63	125	89	253	51	240	86	11	4	9	3	17	27	4	21	00	13	26	253
36	5 79	436	5,082	85	271	269	626	158	514	163	24	4	23	Q	80	3	1	5	10	0	0	91
49	9 101	1,042	880	27	333	990	1,165	310	692	85	20	6	86	37	215	1	4	14	54	127	2	313
50	80	2,258	707	29	238	613	1,058	262	638	60	18	7	145	45	526	2	9	9	38	9	2	390
348	1,057	579	811	48	7,275	544	2,820	773	1.836	121	24	13	22	20	142	7	15	14	70	11	4	336
78	3 167	617	648	35	513	3,943	5,300	779	1,223	83	27	5	42	8	340	2	15	20	25	9	10	1,376
139	463	424	895	45	3,770	266	1,120	312	862	253	46	14	19	14	65	7	9	10	22	10	4	620
66	5 208	319	752	24	1,059	174	492	141	424	188	26	10	20	7	36	, 0	11	17	32	28	1/	545
178	3 316	505	447	31	1,235	967	5,596	3,366	2,942	46	14	1	13	10	146	6	1	1/	21	1/	17	336
106	386	285	1,135	38	1,013	130	486	162	429	508	82	66	9	5	43	12	4	9	22	10	3	2,385
325	5 585	142	202	18	2,047	124	648	442	872	31	3	5	7	1	40	2	3	20	10	10	151	423
21,147	1,042	44	85	9	360	30	97	41	368	11	2	2	2	0	16	2	4	4	/	8	4	1,217
1,05*	24,210	56	98	7	1,932	44	139	56	206	21	8	5	7	2	13	1	0	1	0	0	1	2,170
12	2 38	37,513	216	13	109	371	792	133	300	26	0	3	312	251	399	0	1	5	1	10	2	311
32	2 52	163	45,095	190	235	122	388	97	291	193	19	8	9	9	31	13	13	20	42	18	0	125
14	29	59	862	10,020	95	46	73	30	110	11	2	3	2	0	15	16	36	20	47	30	2	196
213	1,087	165	350	16	62,661	177	789	242	667	60	17	7	14	6	50	5	5	90	17	12	5	44
30	72	426	260	29	195	38,052	4,788	481	652	22	6	1	43	6	429	1	3	4	10	2	2	525
16	5 19	232	92	15	99	953	20,276	1,005	875	10	2	0	17	5	272	0	1	4	19	4	5	2/8
28	40	153	99	9	156	192	1,986	16,467	1,420	7	5	2	1	2	55	0	4	1	9	4	1	2/6
20	17	63	75	6	51	103	379	293	14,530	6	5	1	5	2	85	1	- -	0	4	3	0	791
Ę	5 20	28	136	6	48	23	53	19	34	5,336	135	5	1	1	2	21	0	4	3	1	0	2,335
F	5 4	9	54	10	19	16	18	1	9	322	1,420	4	1	0	4	4	0		1	2	1	40
	13	4	41	5	17	18	15	4	7	10	3	1,442	0	0	1	3	0	3	0	2	0	2
	2 4	2,149	22	6	13	70	88	19	40	0	2	1	6,567	146	62	0	0	2	27	0	0	2
(	) 7	651	25	7	10	27	46	16	23	0	0	1	202	2.278	17	ů O	0	2	05	4	0	20
4	30	267	53	4	15	333	460	51	360	2	2	1	17	4	8.412	Ő	0	1	30	12	0	6
F	6	8	62	39	44	21	17	6	12	108	12	1	2	0	1	858	1	1	3	0	2	80
7	15	9	110	126	44	43	43	25	23	3	3	3	0	2	7	1	1 409	70	2	1	0	6
4	10	16	59	68	66	51	26	25	33	5	0	3	0	1	6	3	21	3 014	5	1	0	16
4	11	155	73	16	37	28	40	16	31	2	0	1	51	170	11	0		2,014	5 632	201	0	25
	4	45	131	15	32	11	28	14	18	4	2	0	12	31	4	0	2	1	218	4 926	2	10
	6	2	8	0	8	0	4	0	5	8	0	3	0	0	1	0	0	0	210	4,030	900	8
265	67	72	91	11	164	47	336	336	3,680	8	6	2	1	4	25	1	1	2	2	1	000	40 754

