The construction of sustainable mobility in a megacity
a Mexico City case study

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The construction of sustainable mobility in a megacity: A Mexico City case study

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Foreword and acknowledgments

Two years ago, I was starting my master program at TU Eindhoven without expecting to have a final project related to mobility and megacities. In 2013, I thought about doing a thesis on ICT for development. Two years later, I am convinced of how appropriate was to select a topic related to big cities and innovation.

Mexico City was my home for more than twenty years. I have personally experienced how painful it is to use the public transport or cycle in the busy infrastructure of Mexico. However, as a proud *chilango*, I am still attracted about its uniqueness: A city with an almost unlimited offer of events for all tastes, multicultural, and in which you cannot lose your capacity of wonder by any chance. I have a love-hate relationship with this city, and probably was the main driver to select this topic.

From selecting the research topic to presenting this thesis more than six month passed. I would like to thank Johanna and Hans for their unlimited support. You were always present suggesting me how to improve the project. I appreciate your dedication and time given to this thesis, and expect to fulfill your expectations. It was not an easy topic and approach, but today, this project has a structure which I did not expect to have three months ago. Thanks!

I would also like to thank Frank Schipper for his support. Also, to all the interviewees and people from Mexico and the Netherlands who participated in one way or another in this project. Obviously, I would like to thank all my friends who were with me the last couple of years in Eindhoven. It has been a wonderful experience meeting you all and receive your support.

Finalmente, pero no menos importante, gracias a mi familia y amigos en México. A mis padres, por su incodicional apoyo. A mis hermanos: Mar y Cell, Lloret, Nuria, y Jaime. A Arturo. A mis amigos y familia que me despidieron cuando iniciaba mi nueva etapa en Eindhoven. Ustedes siempre estuvieron conmigo en los buenos y malos momentos, y fueron un soporte grandísimo (aún a la distancia).

Edgar. August, 2015.

Abstract

The world is becoming primarily urban, and cities with more than ten million are increasing. These cities, *megacities*, have unique characteristics which are not present in settlements with smaller extensions and populations. Megacities mobility has drawn attention in recent years as it has become evident that current mobility practices may not be sustainable in the long term. This paper aims to develop a better understanding of the factors guiding the construction and visions on mobility in a megacity, using Mexico City as a case study (2007-2027). A qualitative approach was pursued. A framework consisting of five dimensions was developed to answer the academic inquiry. Data from the case study was collected from interviews and document analysis. The results showed that there are multiple factors shaping mobility. They were categorized into five dimensions (1) theory and methodology of megacities, (2) institutions and governance, (3) socio-spatial dynamics, (4) mobility practices and interventions, and (5) visions and expectations in mobility. The findings suggest that a more comprehensive view on the topic should be established, taking into consideration context-dependent factors of megacities. It was observed that certain elements that largely shape mobility have not been properly targeted by policy makers and academia. Multiple novel insights can be drawn from this research, especially in relation to land use, sustainability and inclusiveness, the incentives for coordination and competition mechanisms, and the role of different stakeholders shaping mobility.

Key words: megacities, urban mobility, sustainability, visions and expectations, transportation, urban governance, developing world.

Executive Summary

As the world becomes primarily urban, cities have gained attention in academia and policy. In recent decades, the abrupt increase in urban population have created a new types of settlement: *megacities*. Megacities are defined as cities with more than ten million inhabitants, and are largely located in the developing world. They face sustainability challenges, especially as the result of their spatial and demographic dimension. These cities have unique qualitative characteristics which are not present in smaller settlements. The number of megacities in the world is expected to increase in the following decades, generating a wider concern about their environmental impact. However, no sufficient attention has been given to this aspect in innovation sciences and transition studies disciplines.

Mobility seems a general concern in these cities. In megacities, novel transportation alternatives and mobility projects have taken place in recent years, but insufficient attention has been given by academia to these experiments. Moreover, there is a lack of study in relation to the factors influencing interventions and future visions on mobility in megacities. For this reason, this research aims to analyze how mobility is being constructed and envisioned in Mexico City as a case study. The following question was formulated:

Which are the factors shaping the construction and visions of mobility in Mexico City during the period 2007-2027?

With the following subquestions:

1.1. What characterizes mobility systems of megacities and what opportunities and challenges can be detected in the literature?