### Table 11. Home versus Work Trips in Percentage between Districts

		Manda	松山區	信義區	大安區	中山區	中正區	大同區	萬華區 Wanhua	文山區 Wunshan	南港區	内湖區 Neihu	士林區 Shihlin	北投區 Beitou	板橋市 Banciao	三重市 Sanchong	中和市	永和市 Yonghe	新莊市 Sinibuang	新店市 Sindian	樹林市 Shulin
	Hama	Total	102 112	102 207	207 190	214 402	152 475	70 706	83 007	82 866	55 881	00 206	118 201	82 122	183 010	158 023	143 808	55 252	155 534	105 349	74 674
	Songshan	04.056	61 19/	3 204	1 0%	6 8%	3 2%	1 1%	05,997	02,000	1 3%	2.0%	1.0%	0.5%	0.6%	0.9%	0.5%	0.3%	0.6%	0.7%	0.1%
石山四	Sintari	110 227	7 20/	52 50/	9.4%	5.4%	1 1%	0.0%	0.5%	0.8%	2.3%	2.0%	0.9%	0.4%	0.8%	0.8%	0.8%	0.4%	0.6%	1.0%	0.2%
日我回	Daran	120 634	1.3%	2 7%	64 4%	4 5%	4.1%	0.3%	0.6%	0.0%	0.7%	0.9%	0.7%	0.4%	0.9%	0.7%	0.9%	0.5%	0.7%	1.2%	0.1%
大文画	Ihongshan	102 606	4.2 %	1 10	3.0%	69.9%	2 7%	1 3%	0.5%	0.0%	0.5%	1.5%	1.6%	0.5%	0.8%	1.3%	0.6%	0.3%	0.8%	0.6%	0.2%
th THE	Ihongiheng	71 202	4.070	2.5%	6.5%	5 3%	57 9%	1.3%	2 2%	1 1%	0.6%	1.2%	1.1%	0.6%	1.5%	1.2%	1.6%	1.0%	0.9%	1.4%	0.2%
十回度	Datong	57 134	2 3%	1 2%	1.9%	5 1%	2.2%	68.9%	0.7%	0.3%	0.4%	1.0%	1.8%	0.7%	0.8%	2.8%	0.6%	0.3%	1.1%	0.4%	0.2%
東華區	Wanhua	89 465	3.1%	2.0%	3.7%	4.3%	5.2%	1.4%	59.1%	0.7%	0.5%	0.8%	1.0%	0.4%	2.7%	1.6%	2.7%	0.7%	1.1%	1.0%	0.4%
文山原	Wunshan	118 832	4.4%	3.0%	7.6%	4.6%	5.7%	0.8%	0.7%	50.1%	0.7%	1.0%	0.8%	0.4%	0.9%	0.7%	1.4%	0.7%	0.6%	6.3%	0.2%
南港區	Nangang	52 511	7.6%	5.4%	4 1%	3.8%	2.7%	0.7%	0.5%	0.6%	53.0%	3.9%	0.8%	0.4%	0.7%	0.7%	0.6%	0.2%	0.5%	0.7%	0.2%
147200	Neihu	121 460	8.9%	3.4%	4 3%	7.6%	3.3%	1.2%	0.5%	0.5%	2.8%	49.4%	1.9%	0.7%	0.6%	1.0%	0.5%	0.2%	0.7%	0.6%	0.2%
十林原	Shiblin	133 512	3.7%	1.6%	3.2%	7.6%	3.2%	2.7%	0.7%	0.4%	0.5%	1.8%	57.4%	2.5%	0.7%	1.8%	0.5%	0.2%	1.0%	0.5%	0.2%
北科區	Beitou	113 534	3 3%	1.8%	2.9%	7.0%	3.3%	2.2%	0.7%	0.4%	0.6%	1.6%	6.9%	53.5%	0.7%	1.5%	0.5%	0.2%	0.9%	0.5%	0.2%
析橋市	Banciao	240 556	2.7%	1.5%	2.8%	3.6%	3.6%	1.2%	2 4%	0.6%	0.4%	0.7%	0.7%	0.3%	54.2%	1.7%	3.9%	0.6%	3.1%	0.8%	2.9%
二重市	Sanchong	182 303	3.0%	1.5%	2.5%	5.5%	3.0%	2.6%	1.3%	0.4%	0.4%	0.8%	1.6%	0.6%	1.1%	59.1%	0.6%	0.2%	3.0%	0.4%	0.5%
中和市	Ihonghe	193 694	3.8%	2 4%	5.0%	4.6%	5.4%	1.2%	2.0%	1.1%	0.5%	0.8%	0.8%	0.4%	4.0%	1.0%	49.5%	2.7%	1.1%	3.4%	0.6%
永和市	Yonghe	108 494	5.3%	3.7%	8.9%	7.0%	9.7%	1.7%	1.7%	1.4%	0.8%	1.2%	1.1%	0.6%	2.1%	1.0%	5.6%	34.3%	0.9%	2.8%	0.4%
新莊市	Sinihuang	178 716	1.8%	1.1%	1.8%	2.7%	2.2%	1.1%	0.9%	0.4%	0.3%	0.6%	0.7%	0.3%	2.3%	4.4%	1.0%	0.3%	60.2%	0.4%	3.1%
新店市	Sindian	138,497	4.7%	2.9%	6.8%	5.1%	5.8%	1.0%	1.0%	3.8%	0.7%	1.1%	0.9%	0.5%	1.2%	0.6%	3.1%	1.2%	0.7%	49.7%	0.3%
樹林市	Shulin	71.872	1.6%	0.8%	1.3%	1.7%	1.7%	0.6%	0.6%	0.2%	0.3%	0.4%	0.4%	0.2%	3.9%	1.4%	1.2%	0.3%	5.5%	0.5%	63.2%
蒙歌鎮	Yingge	37.597	1.1%	0.5%	0.7%	1.0%	0.9%	0.3%	0.2%	0.2%	0.2%	0.3%	0.4%	0.1%	1.3%	0.4%	0.7%	0.1%	0.8%	0.4%	2.3%
三峽鎮	Sansia	38.231	1.0%	0.7%	1.0%	1.2%	1.2%	0.4%	0.6%	0.3%	0.1%	0.3%	0.3%	0.1%	3.1%	0.7%	1.4%	0.4%	1.1%	0.9%	4.6%
淡水鎮	Danshuei	63,102	2.6%	1.3%	2.4%	5.3%	2.6%	1.6%	0.5%	0.3%	0.4%	1.2%	4.4%	5.3%	0.5%	1.4%	0.4%	0.2%	0.7%	0.4%	0.2%
汐止市	Sijhih	95,073	9.7%	4.3%	4.9%	5.2%	2.5%	1.0%	0.5%	0.6%	5.4%	5.9%	1.0%	0.5%	0.5%	0.7%	0.5%	0.2%	0.5%	0.7%	0.2%
瑞芳鎮	Rueifang	18,866	4.5%	1.4%	1.4%	1.7%	1.4%	0.6%	0.5%	0.5%	1.3%	1.6%	0.6%	0.3%	1.4%	1.0%	0.6%	0.2%	1.0%	0.5%	0.5%
土城市	Tucheng	113,964	1.8%	1.2%	1.8%	2.3%	2.4%	0.7%	1.3%	0.5%	0.3%	0.5%	0.5%	0.2%	8.9%	1.0%	6.5%	1.0%	1.9%	1.2%	2.8%
蘆洲市	Lujhou	77,205	2.8%	1.3%	2.0%	4.9%	2.2%	2.3%	1.0%	0.3%	0.4%	0.9%	3.2%	1.1%	1.0%	9.6%	0.5%	0.2%	3.0%	0.3%	0.4%
五股鄉	Wugu	34,894	1.7%	1.0%	1.6%	2.9%	1.7%	1.3%	0.8%	0.3%	0.4%	0.8%	1.3%	0.9%	1.0%	5.5%	0.4%	0.2%	3.9%	0.4%	0.7%
泰山鄉	Taishan	32,695	1.9%	1.0%	1.4%	2.3%	1.8%	0.9%	0.7%	0.3%	0.3%	0.6%	1.1%	0.6%	1.4%	3.1%	0.6%	0.2%	9.8%	0.3%	1.7%
林口鄉	Linkou	24,843	2.5%	1.1%	2.0%	2.7%	1.8%	0.9%	0.5%	0.2%	0.3%	0.5%	0.9%	0.4%	0.9%	1.4%	0.5%	0.2%	2.5%	0.3%	0.6%
深坑鄉	Shenkeng	11,252	4.1%	3.5%	6.8%	4.8%	3.0%	1.0%	0.7%	7.3%	1.1%	1.3%	0.6%	0.3%	0.7%	0.7%	1.2%	0.3%	0.6%	5.1%	0.2%
石碇鄉	Shihding	3,125	1.9%	1.5%	3.0%	2.2%	1.7%	0.5%	0.7%	6.1%	1.3%	1.1%	1.1%	0.4%	1.5%	2.0%	1.8%	0.9%	0.8%	6.2%	0.3%
坪林鄉	Pinglin	2,486	3.3%	1.9%	1.4%	0.6%	0.8%	0.4%	0.4%	3.1%	1.0%	0.8%	0.7%	0.4%	3.0%	1.4%	2.9%	0.8%	1.4%	7.4%	0.5%
三芝鄉	Sanjhih	11,406	1.3%	0.6%	1.1%	1.8%	0.9%	0.7%	0.2%	0.2%	0.2%	0.5%	1.7%	2.7%	0.6%	1.3%	0.4%	0.2%	0.8%	0.2%	0.2%
石門鄉	Shihmen	4,479	1.0%	0.7%	0.8%	1.3%	0.8%	0.5%	0.1%	0.3%	0.3%	0.9%	2.2%	2.9%	0.9%	2.0%	0.6%	0.3%	1.8%	0.4%	0.3%
八里鄉	Bali	14,859	2.1%	0.9%	1.5%	3.3%	1.5%	1.2%	0.5%	0.3%	0.3%	0.9%	3.5%	5.3%	0.7%	3.5%	0.3%	0.2%	1.3%	0.4%	0.3%
平溪鄉	Pingsi	2,133	4.5%	1.7%	1.2%	1.2%	0.9%	0.8%	0.6%	3.2%	1.7%	1.6%	0.4%	0.1%	4.5%	2.4%	2.6%	0.8%	3.1%	2.3%	1.5%
雙溪鄉	Shuangsi	3,555	4.8%	0.8%	0.8%	1.6%	1.7%	1.1%	0.6%	0.4%	1.4%	1.2%	0.7%	0.4%	5.2%	3.4%	1.8%	0.8%	3.7%	0.6%	1.7%
貢寮鄉	Gongliao	5,324	2.5%	0.7%	1.0%	1.9%	1.0%	0.7%	0.5%	0.3%	0.6%	0.7%	0.9%	0.4%	5.1%	3.1%	1.8%	0.5%	3.0%	0.9%	1.3%
金山鄉	Jinshan	8,848	2.0%	0.6%	1.5%	1.5%	1.0%	0.7%	0.4%	0.4%	0.4%	1.0%	1.2%	0.8%	1.3%	1.2%	0.6%	0.4%	1.1%	0.4%	0.3%
萬里鄉	Wanli	7,621	3.2%	1.5%	1.1%	1.1%	0.7%	0.3%	0.1%	0.3%	0.6%	0.9%	0.7%	0.4%	1.4%	0.8%	0.6%	0.2%	0.7%	0.3%	0.4%
烏來鄉	Wulai	1,507	0.9%	1.9%	1.6%	1.9%	1.4%	0.5%	0.5%	2.5%	0.5%	0.3%	0.1%	0.3%	1.5%	1.0%	1.3%	0.4%	0.2%	17.0%	0.3%
龜山鄉	Gueishan	61,174	0.8%	0.4%	0.5%	0.8%	0.6%	0.3%	0.2%	0.1%	0.1%	0.2%	0.3%	0.1%	0.6%	0.6%	0.3%	0.1%	2.2%	0.2%	1.9%

		WORK	
	Taipei City	Taipei County	Taoyuan County
Total	1,481,635	1,409,659	814,996
Talpei City	68.71%	8.61%	3.21%
Taipei County	26.79%	87.05%	6.98%
Taoyuan County	2.17%	2.65%	88.31%

НОМЕ	Total	Taipei City	Taipei County	Taoyuan County
Taipel City	1,204,382	84.52%	10.08%	2.17%
Taipei County	1,727,197	22.98%	71.05%	3.29%
Taoyuan County	816,345	3.94%	4.57%	88.16%