1.2. How do the characteristics and complexity of megacities affect the way mobility systems are being constructed in Mexico City?

Research approach

To answer the research questions and subquestions, a qualitative approach was pursued. It consisted of developing a framework based on an literature review on the topic of mobility in megacities. A multi-disciplinary approach was followed, to guarantee a comprehensive understanding of mobility construction and visions in Mexico City. The framework was built using academic and non-academic sources to ensure that both theoretical and practical perspectives were included. As a result, a framework of five dimensions was formulated, integrating the most relevant aspect found during this research: the megacities' methodological and theoretical dimension, their institutional and governance dimension, their socio-spatial dynamics, the mobility practices and interventions occurring in these settlements, and visions and expectations regarding future megacities mobility. The first three dimensions come primarily from urban and megacities studies; the fourth one, from transportation and mobility studies; and the last one, from innovation sciences and transition studies.

The case study selected was Mexico City, during the period 2007-2027. This megacity was selected as I am familiar with this city and access to sources were guaranteed. The data was collected from primary documents, a future mobility event held in Mexico, and from eleven interviews, most of them held in Mexico City with knowledgeable informants in the field of mobility interventions and city dynamics. As the framework was developed, the data of Mexico City was interpreted according to it. All data was analyzed in its original language, to avoid any deviation of meanings. The data from Mexico City also provided new insights to refine the existing framework, which is presented in this document.

Findings

Regarding the development of the framework, it was found that the factors shaping mobility can be grouped in five dimensions. The first dimension is concerned with methodology and theory on megacities. Few scholars and policy makers address these settlements as one unit of analysis. Not defining megacities as such, generates inconsistencies of data and methodologies, which results in knowledge gaps. Moreover, it also reinforces a departmentalized, bounded vision of these cities. The second dimension is related to institutions and governance. At the present time, the lack of cooperation and coordination are two elements hindering megalopolitan governance. Moreover, it was observed that novel actors and paradigms are emerging in these megacities. Cities face three major challenges in this dimension: institutional and legal weaknesses, the lack of long-term visions for urban planning and management, and the emergence of informal organizations.

The third dimension is related to socio-spatial conditions. It was observed that social processes and space are intrinsically related. Spatial planning reinforces the conditions of inequality and segregation occurring inside urban areas. A megacity can contain multiple socio-economic realities: Rich and low income population cohabit the same urban settlement, but have different patterns of consumption and mobility. The socio-spatial conditions

are largely dependent on the specific historical contexts.

The fourth dimension is related to mobility practices and interventions. Mobility practices are largely shaped by mobility cultures, and currently is based on an increasing trend of car use. Current mobility practices are not sustainable in the long terms, due to its environmental effects and economic constrains. The practices are primarily motorized. Regarding mobility interventions, four types were found: targeting supply, targeting demand, enabling inter-modality and mixed-land use, and promoting technological innovations. The emerging design principles in mobility interventions are affordability, accesibility, acceptability and availability. The final dimension is concerned about visions and expectations. These should be collectively shared by policy actors to enable guidelines to intervention in the field of mobility. They have multiple benefits, but their limitations have not been sufficiently studied. It is suggested that fifteen elements should be taken into account to analyze megacities mobility.

When this framework was applied to the case study, it was evident that certain factors have not been sufficiently considered in the literature. The most contrasting elements were the institutional fragmentation, the incentives of competition and no cooperation for mobility solutions at a megalopolitan level, and the role of informal institutions. Moreover, it was found that basic barriers are limiting the implementation of smart solutions on mobility in governmental agencies. Actors such as embassies or civil society organizations have a vital role in fostering sustainable mobility. A historical inertia reproduces old vices in mobility implementation and policy in Mexico City. There were common visions on mobility, but they are minimal and subject to controversy.

Conclusions

From this research, it can be concluded that context-dependent factors largely shape the way in which the future of mobility is being constructed and envisioned. It was observed that one of the first challenges in understanding mobility in a megacity was the lack of an integrated, megalopolitan vision. No long-term vision on mobility was found in the case study. It is suggested that agency-based models may not be suitable to analyze megacities mobility, as these settlements have strong inertia and large dimensions. Moreover, the mobility regime appears to be completely resilient to changes and it is adaptive. It is suggested that sustainable mobility interventions can be contested by population fearing the negative effects in the built environment and their everyday life.

The framework became a useful tool for analyzing the case study mobility. The benefits of agglomerating factors into dimensions is its modularity. New dimensions can be added, and new relations between and factors inside dimensions can be suggested. Future research can be related analyzing new factors, mapping relations among them, or propose new dimensions.

Contents

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Chapter 1

Introduction

1.1 Problem Statement

Since the 1950s, the world has experienced an increasing number of urban settlements with more than five million inhabitants and complex urban dynamics. These cities, or megacities, are home in total of more than 600 million inhabitants and are defined in qualitative terms by Kraas and Mertins (2014). These cities provide agglomeration effects and positive externalities to the areas in which they are located. However, evidence suggests that they face increasing sustainability challenges. Megacities use intensively materials, energy and space (Bugliarello, 2009); and have increasing socio-economic vulnerability as the result of spatial segregation, fragmentation, and lack of governance (Kraas, 2007). Additionally, more than four out of five megacities are located in the developing world, which is characterized of insufficient planning and over-urbanization (Etienne et al., 2008). Megacities face complex and dynamic processes that are not present in smaller settlements, and which require major research attention (see Soja, 2000; Kraas and Mertins, 2014; Kotter, 2004).

The unsustainability of megacities has been addressed in different disciplines. The mobility domain has gained attention recently as the current mobility regime is not suitable for such large agglomerations. Efforts in this domain have encompassed technical and non-technical innovations (new business models, novel approaches to urban space, radical and incremental innovations, among others). As a result, several experiments have been made in megacities to increase their sustainability. These experiments, including Bus Rapid Transit (BRT) systems, public bicycles schemes, and rehabilitation of pedestrian spaces, may indicate novel sustainable transportation alternatives compared to the current mobility regime.

Despite the fact that mobility in megacities represents a major challenge, it has been understudied in transition studies. Transition research on socio-technical regimes has mainly focused on Europe and isolated niche experiments in developing world (STRN, 2010), which

may not be suitable for the socio-economic and institutional contexts of megacities. Furthermore, no attention has been drawn to the megacities sustainability renewal projects (or master plans) that attempt to reverse the unsustainability condition of these settlements. These projects, such as Paris 2050, or Mexico City's Plan Verde, may indicate visions and expectations of the future of mobility in these cities. For transitions, visions and expectations play an essential role. They reduce uncertainty, mobilize resources, and coordinate actors (Smith et al., 2010); they also allow scenario building, backcasting, and small-scale experimentations, which contribute to transit to more sustainable socio-technical regimes (Vergragt and Brown, 2007).

For these reasons, this project analyzes how the future of mobility is being realized in megacities, taking Mexico City as a case study. Mexico City is a dynamic megacity, with more than 22 million inhabitants, and has one of the most extensive public transportation systems in the world; however, it faces major challenges due to excessive car usage, built environment, geographic location, and long term inefficient planning. Recent strategies have attempted to reverse this situation, and have had impact in the mobility policy. This time frame will embrace twenty years since the establishment of Plan Verde (2007-2027). This year is used as *Plan Verde* gained national and international attention, and seemed to have changed the institutional inertia of the old mobility paradigm.

1.2 Research question and subquestions

The general research question is:

Which are the factors shaping the construction and visions of mobility in Mexico City during the period 2007-2027?

With the following subquestions:

1.1. What characterizes mobility systems of megacities and what opportunities and challenges can be detected in the literature?

1.2. How do the characteristics and complexity of megacities affect the way mobility systems are being constructed in Mexico City?

1.3 Significance of this study

This study is intended to make two contributions to innovation sciences discipline: On one hand, analyzing sustainability transitions in a complex, dynamic, and uncertain scenario such as megacities. This case study is intended to generate a better understanding

of innovation in mobility in the case study, while also grasping limitations of traditional approaches in sustainable transitions when analyzing developing world dynamics. Also, it is significant as megacities have been understudied in the field of innovation. It may a basis for future research in the area and (hopefully) stress the relevance of attending this urban agglomerations and their sustainability challenges.