Table 12. Commute from Cities

Table 13. Commute to Cities

黛 Yir	歌鎮 ngge	三峽鎮 Sansia	淡水鎮 Danshuei	汐止市 Sijhih	瑞芳鎮 Rueifang	土城市 Tucheng	蘆洲市 Lujhou	五股鄉 Wugu	泰山鄉 Taishan	林口鄉 Linkou	深坑鄉 Shenkeng	石碇鄉 Shihding	坪林鄉 Pinglin	三芝鄉 Sanjhih	石門鄉 Shihmen	八里鄉 Bali	平溪鄉 Pingsi	雙溪鄉 Shuangsi	貢寮鄉 Gongliao	金山鄉 Jinshan	萬里鄉 Wanli	鳥來鄉 Wulai	龜山鄉 Gueishan
27	,416	32,747	52,801	82,585	13,432	88,770	51,034	55,338	28,135	43,424	10,073	2,226	1,743	7,835	3,255	12,147	1.067	1.641	3.676	7.152	6.327	1 185	69 655
	0.0%	0.1%	0.3%	1.5%	0.0%	0.2%	0.1%	0.4%	0.1%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
	0.0%	0.1%	0.3%	1.8%	0.1%	0.2%	0.2%	0.3%	0.1%	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	0.0%	0.1%	0.3%	0.9%	0.0%	0.3%	0.1%	0.3%	0.1%	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	0.0%	0.1%	0.3%	0.7%	0.0%	0.2%	0.3%	0.5%	0.2%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	0.0%	0.1%	0.4%	0.7%	0.0%	0.5%	0.2%	0.4%	0.2%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	0.0%	0.1%	0.4%	0.5%	0.0%	0.2%	0.6%	0.8%	0.1%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	0.1%	0.2%	0.3%	0.5%	0.0%	0.6%	0.2%	0.6%	0.2%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	0.0%	0.2%	0.3%	0.9%	0.0%	0.4%	0.1%	0.3%	0.1%	0.3%	0.9%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	0.0%	0.1%	0.3%	5.6%	0.1%	0.2%	0.2%	0.5%	0.1%	0.5%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	0.0%	0.1%	0.4%	4.2%	0.1%	0.2%	0.2%	0.5%	0.1%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.3%
	0.0%	0.1%	0.8%	0.7%	0.0%	0.2%	0.7%	0.9%	0.2%	0.5%	0.1%	0.0%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
	0.0%	0.1%	2.0%	0.6%	0.0%	0.2%	0.5%	0.9%	0.2%	0.6%	0.1%	0.0%	0.0%	0.1%	0.0%	0.5%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.3%
	0.1%	0.4%	0.2%	0.3%	0.0%	3.0%	0.2%	1.2%	0.3%	0.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%
	0.0%	0.1%	0.3%	0.4%	0.0%	0.3%	2.2%	2.9%	0.4%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
	0.1%	0.2%	0.2%	0.5%	0.0%	1.9%	0.1%	0.6%	0.2%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
	0.1%	0.2%	0.3%	0.7%	0.0%	1.0%	0.2%	0.5%	0.1%	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
	0.1%	0.2%	0.3%	0.3%	0.0%	0.7%	0.5%	3.1%	1.9%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%
	0.1%	0.3%	0.2%	0.8%	0.0%	0.7%	0.1%	0.4%	0.1%	0.3%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%
	0.5%	0.8%	0.2%	0.3%	0.0%	2.8%	0.2%	0.9%	0.6%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.7%
	56.2%	2.8%	0.1%	0.2%	0.0%	1.0%	0.1%	0.3%	0.1%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.8%
	2.7%	63.3%	0.1%	0.3%	0.0%	5.1%	0.1%	0.4%	0.1%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%
	0.0%	0.1%	59.4%	0.3%	0.0%	0.2%	0.6%	1.3%	0.2%	0.5%	0.0%	0.0%	0.0%	0.5%	0.4%	0.6%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%
	0.0%	0.1%	0.2%	47.4%	0.2%	0.2%	0.1%	0.4%	0.1%	0.3%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	0.1%	0.2%	0.3%	4.6%	53.1%	0.5%	0.2%	0.4%	0.2%	0.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.2%	0.5%	0.1%	0.1%	0.0%	0.2%
	0.2%	1.0%	0.1%	0.3%	0.0%	55.0%	0.2%	0.7%	0.2%	0.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
	0.0%	0.1%	0.6%	0.3%	0.0%	0.3%	49.3%	6.2%	0.6%	0.8%	0.0%	0.0%	0.0%	0.1%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%
	0.0%	0.1%	0.7%	0.3%	0.0%	0.3%	2.7%	58.1%	2.9%	2.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%
	0.1%	0.1%	0.5%	0.3%	0.0%	0.5%	0.6%	6.1%	50.4%	4.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.4%
	0.1%	0.1%	0.3%	0.3%	0.0%	0.2%	0.4%	1.5%	1.2%	58.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	9.4%
	0.0%	0.2%	0.2%	1.2%	0.1%	0.4%	0.2%	0.5%	0.2%	0.3%	47.4%	1.2%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%
	0.2%	0.1%	0.3%	1.7%	0.3%	0.6%	0.5%	0.6%	0.0%	0.3%	10.3%	45.4%	0.1%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%
	0.2%	0.5%	0.2%	1.6%	0.2%	0.7%	0.7%	0.6%	0.2%	0.3%	0.4%	0.1%	58.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
	0.0%	0.0%	18.8%	0.2%	0.1%	0.1%	0.6%	0.8%	0.2%	0.4%	0.0%	0.0%	0.0%	57.6%	1.3%	0.5%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.2%
	0.0%	0.2%	14.5%	0.6%	0.2%	0.2%	0.6%	1.0%	0.4%	0.5%	0.0%	0.0%	0.0%	4.5%	50.9%	0.4%	0.0%	0.0%	0.0%	2.1%	0.3%	0.0%	0.1%
	0.0%	0.2%	1.8%	0.4%	0.0%	0.1%	2.2%	3.1%	0.3%	2.4%	0.0%	0.0%	0.0%	0.1%	0.0%	56.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
	0.3%	0.3%	0.4%	2.9%	1.8%	2.1%	1.0%	0.8%	0.3%	0.6%	5.1%	0.6%	0.0%	0.1%	0.0%	0.0%	40.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
	0.2%	0.4%	0.3%	3.1%	3.5%	1.2%	1.2%	1.2%	0.7%	0.6%	0.1%	0.1%	0.1%	0.0%	0.1%	0.2%	0.0%	39.6%	2.0%	0.1%	0.0%	0.0%	0.5%
	0.1%	0.2%	0.3%	1.1%	1.3%	1.2%	1.0%	0.5%	0.5%	0.6%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%	0.4%	56.6%	0.1%	0.0%	0.0%	0.5%
	0.0%	0.1%	1.8%	0.8%	0.2%	0.4%	0.3%	0.5%	0.2%	0.4%	0.0%	0.0%	0.0%	0.6%	1.9%	0.1%	0.0%	0.0%	0.0%	63.7%	4.3%	0.0%	0.1%
	0.0%	0.1%	0.6%	1.7%	0.2%	0.4%	0.1%	0.4%	0.2%	0.2%	0.1%	0.0%	0.0%	0.2%	0.4%	0.1%	0.0%	0.0%	0.0%	2.9%	63.5%	0.0%	0.1%
	0.3%	0.4%	0.1%	0.5%	0.0%	0.5%	0.0%	0.3%	0.0%	0.3%	0.5%	0.0%	0.2%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	0.1%	57.5%	0.2%
	0.4%	0.1%	0.1%	0.1%	0.0%	0.3%	0.1%	0.5%	0.5%	6.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	66.6%

#### 2.13 Urban Interface

Although streets and roads have different widths, the things affect the urban environment the most are the interfaces between streets and urban space, which are sidewalks and arcades. These two elements are the only two parts of streets that residents will have to interact with while they are doing their daily activities except driving, the other parts of the roads just designed for cars to pass by. Based on different combination of arcades and sidewalks, they are eight types of basic street interfaces in Greater Taipei Area. From no arcade no sidewalk to arcade with sidewalk greater than 3.5 meters wide, different sizes of sidewalks and arcades will have different possibilities for pedestrian to use the space. The size of sidewalk is usually related to width of streets and roads. Most of the streets less than 10 meters wide usually have no sidewalk. Most of sidewalks start from minimum 1.5 meters wide. Up to 1.5 meters to 3.5 meters, trees are allowed to plant on sidewalks and scooters are allowed to park between tree rings. Greater than 3.5 meters, scooter parking turns can be constructed. Most of commercial and commercial mixed with residential streets have arcades, because of the rainy climate in Taipei. Arcades will be the major passages for pedestrian to walk by without getting wet. Sidewalks can be added on the sides.



Figure 49. Sidewalk and Arcade



Figure 50. Different Types of Street Interface



Figure 51.



Figure 51.