1.4 Outline of this report

This report is structured as follows. Chapter 2 explains in detail the methodology used for answering the research question. A framework was used to answer the research question. This framework incorporates literature from different academic disciplines and from the case study. The framework is developed, explained an applied in the next two chapters. Chapter 3 encompasses the literature review findings and their systematization into a analytical framework for the case study. Chapter 4 contains the interpretation of the data collected based on the framework. The final chapter provides general conclusions and recommendations. The acronyms, references and appendixes finalize this report.

Chapter 2

Methodology

To answer the research question, about how mobility is envisioned and constructed in Mexico City during the period 2007-2027, and its two sub questions regarding megacities mobility systems and megacities characteristics, it was opted for a qualitative research design. This design is suitable for research questions in which the topic's locality and specificities are relevant, for exploratory cases in which there is no much literature available (Creswell, 2009; Mack et al., 2005), and for cases in which processes of reflexivity, attribution of meanings, and construction of social reality are present (Flick et al., 2004).

The research design consisted of a literature review on the topic of mobility and megacities, which was complemented with a case study. The literature review included academic and non-academic sources. The collected data of the case study included academic and non-academic literature, primary texts -as legislations, policy documents, among others-, and interviews with knowledgeable informants. The case study selected was Mexico City. My affinity with the case study and access to data were the main drivers to choose this city. To analyze data –and aiming to present in a systematic approach the findings-, I developed a framework incorporating elements of the sources stated above, and use to analyze Mexico City mobility. To present the results, I followed a narrative style which is the basis of the next two chapters. The research took place in Eindhoven and Mexico City, and lasted six months. This section contains the research design, including subjects and materials of data location, data collection and analysis procedures, and limitations. These are described in the sections below.

Research Design

The research aim of this project was to analyze how mobility is being constructed and envisioned in a megacity, with a special focus on Mexico City. I took Mexico City as a

case study to evaluate current academic and nonacademic literature in megacities mobility. Moreover, it was of my interest to map and analyze the characteristics of mobility systems in megacities, and how megacities' complexity affects the development of mobility in the case study.

Another research interest was to integrate literature on megacities in both academic and non-academic literature for analyzing mobility construction and envision in megacities. For this reason, I opted to develop a framework from scratch with major components to be considered for this analysis. Frameworks are useful for developing novel theoretical insights by mapping concepts and their relationships, which can be later applied to empirical data. Moreover, they allow integrating relevant *a priori* and emergent concepts. Designing a framework is an iterative process, in which the researcher begins with developing a basic scheme, which is refined on a later stage. This refinement is based on empirical and theoretical insights obtained by the analysis of relevant literature in the topic. The sources for this framework come mainly, from three disciplines: (1) urban studies concerning the area of megacities, (2) mobility and transportation studies, and (3) transition studies.

Preliminary findings suggested that two major aspects needed to be considered for developing this research: First, most of the literature on the topic is widely spread in different disciplines, and usually narrowed to understand mobility as transportation. However, and as in the next chapter it will be explained, mobility encompasses more than transportation policy. The second aspect was that most of the findings come from 'gray literature': Publications done by scholars, but which are published by non-academic institutions. The nature of these publications is more practical and less theoretical. These two aspects were present along the research and shaped largely the development of the framework. The framework that was envisioned ought to include a literature review of both academic and non-academic sources, complemented with a case study, which would help to evaluate and refine the framework proposed.

The case study is Mexico City. This city was chosen because I have professional experience in Mexico City policy, my native language is Spanish, and I followed my education there in the faculty of Political Science at the National Autonomous University of Mexico. These aspects would be of great advantage for access to data sources and data analysis, and for developing an in-depth analysis of the institutional, social, and political dynamics in the megacity. Moreover, this case study is of scientific relevance as a limited number of publications have analyzed Mexico City as a megacity and its mobility regime. This situation made the selected city a niche for my master project research.

I opted to select a time frame of twenty years to analyze my case study, starting from 2007. This year was selected as a sustainability urban plan was implemented in that year and had a time frame of fifteen years (2007-2022). It was of my interest to analyze the complete time frame of this plan because it was the first sustainability policy lasting more than a governmental term. The majority of the Mexican policies are intended to last six or three years at the most (one state or local term, respectively). However, since the establishment of the sustainability plan eight years have passed. Therefore, I considered

adding five years after the original time scope of the plan to evaluate if any follow-up policy has been considered since 2007. A final consideration for selecting this time frame was that it is possible to evaluate eight years of policy interventions (2007-2015) with another twelve years to come (2015-2027).

Concerning the collected data, it is possible to distinguish two categories: (1) data used for analyzing megacities and mobility, and (2) data concerning the case study. The collected data for analyzing megacities and mobility comes from academic and non-academic literature on the topic. Academic literature comprised sources of multiple disciplines, such as transportation, urban, policy and innovation studies. Disciplinary diversity was opted to guarantee multiple perspectives on the topic. The consulted documents are available in academic websites such as ScienceDirect or Redalyc, or via TU Eindhoven network.

Academic literature was complemented with non-formally academic literature such as reports and policy briefs. Also known as 'gray literature', this type of sources is generally less theoretical and more concerned about policy interventions in the field of mobility. Gray literature was necessary as the topic has been widely understudied by scholars, the majority of mobility analysis has focused on developed countries and/or small settlements, and some of the elements that concerned this project have not been considered in-depth by academia.

Regarding the data collected from the case study, it consisted of literature review, interviews, primary text analysis and an urban mobility event held in Mexico City in March, 2015. The revised literature of the case study was also academic and non-academic, for the same reasons as in the topic of mobility and megacities. The academic resources are primarily from higher education institutes in Mexico City, such as El Colegio de México, the Universidad Autónoma Metropolitana, and the Universidad Nacional Autónoma de México. Most of the documents are available in Spanish and deal with the complexity of Mexico City and/or mobility from a multidisciplinary perspective. This multiplicity of perspectives included, i.e. the reconfiguration of urban space, the social dimension of urban mobility, and the metropolitan governance of Mexico City. The non-academic literature consulted was from organizations collaborating in urban mobility solutions in the megacity. These organizations include consultancy organizations, think-tanks, international donors, transport agencies, among others.

Data was also collected by primary sources. The most significant data source for this research was interviews. Interviewing is a suitable qualitative method as it allows integrating multiple perspectives and interpretations, and describing processes (Weiss, 1995). During three months, I interviewed eleven knowledgeable informants and researchers on megacities and mobility. A panel of knowledgeable informants was preferred, as it is a more suitable approach in forecasting and developing visions and expectations.

To guarantee the integration of diverse sources, interviews were held with informants with different expertise. Two of them are Mexican scholars, with an interest in sustainability and transportation. Two interviewees work in an international transport organization which has been actively participating in urban mobility policies in Mexico for more

than a decade. One respondent had wide experience in metropolitan transportation policy. Two interviewees collaborate on an environmental research institute in Mexico working on, among other topics, in sustainability and transportation. Two respondents work in civil society organization and a public policy consultancy. Two final interviews were held in the Netherlands with Dutch scholars. Interviewees' area of knowledge was history of mobility and megacities in the developing world, respectively. In the second appendix, table B.1 shows the background of each informant. To guarantee privacy, names and institutions are omitted.

Interviews were semi-structured, as they are suitable for clarification and in cases when the interviewees have a different background (Louise Barriball and While, 1994). The content of each interview depended on the expertise area of each interviewee. The interviewees were contacted by e-mail with an invitation to participate in this research, and about the specific topics I wanted to consult with them. Most of the interviewees answered favorably to the invitation. However, my interview request was declined by five pre-selected participants. These participants argued lack of time to answer the interview. Some of the participants who declined the invitation gave me access to their recent publications in the topic. Naturally, before each interview I researched about the respondent, in order to tailor my research inquiries into their area of expertise. Most of the interviews were face-to-face in Mexico City, except two that were made by skype. Nine of eleven interviews were transcribed, and no special software was used. The other two were based just on memos due to technical difficulties.

It was considered that primary texts were also suitable data for this research. Primary sources allow analyzing how relevant stakeholders addressed and thought about a particular situation back in time (Gray, 2013). Moreover, primary texts contain data about policy actions taken in the mobility sector. Primary sources included governmental reports and planning documents, newspapers and magazines, political parties' documents, legal institutional documents, and the latest Origin-Destiny survey of Mexico City (2007). All reviewed primary documents language was Spanish. These documents were obtained by electronic means.