Carilli S



#### 2.14 Streets in Greater Taipei Area

The ideal street section in Greater Taipei Area should look like the diagram the first on the left. Each type of vehicles should have its own lane and sidewalk is for pedestrian only. Because of the scarcity of the available land and high population density in Taipei, streets are multifunctional. The street section diagram is the second on the left. Only inner lanes are for cars only, the slow speed lanes are often both for cars and scooters. Sometimes street parking will also occupy some space from slow speed lanes. The traffic conditions in these lanes are chaotic. Scooter drivers not only have to watch out cars in the same lane, they also have to avoid the unexpected opening doors from the parking cars. The car drivers also have to pay extra attention to scooter drivers to avoid collusion. It is never easy to drive on Taipei streets. Except highways and expressways, streets of Taipei can be divided into two categories, one is main and secondary streets, and the other is communal streets. Main and secondary streets are mostly full of commercial activities and the major arteries in connecting each part of the city. A lot of people go to these places to work and transfer. The communal streets usually have only a little commercial activities and the rest just all residential areas. Because there were too many cars and especially scooters parked on the main and secondary streets and on the sidewalks which caused a lot of messy views of urban environment, this city government tried to ban parking in those areas, however, there are still a lot of demand for parking spaces instead of parking in those areas. These

vehicles flooded into communal streets. These streets should be the major living space for local residents, but now they become free parking lots. These communal streets share 60% of the total street area of Taipei city. The ban actually made living space worse.

Figure 56.



**Communal Street Type 1:** 4 meters wide street.







Figure 58.

**Communal Street Type 2:** 6 meters wide street.





Car		Car
Scooter		Scooter
2.5m	0.5m	2.5m
	6m	

Figure 60.

.

**Communal Street Type 3:** 8 meters wide street.







Figure 62.

# **Communal Street Type 4:** 10 meters wide street.





Figure 64.

10m

Main Street Type 1: Street without sidewalk.







Figure 66.

Main Street Type 2: Street with 1.5 meters wide sidewalk.







Figure 68.

Main Street Type 3: Street with 1.5~3.5 meters wide sidewalk.



0	2m	2.5n	١	I.	2m	-	3m	I	3m	2m	-	2.5m	-	2m	0.0
m	2.5m							15m						2.5m	m
								20m							

Figure 70.

#### Main Street Type 4:

Street with sidewalk greater than 3.5 meters in width.



Figure 72.

**Main Street Type 4:** Street with sidewalk greater than 3.5 me-ters in width.



Side V	Side Walk				Car Lane		Car Lane			ixed	Lane	Side Walk		
S	Scooter	Car		n (ne per per per per per <b>p</b> eriodo) de	a para di kulu yang di pang di						Car	Scoote	۲	
1.5m 3.5r	2m   n	2.5m	1 2n	n I	3m	15m	3m	I	2m	ł	2.5m	2m 3	⊢1.5m .5m	
						22m	)							

Figure 74.

#### Main Street Type 5: Street with arcade without sidewalk.





Figure 76.

12m

#### Main Street Type 6:

Street with arcade with 1.5 meters wide sidewalk.







Figure 78.

### Main Street Type 7:

Street with arcade with 1.5~3.5 meters wide sidewalk.





Main Street Type 8: Street with arcade with sidewalk greater than 3.5 meters in width.



Side	Side Walk		Mixed Lane				Car Lane Car Lane					Mixed Lane				Side Walk		
	Scooter		Car										Car		Scooter	•		
1.5m   3.5	2m ōm		2.5m		2m	1	3m	15m 22m	3m		2m	I	2.5m	and the factor of the factor of the	2m 3.	1.5m 5m		

Figure 82.

1

Main Street Type 8:

Street with arcade with sidewalk greater than 3.5 meters in width.





# **3.0 DESIGN PROPOSAL**

#### 3.1 Mobility-On-Demand System

Mobility-On-Demand System is the supporting transportation system for the existing transportation network. It is going to solve the first mile and last mile problems which public mass transit systems can not deal with. Mobility-On-Demand System is a one-way vehicle rental system which has stations with different types of vehicles throughout the city. The vehicles are all electric and constantly charging themselves when they are parked in the station for users to pick up. Users can go to any of these stations and simply use a membership card to pick up any available vehicle and drive away. They could return to their vehicles to any other station and walk away. Mobility-On-Demand System is both public and private. Anyone with a membership card could use this service, but it is also personal, fast, convenient, and pointto-point. The best of all, users do not have to pay for the time they are not using these vehicles, such as parking fee, insurance fee and depreciation.

The most important thing about Mobility-On-Demand System is where users can find stations to rent M.O.D. vehicles and

Figure 85. City Car

after rented where they can find stations to return them. The location and identification of M.O.D. stations will be the crucial key to make this system working. First, the stations will be placed nearby the existing major mass transit stations. The M.O.D. stations will provide extended mobility for passengers to go to their destinations from existing stations. Second, the stations will be placed nearby places with clear identities and need to be distributed evenly throughout the city. Therefore, people will not have problems to find stations even in unfamiliar areas. The last but not least, based on different urban fabrics, population density and land use pattern, some stations should be placed in some areas when the first and second ones are not walking efficiently.

With the tradition of car rental service, such as Hertz, Avis, users can only rent cars by days. Most of the time users had to return their cars to original stations or they may need to pay different rates in the first place. With the recent car sharing rental service, such as Zipcar, users can rent cars by hours, but they have to return the cars to the same parking spots. Unlike these services, with Mobility-On-Demand System, it only charges its users for the time or the distance they are actually using or driving these vehicles. They can pick up any M.O.D. vehicle from any station, in any time, as long as it is available.

The vehicle types for Mobility-On-Demand System range from segaway, bike, scooter, car, and so on. Users can choose what ever vehicles which fit their purposes the most. For example, if the weather permits, people do not have to rent a car to go to a supermarket. They can ride a bike to the supermarket and drive a car back with groceries. They do not even need to pay for the time when vehicles were parking and the parking fees. These vehicles are all electric, small footprint, and some even foldable, such as Roboscooter and Citv Car developed by Smart cities, Media lab, Massachusetts Institute of Technology. When vehicles are folded and parked in the station, they only occupy a small space and are constantly charging themselves. Therefore, users do not have to worry about the energy level of the vehicle.

Figure 86. Roboscooter



#### **Electricity Farm**

M.O.D. vehicle is an environmental friendly vehicle and so does its power source. Smart Cities Group engages in finding possible ways to recharge vehicles wirelessly from photovoltaic batteries. In Greater Taipei Area, the roofs will be the best place to become the electricity farm. From the aerial photo, after adjusting the brightness and contrast, the brighter colors they present the steel roofs on each building. Because of the sub-tropical climate, Taipei has a lot of rain all seasons long. Preventing from the raining leakage, residents always remodel their buildings with steel roofs. They can become the perfect places to install the photovoltaic batteries.







# ORIGIN

one way rental Mobility-On-Demand station either by distance or price. service.

Imaging user at origin wants to use He can search any nearby pick up

Just walk one to five minute, he can reach the desired station.



#### 3.2 One Way Rental Service

One way rental service is like taking a cab, but you are the cap driver. Users don't have to return their rental vehicles to the original rental stations. They can pick up vehicles from stations which near to their origins the most and return vehicles to the nearest stations to their destinations. The ordinary rental service charges users by days or hours. After rented vehicles, even though users just used one tenth of the time driving and the rest time just parked in parking lots, users still had to pay the unused time. The one way rental service is different, people only pay the time they are actually using vehicles. It saves users more money and vehicles can be used more efficiently.



Because of M.O.D. system, traffic is always good. No pollution and no noise.



He can go to any subway station or other destination.

He can simply use a membership card to pick up the vehicle which was automatically fully charged at station.

He can drive the vehicle toward destination in no time.





He can search any

nearby drop off sta-

tion either by dis-

tance or price.



He can drop off the vehicle at station

and walk away.



Figure 99.

The vehicle will automatically charged itself and he can just walk one to five minute to his destination.

# DESTINATION



### 3.3 Mobility-On-Demand Rental Process



Figure 100.

Station A



## **Travel Lantency**

From Station A to Station B


Figure 101.



# 3.4 Mobility-On-Demand System in Greater Taipei Area

Everyone wants to have a very good car to drive, such as Porsche. The top speed of Porsche 911 GT2 is 328 kilometers per hour. However, the average Taipei city traffic speed is 27.2 kilometers in morning peak hours; 30.1 kilometers in morning off-peak hours and 25.9 kilometers in afternoon peak hours.<sup>24</sup> Why bother to buy a Porsche to use in this kind of traffic. Although the top speed of M.O.D. vehicles could not catch up with ordinary gasoline vehicles, the M.O.D. vehicles will drive faster and are more environmental because they have smaller footprint and they are fully electric. The M.O.D. transportation system will not replace the existing transportation systems, on the contrary, it will supplement the current systems and make them work more efficiently. The existing transportation network has different systems, and they are now fully integrated. Sometimes it's very hard to use one system and transfer to another one because the routes and schedules don't work together very well. By introducing the M.O.D. transportation system, it not only solves the first mile and last mile problem, it will also become the bridge and lubricant of different transportation systems. The integration of different transportation systems can make passengers' commute become more efficient and save more money and time. Because of the high density of vehicles and congested traffic in Greater Taipei Area, the M.O.D. system will only introduce City Car and Roboscooter as M.O.D. vehicles in the first stage. It will be dangerous to use bikes and Segways while the traffic speed is very fast and there are not a lot special lanes for these kinds of vehicles.



Figure 102.

# **Mobility-On-Demand System**







### 3.5 Backbone System: MRT Stations

The Taipei Rapid Transit System, also known as the MRT, Metropolitan Rapid Transit, is a rapid transit system connecting the Greater Taipei Area. After the MRT first began operating in 1996, passengers grew from 40,000 passengers per day to 1,239,761 passengers per day today.<sup>25</sup>The MRT is the second most popular public transportation system in Greater Taipei Area. There are eight routes, 69 stations in service right now. The total routes length is 74.4 kilometers.<sup>26</sup> There will be 135 stations and 154.1 kilometers routes length in 2014. The length of total routes will grew up to 270 kilometers in the future planning phase<sup>27</sup>Based on MRT's characteristics, the growing number of passengers it carries, the distribution throughout the city, the size of stations, and landmarks which stations became to the neighborhoods, MRT Stations will be the perfect places to become the M.O.D. stations. MRT will play the role to take a large number of people

to travel from one place to another in distance, M.O.D. will be responsible to take these people from MRT stations to their destinations. Therefore, M.O.D. System is introduced to solve the first mile and last mile problems between the MRT Stations and people's destinations. MRT stations will become the backbone system of the M.O.D. System. M.O.D. vehicles will be parked near the entrances of MRT stations or parking lots. People who use M.O.D vehicles from their origins can simply drop off vehicles in these places. Once passengers left the MRT Stations, they can also pick up of any available M.O.D. vehicle near stations and drive them to their destinations. since a lot of times passengers' destinations are not within walking distance. They can simply use the same MRT easycards to rent and activate M.O.D. vehicles. When they arrive at the destinations, they can follow the Ubiquitous System to guide them to stations near their destinations.

Chart 2. Total Passngers of MRT in Each Year (10,000/year)





Figure 104. MRT Routes Map

# Throughput Table of MRT in 2008

																	31
	小碧潭 站	新店站	新店市 公所站	七張站	大坪林站	景美站	萬隆站	公館站	臺電大樓站	古亭站	中正紀念堂站	頂溪站	永安市場站	景安站	南勢角 站	小南門站	臺大醫院 站
Station	Xiaobitan	Xindian	Xindian City Hall	Qizhang	Dapinglin	Jingmei	Wanlong	Gonggua n	Taipower Building	Guting	C.K.S. Memorial Hall	Dingxi	Yongan Market	Jingan	Nanshijia o	Xiaonan men	NTU Hospital
In	1,871	8,903	9,000	12,484	15,710	13,968	6,839	26,710	14,129	25,839	21,484	25,323	17,806	16,387	16,387	4,161	21,871
Out	1,903	8,161	9,065	11,935	15,129	13,903	6,548	26,452	13,516	25,903	21,226	26,774	17,484	16,097	15,645	4,484	22,129
People Trips/ Day	1,887	8,532	9,032	12,210	15,419	13,935	6,694	26,581	13,823	25,871	21,355	26,048	17,645	16,242	16,016	4,323	22,000
	臺北站	中山站	雙連站	民權西 路站	圓山站	劍潭站	士林站	芝山站	明德站	石牌站	唭 哩 岸 站	奇岩站	北投站	新北投 站	復興崗站	忠義站	關渡站
Station	Taipei Main Station	Zhongsh an	Shuangli an	Minquan W. Rd.	Yuansha n	Jiantan	Shinlin	Zhishan	Mingde	Shipai	Qilian	Qiyan	Beitou	Xinbeitou	Fuxingga ng	Zhongyi	Guandu
In	126,710	30,742	19,677	29,581	23,710	34,355	23,677	14,484	11,710	24,355	6,355	7,226	14,742	4,452	3,032	2,742	11,065
Out	122,613	31,903	21,258	29,613	23,161	33,935	23,968	14,613	11,097	25,419	5,839	5,387	16,161	4,097	3,032	2,677	11,677
People Trips/ Day	124,661	31,323	20,468	29,597	23,435	34,145	23,823	14,548	11,403	24,887	6,097	6,306	15,452	4,274	3,032	2,710	11,371
	竹圍站	紅樹林站	淡水站	新埔站	江子翠 站	龍山寺站	西門站	善導寺 站	忠孝新 生站	忠孝復興站	忠孝敦 化站	國父紀 念館站	市政府站	永春站	後山埤站	昆陽站	中山國中 站
Station	Zhuwei	Hongshul in	Danshui	Xinpu	Jiangzicu i	Longsha n Temple	Ximen	Shandao Temple	Zhongxia o Xinsheng	Zhongxia o Fuxing	Zhongxia o Dunhua	Sun Yetsen Memorial Hall	Taipei City Hall	Yongchu n	Houshan pi	Kunyang	Zhongsha n Junior High School
In	8,677	5,742	35,065	37,032	19,355	22,323	49,258	16,000	18,129	40,839	28,710	17,484	41,677	16,677	15,968	28,065	16,194
Out	8,774	5,968	34,290	36,258	19,226	21,581	49,516	17,290	19,129	40,484	31,903	18,935	42,419	16,419	15,710	28,226	14,968
People Trips/ Day	8,726	5,855	34,677	36,645	19,290	21,952	49,387	16,645	18,629	40,661	30,306	18,210	42,048	16,548	15,839	28,145	15,581
	南京東 路站	大安站	科技大 樓站	六張犁 站	麟光站	辛亥站	萬芳醫 院站	萬芳社 區站	木柵站	動物園 站	板橋站	府中站	亞東醫 院站	海山站	土城站	永寧站	總計
Station	Nanjing E. Rd.	Daan	Technolo gy Building	Liuzhang li	Linguang	Xinhai	Wanfang Hospital	Wanfang Communi ty	Muzha	Taipei Zoo	Banqiao	Fuzhong	Far Eastern Hospital	Haishan	Tucheng	Yongning	TOTAL
In	17,387	11,581	10,710	8,645	19,355	2,516	10,903	1,903	3,806	7,452	18,548	22,613	11,742	14,355	5,000	11,129	1,226,194
Out	18,613	12,161	10,677	8,581	19,226	2,355	11,548	1,548	4,065	7,613	20,226	21,194	10,258	14,161	5,000	11,129	1,226,161
People Trips/ Day	18,000	11,871	10,694	8,613	19,290	2,435	11,226	1,726	3,935	7,532	19,387	21,903	11,000	14,258	5,000	11,129	1,226,177

Table 14. Daily Passengers Numbers in Each Stations in May, 2008







汉 - 1.1 Figure 108. View of Junior High School Field 00

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#### 3.6 Ubiquitous Sub-System 1: School Stations

Because Taipei City and Taipei County are mix-used cities, there is no clear boundary among residential, commercial and industrial zones. Residential areas can be found anywhere inside and outside the city's limit. Where there is a residential area. there are schools near by it. The education for children from elementary school to iunior high school is compulsory in Taiwan. Except a small number of special and private schools, most of elementary schools and junior high schools are community schools. They are usually within the walking distance for students who live in nearby neighborhoods to attend. Most of parents in Taiwan don't drive their children to schools like parents in United States do: instead. most of students who go to schools on feet or by bicycles. Elementary schools and junior high schools are necessity for every residential area. These schools don't just play roles in education systems, they are actually become community centers. People go to schools to vote in every election.