A final data source was a meeting on urban mobility in Mexico City. It was organized by the Mario Molina Centre and the Embassy of Germany in Mexico. In this event, the participants came from educational institutions in Mexico and Germany, a car manufacturer working on smart auto mobility, and a private company which has worked in big data analytics for sustainable mobility.

To analyze all the data, a framework was developed. Developing a framework is an iterative process. This process indicates that no clear stages can be drawn to analyze sequentially this research. It was necessary to go back and forward between academic, non-academic, and primary source documents, to establish a preliminary framework to analyze the case study. The basic components and relations of the framework were the results of the literature review on megacities and mobility. The non-academic and primary source documents were used to refine the framework as new questions emerged. An especial focus

was given to sources coming from Latin America and Mexico. This focus polished the framework, i.e. by understanding that the social dimension of mobility for Latin American scholars was a more significant concern in comparison to their European and American counterparts. I consider that the framework is one of the academic contributions of this research, as no previous tool for analyzing mobility in megacities was found.

As the framework was developed, data of Mexico City was interpreted according to the framework. Especially, it was of my interest to understand general conditions of megacities mobility, and visions and expectations and mobility policy actions in Mexico City. All the data was analyzed and treated in its original language, to avoid deviating meanings of documents and interviews. Findings on urban mobility in Mexico City allowed a refinement of the framework. Evidence was looked for supporting or discrediting the framework elements and relationship found. Moreover, this stage provided new information for improvement. For example, land use regulations were given a complete different dimension in the reviewed literature and in the collected data. This discrepancy resulted in a modification of the framework.

Presentation of findings and limitations of this research

To present the findings, I opted to present my results in a two chapters: One regarding the general conditions, characteristics and dynamics of mobility in megacities and the second concerning the findings of the case study. A final chapter provides the conclusions of this work.

It is necessary to enlist some limitations of this research. First, the origin-destination survey was made eight years ago. From 2007 to the present time, considerable efforts in mobility have been made in Mexico City; and the urban infrastructure have changed with the operation of different BRT lines, new environmental regulations, and bicycles schemes. It was impossible to get newer data from the case study. Second, the collected primary documents are sparse in several institutions from different level of governments. Collecting primary documents from the case study was not an easy task. Even though I required data from the case study using governmental transparency requests, replies were limited. This difficulty was overcome by a large an exhaustive research in multiple ministries websites. A final limitation is that the topic of megacities mobility is vast, and it was necessary to select the most relevant data sources to make this research. This literature review is an exploratory study that may be useful for further research on the area of megacities and mobility.

Chapter 3

Literature Review

Cities are a major area of research in the twentieth-first century in areas such as urban geography, urbanism, and economics. In 2014, 54% of the world population resided in urban areas, and it is expected a growth in total urban dwellers in forthcoming years, up to 66% by 2050 (United Nations Department of Economic and Social Affairs, 2010). Cities represent centers of knowledge, innovation, and transformation. However, only a reduced number of cities have a bigger significant role in the global economy than others. For example, only six hundred cities concentrate about one third of the global economic output (Dobbs (2011) as cited in Storper, 2013); and a reduced number of cities coordinate the global economy (Sassen, 2005).

Cities should be an area of innovation discipline interest for two reasons: They are (1) places where innovation takes place, and where (2) many innovative solutions to sustainability problems are being proposed. Cities have agglomeration benefits that foster innovation and creativity (Soja, 2000), innovation seems to be a predominantly urban phenomenon (Feldman and Audrestch, 1999), and innovation and highly skilled processes are influenced by geographic proximity, which is reduced in these agglomerations. Urban socio-technical regimes may not be sustainable in the long term, making cities places where innovative solutions are being proposed. Cities are living laboratories for sustainable experiments, which are increasingly important as global population is becoming primarily urban.

The interest of this research is not about urban innovation as a whole but rather innovation in mobility and its connection with urban areas. Systematizing literature and theories that target the city and urban mobility is to some extent troublesome, primarily for three reasons. First, studying 'the urban' has led to several and multiple approaches, many of them departmentalized and according to research interests. Diversity and complexity of theoretical insights of academic literature contrast with non-formally academic reports targeting primarily specific transport interventions. Second, mobility encompasses more than merely transportation interventions such as governance, citizen's preferences and cultural values, or innovations. Third, developing countries megacities has been widely understudied

in academia.