A lot of lectures and local clubs are taking place in schools. Nearby residents always use schools like their own back yards to do exercise and sports. Schools even become shelters for nearby citizens when unexpected disasters taking place. Schools are very important to every neighborhood and they are ubiquitous throughout Greater Taipei Area. From university to elementary school, there are 309 schools in Taipei City and 345 schools in Taipei County. A total of 654 schools in Greater Taipei Area<sup>28</sup>489 of them are elementary schools or junior high schools, nearly 75% of total schools. Since school is ubiquitous and have its own campus, the M.O.D. system can take the advantage of its distribution, density, available space and the role it plays and turn it into Ubiquitous System Station for M.O.D. system. People could pick up their desire vehicles from School Stations. Because schools are always within the walking distance for residents in the same neighborhood, people will have no problem to go to

	Taipei City	Taipei County
Universitys & Colleges	25	17
Junior Colleges	2	1
High Schools	50	37
Vocational High Schools	17	16
Junior High Schools	62	65
Elementary Schools	153	209
Table	15. Schools in	Greater Tainei Area

. . .

nearby schools either from home or work place in a short time. Parents could even walk their children to schools and pick up vehicles to go to work from School Stations. If users go to a unfamiliar area, they would have no problem to find a School Station to pick up a vehicle or to find a drop off parking space either by asking people or using on-board GPS. There are four different types of parking possibilities for School Station parking. They are parking near the school's perimeter, parking inside certain areas of school, parking everywhere inside school and parking under school. They can accommodate both City Car and Roboscooter parking.

### Type 1:

Stations the near school's perimeter. There are usually free parking spaces for neighborhood residents along most of schools' perimeter. The M.O.D. system can convert some parking spaces into M.O.D. stations. Stations can be distributed along the perimeter of schools for easy access. Most of the local residents won't have difficulties to pick up a vehicle in School Station, because a large number of them don't have parking spaces of their own. They usually park their private cars in these parking spaces. The walking distance for users to use a vehicle will be the same.



Figure 109.





#### Type 2:

Stations inside certain areas of school. Because of the shortage of parking spaces in Greater Taipei Area, some schools open certain parts of their campuses for overnight parking for neighborhoods. The M.O.D. system can convert some of these parking spaces into M.O.D. stations. It can be either 24 hours operating station or 12 hours, 7 P.M. to 7 A.M., operating station. Type 1 and Type 2 stations can work together to increase the capacity of M.O.D. system.



Figure 112.





# Type 3:

Stations everywhere inside school. Most of universities and colleges have relatively larger campuses than other types of schools. Most of them have a lot of parking spaces inside their campuses either for faculty and students parking or neighborhood's parking. The M.O.D. system can convert some parking spaces into M.O.D. stations. It could either be a inner-school transportation system and link outside to campus for large campuses schools or for neighborhood parking usage. These large universities campuses always attract a lot of local people to use their facilities on daily basis.



Figure 115.





#### Type 4:

Stations in school's basement. Because of the shortage of parking spaces, city government officials encourage a lot of schools in Greater Taipei Area convert or reconstruct their basements into parking lots to solve the parking issue and generate extra revenues. The M.O.D. system can convert some parking spaces into M.O.D. stations. People can pick up M.O.D. vehicles like they pick up their private cars before. Moreover, they don't have to pay overnight parking fees for using M.O.D. vehicles.



Figure 119.



# Schools Distribution Diagram in Greater Taipei Area

There are 654 schools in Greater Taipei Area and approximately at least 582<sup>29</sup> schools are shown on this map. Most of schools are within urbanized area and still some are outside urban area. Within urbanized area, schools are distributed evenly everywhere and ubiquitous. Where there are people, there are schools.

5 Km

Figure 121.

86

the

School

# Schools Density per Square Kilometer Diagram in Greater Taipei Area

From the density diagram, it has shown that there is at least one school per every square kilometer in urbanized Greater Taipei Area. In some parts, there are even six schools per one square kilometer. The sheer density and even distribution of schools can be a very good characteristic for Ubiquitous System of M.O.D. system.

5 Km





		DO OPEN		2 2 2	
	BET		Stores	Density (stores/km2)	People serving
		Japan	12,013	31	10,636
		USA	5,863	1,642	51,443
		Taiwan	4,807	8	4,781
and the second s		Thailand	4,055	127	16,139
the second is a second in the second s		South Korea	1,433	70	34,211
		Malaysia	FRES	391	32,230
		Hong Kong			8,704
		Mexico	TT 771600	2,909	70.050
		Canada	409	21,209	11 210
State of the second sec		Australia	366	21,239	58 283
		China		28,152	3.876.398
		Philippines	291	1.031	304,380
		Norway	102	3,179	46,595
		Turkey	79	9,881	891,316
and the second se		Sweden	74	6.01	124,004
		Denmark	61		

Figure 123. View of 7-11 in Taipei

Table 16. 7-11 Density and One Store per Serving People in Different Countries



## 3.7 Ubiquitous Sub-System 2: Convenience Store Stations

Taiwan has the highest density of convenience stores per person in the world. There are 9,029 convenience stores<sup>30</sup> in Taiwan, serving 23 million population in an area of 35,801 m2, average 2,700 potential customers per one store and every 3.97 km2 serving area per one store. 80% of urban household shoppers in Taiwan go to a convenience store every week. The top four franchises convenience stores brands own 94.1% of the total convenience stores in Taiwan. They are 7-11, 48.57%; Family Mart, 22.28%; Hi-Life, 13.96% and OK, 9.29%<sup>31</sup>Only 7-11 along has 6 million customer visits per day. Nearly one out of four people in Taiwan shops in 7-11 everyday. Japan has 12,0137-11 convenience stores, ranked 1st in the world; USA is in 2nd place, has 5,863 stores; Taiwan ranked 3rd . has 4.807 stores<sup>32</sup>However, if you compare the size of Taiwan with Japan and USA, Japan is 11 times and USA is 275 times bigger than Taiwan, Taiwan is 2/5 of Japan's store number and only 1,056 stores less than

total number of stores which USA has. Convenience stores in Taiwan not only sell foods, beverages, snacks newspapers and book, they also provide all kinds of service, such as movie and concert tickets, delivery service, on-line shopping pick up and payment service, ATM, Taxi, fax, printing, scanning, photo printing, video rental pick up, insurance, recycling, donation and customer can pay all kinds of bill such as cell phone, internet, credit card, utility, parking fee, traffic violation fine in these convenience stores. Convenience stores in Taiwan actually function like community center. People go there to meet friends, find solution and feed their needs. Because all the convenience stores are operating 24-7, people always feel secure mentally and physically that there's a place you can go anytime you want and have anything you like. Based on the wide distribution and density that convenience stores have, they can be a perfect place to become the Ubiguitous System for M.O.D. system. People can go there not only buy all sorts of things and pay all kinds of bills, but also fulfill

their need for mobility. Because the top four brands have 94.1% share of the total convenience stores. It would be relatively easier to negotiate with just four franchises about implementing the M.O.D. network. There are seven different general types of convenience stores in Taiwan. Each of them will have different parking strategies for City Car and Roboscooter. These vehicles don't always need to park in front of stores, they can be parked near them. Convenience store can just provide a locating point for user to locate the station.

## Type 1:

Convenience stores without sidewalks. These stores often can be seen in communal alleys and pedestrian walking zones. Cars and scooters can be parked against the walls.

## Type 2:

Convenience stores with sidewalks between 1~2.5 meters wide. These stores can easily be found in secondary streets and urban neighborhoods. Cars and scooters can be parked near curbs.









# Type 3:

Convenience stores with sidewalks greater than 2.5 meters wide. These stores can easily be seen in main and secondary streets. Cars and scooters can be parked near curbs and scooters may also be parked on sidewalks.

# Type 4:

Convenience Stores inside arcades without sidewalks. These stores often locate in secondary streets in old commercial and residential mix-used neighborhoods. Cars and scooters can be parked near curbs.



Figure 128.







# Type 5:

Convenience Stores inside arcades with sidewalks between 1~2.5 meters wide. These stores can often be seen in main and secondary commercial and mix-used streets. Cars and scooters can be parked near curbs.





## Type 7:

Free standing convenience Stores with parking space. These types of convenience stores are very hard to find in urban area. They can only be seen in suburban or rural area.

# Type 6:

Figure 134.

Convenience Stores inside arcades with sidewalks greater than 2.5 meters wide. These stores can often be seen in main commercial streets. Cars and scooters can be parked near curbs and scooters may also be parked on sidewalks.





# Convenience Store

## Convenience Stores Distribution Diagram in Greater Taipei Area

There are approximately at least 1,579 convenience stores in Greater Taipei Area.<sup>33</sup>Almost all the convenience stores are within urbanized area and especially in central part of Taipei City. Within urbanized area, convenience stores are distributed evenly everywhere and ubiquitous. Where there are people, there are convenience stores.

5 Km

8° 0

92

Figure 138.