For these reasons, this research aims to systematize the literature in five emerging categories that were found, and to propose a framework for studying megacities mobility. This chapter was intended to develop the framework and answer the research subquestion 1.1. *What characterizes mobility systems of megacities and what opportunities and challenges can be detected in the literature?*, and also contribute to answer the research question the factors shaping the construction and visions of mobility in Mexico City during the period 2007-2027. This chapter encompasses an introduction (section 3.1) and the dimensions which were observed in the literature: Nature, theory & methodology on megacities (sections 3.2), institutional & governance (section 3.3), socio-spatial dynamics (section 3.4), mobility practices and interventions (section 3.5), and visions, expectations and future outcomes shaping mobility (section 3.6). The chapter finishes with the proposed framework.

3.1 Introduction to megacities

For the first time in history, in this century more people will reside in cities in comparison to rural areas. Even though urbanization is not a new process, the pace of urbanization and percentage of urban population in recent decades have grown dramatically. At the moment, the Americas and Europe are the two continents where urban surpass rural population; but in the next decades Asia and Africa will have the more than 50% of their population residing in urban areas (UN Habitat, 2009). Next to increasing population, three major shifts are happening in cities: City growth at unprecedented rate, big cities are expected to experience major absolute growth in population and size, and major urban expansion is happening in developing countries.

Cities are growing in rates that have not been seen before, and this growth is primarily localized in developing countries (World Health Organization, 2015). In just a few decades, megacities in these countries are reaching population and sizes that took developed countries cities almost a century. Population in urban areas still have an annual growth rate of 2.5% (Schubel and Levi, 2000). Figure 3.1 shows a map with the estimated growth rate in urban population in the period 2014-2030. As can be seen, almost every major increase will occur in the developing world; ninety-three percent of urban population growth in the years 2010-2050 is happening in developing countries (Moss and O'Neill, 2012).

Moreover, the average size of the world's largest cities grew from 200,000 in 1800 to five million in the 1990s (UN Habitat, 2009). Table 3.1 shows the total number of citizens living in urban areas with more than 75,000 inhabitants categorized by each country's Human Development Index (HDI) in the period 1975-2025. HDI is a useful measure to emphasize a country's level of development not simply by its economic output (UNDP, 2014b). As can be seen, major increases is occurring in countries of low, medium and high HDI levels. In average, countries of these HDI levels will almost quadruple their populations in large cities in just fifty years.

Figure 3.1: Growth rates of urban agglomerations (2014-2030) (source: edited from UN)

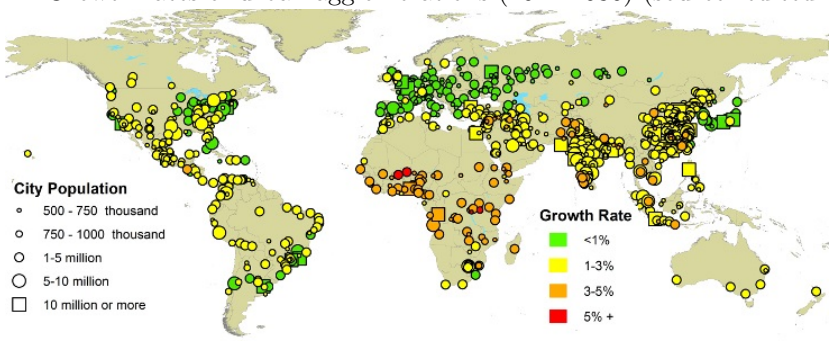


Table 3.1: Population living in cities with more than 75,000 inhabitants (source: own, based on Ahlenius (2014) and UN)

HDI level	Total population (thousands) 1975	2000	2025*	Increase 1975-2025
Very High HDI	300.7	400.51	445.94	148%
High HDI	229.37	537.66	708.8	237%
Medium HDI	140.12	283.38	426.775	305%
Low HDI	44.29	118.7	229.621	518%

However, evidence suggests that current urban population growth in developing countries tend to allocate in cities than more than five million inhabitants. According to Satterthwaite (2002), London and Beijing were the only two cities in the 1800 with more than one million inhabitants. By 1950, this number increased to 85; and by 2000, to 387. Again, the biggest increase has been observed in developing regions, and this trend is expected to continue. Table 3.2 shows the total number of cities with more than 5 and 10 million inhabitants by region and HDI level.