Figure 140. Street View of Taipei City

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## 3.8 Ubiquitous Sub-System 3: Bus Stop Stations

Public buses are always very important to public transportation in Greater Taipei Area. Since operating, public buses are the major commute method to Taipei citizens, even after MRT operating. Public buses have average 1,687,960 passengers per day, which MRT only has 1,239,761 passengers per day. There are more passengers using public buses to commute than using MRT. Even after MRT started to operate, buses passengers only 90,000 less after 10 years, see upper-right chart. There are 11 companies, running 287 routes, 3,877 buses per day. Bus stops are everywhere throughout the Greater Taipei Area. Almost everywhere can be reach by bus. Sometimes people don't have to transfer to another route to their destinations, because every route all try to cover as many stops as possible. This makes the bus routes in Greater Taipei Area extremely complicated and even difficult to understand for some local residents. There are only a few buses' routes that always stay on the

same main roads and people can transfer to their destination by taking another these type of buses, known as chessboard route. Based on the wide coverage, density and passenger trips per day which bus stops have, they can be the perfect Ubiquitous System for M.O.D. system. M.O.D. system can also solve complex routes problem by giving passengers an extra mobility to link with MRT stations or other bus stops, all they have to do is to pick up a vehicle and drive it to their transfer station or destination. There are two types of bus stops in Great Taipei Area, one is with bus route sign standing on the sidewalk, the other is bus kiosk usually near the designated bus line.



1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006





## Bus Stops Distribution Diagram in Greater Taipei-Area

There are approximately at least 4,261 bus stops,34 which belong to Taipei public bus system, in Greater Taipei Area. Most of bus stops are within urbanized area and especially in central part of Taipei City, some stops are in mountain hills for tourists. Within urbanized area, bus stops are distributed evenly everywhere and ubiquitous. Where there are people, there are bus stops.

Figure 143.



5 Km

0

96

## Bus Stops Density per Square Kilometer Diagram<sup>2</sup> in Greater Taipei Area

From the density diagram, it shows that every square kilometer in urbanized Greater Taipei Area has more than one bus stops. In central part of Taipei, the average is over 30 bus stops and up to 44 in one square kilometer. One bus stop may have dozen of routes buses. The sheer density and even distribution of bus stops is a perfect characteristic for Ubiquitous System of M.O.D. system.

Figure 144.

5

1

11

11

2







### 3.9 Ubiquitous System

When School Stations. Convenience Store Stations and Bus Stop Stations all work together, they become the Ubiquitous System. There are total at least 6,422 points could be the possible Ubiquitous System Stations throughout the Greater Taipei Area, mainly in urbanized area. Each Ubiguitous Sub-system is distributed evenly and covers near every corner of urbanized area. Although the density of potential Ubiquitous System is very high, each sub-system is not overlay with each other. Nearly every square kilometer in urbanized Greater Taipei Area has more than one school and dozens of convenience stores and bus stops. These Ubiquitous Stations can provide pick up and drop off spaces for M.O.D. vehicles. Users can always pick up and drop off any M.O.D. vehicles near their origins or destinations in no time. By synergy, all sub-systems can work as one and become a ubiguitous transportation network for Greater Taipei Area.

After users leave MRT station, Backbone System, and take M.O.D. vehicles to their desire destination, they will need stations to drop off their vehicles if there is no MRT stations nearby and vice versa. Ubiguitous System Stations be the stations which solve the first mile and last mile problems for M.O.D. users. Therefore, the distance and time from users' origins and destination to the nearest Ubiquitous System Stations are very important and will affect users' decisions whether they want to use the M.O.D. system or not. Accessibility to Ubiguitous System Stations can be measured by the distance between these stations to any point of urbanized area in Greater Taipei Area, since most of the commute will take place in this area. The accessibility to Ubiquitous System Stations can be shown on the diagrams of walking distance and time consumption from these stations.

The diagram on left page shows the loca-

tion of Ubiquitous System Stations. The following diagrams in the next four pages show and how much time it takes and how far it gets from stations. An average person in normal walking speed can walk 80 meters in one minutes.





# 5 Minutes Walking Distance from School Stations/ 400 Meters



5 Minutes Walking Distance from Convenience Store Stations/ 400 Meters







### Synergy of Ubiquitous Sub-Systems

Only one minute walking, 80 meters in distance, from all the Ubiguitous System Stations, it could cover roughly 45% of the total urbanized area in Greater Taipei. Two minutes walking could cover 60%; Three minutes for 75%; Four minutes for 85% and five minutes walking from stations can cover up to 95% of the urbanized area in Greater Taipei. It suggests that users of M.O.D. System could find a M.O.D. Station anywhere in urbanized Greater Taipei Area in less than 300 seconds. People could pick up M.O.D. vehicles from stations which near their origins in less than 300 seconds, 400 meters walking distance. People could drop off M.O.D. vehicles to stations which near their destinations and arrive their destination in less than 300 seconds, 400 meters walking distance. The three diagrams on the left hand side show five minutes walking distance from each sub-system. Each sub-system could not cover 95% of the urbanized area in Greater Taipei just on its own, they have to work together as one to achieve it.









# 3.10 Supporting Systems: Parking Strategies in Different Zones

MRT Stations, School Station, Convenience Store Stations and Bus Stop Stations will the major roles for M.O.D. System in each zone; however, every zone the density and coverage of Backbone System and Ubiquitous System Stations will not always be the same, based on different public transportation accessibility and urban fabric density in different zones, each zone will has its own supporting system toward parking issues. It will also correspond to its land uses and population. For instance, in Core Commercial Area, both the urban fabric and public transportation density are high. The top four busiest MRT Stations are located here. Districts near these MRT Stations are always the busiest in Taipei City. There are tall buildings everywhere and a lot of people come here to work. There aren't a lot of street parking spaces near curbs or in the alleys. Parking lots

are mostly in the basements. In the Core Commercial Area, because of the scarcity of spaces, a lot of the M.O.D. vehicle parking will be away from the major streets. Parking towers will be served as the car vending machines behind the main streets. People can always drop their M.O.D. vehicles or take their wanted M.O.D. vehicles in a second. In the busiest streets, such as in front of SOGO department store, there will be cars folding parking along the curbs, to encourage people to use M.O.D. System. Because a lot of people will ride Roboscooters to Core Commercial Area to work, parking trailers will be served as the mobile Roboscooters parking lots during the rush hours in the busiest spots. Some of them would return to the same spots for the evening rush hours and others would carry Roboscooters to other needed places.





# Urban and Public Transportation Fabrics Analysis and Parking Strategies in Each Zone

Density scale is counted from 1 to 10; Loose, from 1 to 4; Even, from 5 to 7 and Dense, from 8 to 10. Vehicle types distribution is counted in percentage. It shows how many share of certain type of vehicles in the certain type of station.

ZONE 7 ZONE 5 ZONE 6 ZONE 1 ZONE 2 ZONE 3 ZONE 4 Outskirt Residential **Organic Mix-Use** Density **Core Commercial Newly Developed Residential Area** Secondary **Old City Area Fabric Area** inside Citv Area **Commercial Area** Area Area Dense (9) Even (7) Even (6) Urban Fabric Dense (10) Dense (9) Dense (8) Dense (9) Even (6) Even (6) Loose (4) Even (7) Dense (8) **Public Transportation** Dense (10) Even (7) Even (6) Even (6) Loose (4) MRT Station Dense (10) Even (7) Dense (8) Dense (8) Even (6) Dense (10) Dense (9) Dense (8) School Station Even (5) Dense (10) Loose (2) Even (7) Even (6) Even (7) **Convenience Stores Station** Dense (10) Dense (8) Loose (2) Dense (10) Even (6) Even (6) **Bus Stop Station** Dense (10) Dense (10) Even (7) Dense (10) Even (7) Vehicle Types Distrubution in Car Scooter Stations Backbone 20% 10% 20% 10% 10% 20% 25% 15% 20% 20% MRT Stations 10% 20% 15% 20% System 20% 25% 20% 30% 15% 35% **School Stations** 20% 10% 35% 15% 5% 2.5% 30% 20% Ubiquitous Convenience 25% 5% 15% 15% 30% 10% 20% 10% 30% 10% 15% 5% 2.5% 20% Systems **Stores Stations** 20% 20% 10% 20% 10% 20% **Bus Stop Stations** 5% 20% 10% 15% 15% 25% 20% 25% **Parking Towers** 30% 2.5% Ground Parking 10% 2.5% 2.5% 2.5% Lots Basement Parking 5% 15% 5% 30% 25% Lots Street 10% 15% Perpendicular 5% 15% 10% Supporting Parking Systems Street Folding 2.5% 10% 5% 5% 5% 10% Parking Community 20% 5% 10% 15% 10% 10% 20% 15% 5% 5% 10% 20% 10% Parking 10% Parking Trailer 10% 5% 10% Pedestrian 5% 5% 7.5% 5% Parking

Table 17.














# **4.0 CONCLUSION**

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## 4.1 Taipei Mobility: Gone in Less Than 300 seconds

After the implementation of Mobility-On-Demand System in Greater Taipei Area, people could change from one type of transportation method to another one in less than 300 seconds. People could use Backbone M.O.D. System to travel from their origin stations to MRT Stations or from MRT Stations to their destination stations in less than three minutes. 180 seconds. People could travel from their origins to nearby Ubiguitous System Stations or from Ubiquitous System Stations to their destinations in less than five minutes, 300 seconds. Therefore, That's why the thesis topic called "Taipei Mobility: Gone in Less Than 300 Seconds." With the density and coverage of schools, convenience stores, bus stops, and MRT Stations in greater Taipei area, M.O.D. System can be a one-way rental system and can be easily accessed from every corner of the city. M.O.D. system will not only serve as a transportation system, but it will also be a urban catalyst and bring its ultra-convenience to the city residents.



# 4.2 Streets with M.O.D. System in Greater Taipei Area

After the implementation of Mobility-On-Demand System Greater Taipei Area, streets will have more room for all types of vehicles even though they are still multifunctional. Compared to traditional cars and scooters parking, because Roboscooter and City Car are both foldable, they occupy less space even when they are parking perpendicularly facing curbs. When City Car is folded, it is only 1.7 meters in length, even 0.3 meter less than an ordinary scooter. Because it is front egress, passengers can in and out the vehicles directly from sidewalks, so the space between each City Cars can be very small and can save more space for more parking. Also when Roboscooter is folded, it is only 0.7 meter in length. It can be parked on sidewalks without obstructing pedestrian, because it only takes seconds to unfold and ready to go. With M.O.D. System, scooters and cars on main streets will have less chance to collide because mixed-lanes become bigger. Moreover, the opening doors issues are no longer existing because City Cars are from egress. The most important improvement of streets environment will take place in communal streets. Most of the communal streets do not have sidewalks because they are under ten meters in width. With M.O.D. System, communal street could have sidewalks for people to walk and could also have trees. Residential areas should be the most important space to have the best living quality. Instead of being parking lot for main streets, communal streets now can become relaxing and communal public space for local residents.



Figure 167.





Mixed Lane

0.5m

Car

2.5m

Scooter

Mixed Lane

Car

2.5m

Scooter

## Communal Street Type 2:

6 meters wide street. The original streets are hard for cars to pass through when thereare parking in both sides. With M.O.D. System, a 6 meters wide street can have Roboscooters parked in one side and City Cars parked in the other side and there is still some room left for cars and people to pass through when they are both folded. Or trees can be planted in the middle of the street. Roboscooters and City Cars can park aligned with tree wells. One side of the street can become sidewalk and the other side can be a lane for cars to pass through.













 Main Street Type 2:
 2.5m
 2m
 3m
 2m
 2.5m

 Street with 1.5 meters wide sidewalk.
 1.5m
 1.5m
 1.5m
 Figure 183.

















Figure 191.









## 4.3 Scenario: A Day in Taipei City with M.O.D. System

Mr. and Mrs. City run a design firm together. They live in Taipei County and work in Taipei City. Today, they have a busy schedule. They have to print out their design proposals and pick it up. meet their partners to discuss about it, present their proposal to clients, meet their partners for the follow up meeting in partner's office and have a celebration party. How could they keep up with this busy schedule? Don't worry. Mobility-On-Demand System will figure it out for them.



## 1. Home to Banqiao Station

**7:00 AM** / After breakfast, Mr. City went down stair and check the weather outside, it's raining. There's must be a lot of traffic on the road to MRT station. **7:15 AM** / Mr. City drove their City Car to MRT Banqiao Station. There's a express lane for private LEV from their home to Banqiao Station. It saved a lot of time. **7:25 AM** / Mr. City parked his car in the parking lots near MRT station. Then he took MRT to Taipei Main Station, the station with the largest throughput in Taipei.

## 2. Banqiao Station to Taipei Main Station

**7:50 AM** / The Cities stopped at main station and took a city car near the curb to go work. Their office is in the intersection of Song-Jiang Rd. and Chang-Chun Rd..

# 3. Taipei Main Station to Office

**8:05 AM** / He parked the car near the pedestrian of Da-Tong Senior High and went to their office.

## 4. Office to Printing Shop

**8:45 AM** / They have a presentation to their clients this afternoon and need a hardcopy proposal. Time was a little bit short. Mrs. City wanted to go the printing shop to print their proposal. She went down stair and found out it's not raining outside. She picked up a scooter and rode it to the shop. During the rush hours, scooter is the best solution. **9:10 AM** / Printing shop is located in Wan-Hua, the Old City Area. She parked the scooter on the community rack which located on the same alley with the printing shop and went inside.



### 5. Office to Starbucks

**10:10 AM** / Mr. City needed to meet partner A around 10:30. He left the office and picked a scooter near the convenient store. **10:25 AM** / Mr. City will meet partner A in Starbucks near Zhongxiao Fuxing MRT Station. He rode the scooter and arrived a little bit early. Because it's still rush hours, the parking trailer still parked outside MRT Station. He parked the scooter to the trailer and went to Starbucks.

#### 6. Printing Shop to Starbucks

**10:10 AM** / At the same time, Mrs. City got their hardcopies of proposal. She took a scooter from the community rack and headed to the Starbucks near Zhongxiao Fuxing MRT Station. **10:30 AM** / Mrs. City arrived at the Starbucks and parked the scooter on the pedestrian in front of the convenient store. She met Mr. City and partner A inside coffee shop and had a discussion.

### 7. Starbucks to Client

**11:30 AM** / Mr. and Mrs. City finished their meeting. They went to the Parking Tower behind the main street and rent a city car to go to their client's office near Taiwan University. **12:00 PM** / The Cities arrived at Taiwan University and parked the city car on the lower level of the Campus. They took their time to walk to the client's office. They will do a presentation today.

#### 8. Client to Wanfang Hospital

**2:15 PM** / After the meeting, the client seemed to be very satisfied with their proposal. Mr. City suddenly remembered he needed to visit a old friend in Wanfang Hospital, but the visiting hours is from 12:00 PM to 3:00 PM. They will be late if they take MRT to hospital. Mr. City decided to pick a scooter on campus and rode it to hospital. **2:30 PM** / He parked the scooter at convenient store near hospital.



# 9. Wanfang Hospital to Taipei 101

**3:15 PM** / After visiting their old friend, they got a phone call from clients and said they were looking forward to working with Mr. and Mrs. City. They decided to go to partner A's office in Taipei 101 to have the further discussion. **3:35 PM** / They picked a car in the basement of hospital and drove it to Taipei 101. There's a expressway in the tunnel just for TAXI, BUS and City Car. They could arrive 101 very quickly. **3:45 PM** / They parked the car in the basement parking lots of Taipei 101 and went to meet their partner A.

# 10. Taipei 101 to Tamsui Station

**4:30 PM** / After meeting, they decided to have a celebration in Tamsui at 7:00 PM. They walked to City Government MRT Station and took the MRT to Tamsui. **5:15 PM** / They arrived at Tamsui Station. They decided to see the sunset on the famous "Long Dike" near the Tamsui Harbor.

## 11. Tamsui Station to Long Dike

**5:20 PM** / They rent a city on the curb of Tamsui MRT Station and drove it to the harbor. **5:35 PM** / In the harbor, they parked the car near the dike and enjoyed the beautiful sunset.

# 12. Long Dike to Restaurant

**6:35 PM** / It's getting dark, they rented a scooter and headed to the restaurant and parked the scooter in front of the convenient store.



#### 13. Restaurant to Tamsui Station

8:35~PM / After celebration, they walked though the most popular and crowd night market in Tamsui. 9:30~PM / They arrived at Tamsui station and took the MRT to go home.

#### 14. Tamsui Station to Minquan W. Rd. Station

**9:45 PM** / They were going to take MRT to Banqiao Station and drove their car home. However, the train was a little bit humid. Mr. City used cell phone to search for returning city car. **9:50 PM** / Mr. City found returning car in Minquan W. Rd. Station. They decided to drive the car to Banqiao Station.

#### 15. Minguan W. Rd. Station to Bangiao Station

**9:55 PM** / They took off the MRT at Minquan W. Rd. Station and found the returning car near he entrance. They drove the car back the Banqiao Station. **10:15 PM** / They parked he city car in the parking lot near the Banqiao Station and went to drive their car back home.

#### 16. Banqiao Station to Home

 ${\bf 10:35}~{\bf PM}$  / Finally they were home, today was a very busy day for the Cities.



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