These cities, are also called ***megacities***. It is expected that 447 million will live in cities with more than 10 million inhabitants by 2025 (World Association of the Major Metropolises, 2011). Defining cities in quantitative terms is not an easy task. On one hand, there is no academic consensus about the minimum number of inhabitants for calling a urban settlement a megacity. At the moment, United Nations considers a city with more than 10 million inhabitants a megacity (EURAMET, 2013), but this number has changed three times in less than a century. Table 3.3 shows the most populated cities according to the United Nations Human Settlements Programme (2014). Cities in developing countries (from low to high HDI) are in bold. As can be seen, the predicted largest agglomerations in the world will be located in these countries.

However, qualitative research on megacities has been done in recent years to explain the nature of these urban settlements. We can appropriately observe that megacities share certain qualitative conditions. Megacities are characterized by intensive expansion, suburbanization, inner-urban consolidation processes, functional primary city dominance, ecological and infrastructural capacity overload and stress, diversification of urban centers structures,

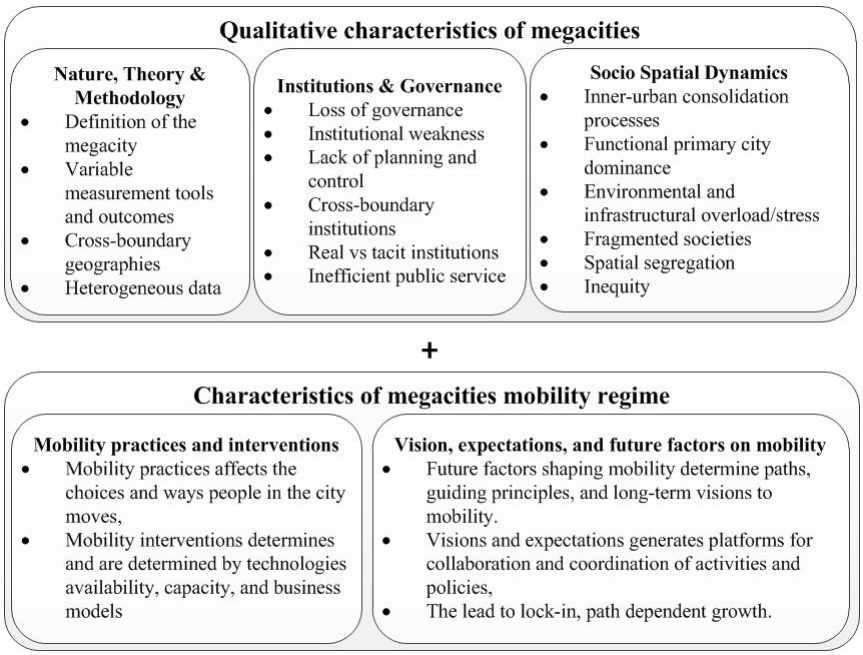
Table 3.2: 5 and (10 million inhabitants) cities (source: own, Ahlenius (2014))

HDI level	Region	Total number of cities 1975	2000	2025
Very High	Asia	2(1)	3(2)	5(2)
	Europe	2(0)	2(0)	2(1)
	Latin America & the Caribbean	1(0)	2(1)	2(1)
	North America	3(1)	4(2)	10(2)
High	Asia	3(0)	11(2)	16(6)
	Latin America & the Caribbean	6(1)	18(3)	25(3)
Medium	Africa	1(0)	1(1)	1(1)
	Asia	2(0)	10(4)	16(7)
Low	Africa	1(0)	4(1)	18(4)
	Asia	2(0)	2(1)	4(2)

Table 3.3: Largest urban agglomerations in the world (source: UN (2014))

Position	1990	2014	2030*
1	Tokyo	Tokyo	Tokyo
2	Kinki M.M.A.	**Delhi**	**Delhi**
3	New York	**Shanghai**	**Shanghai**
4	**Mexico City**	**Mexico City**	**Mumbai**
5	**Sao Paulo**	**Sao Paulo**	**Beijing**
6	**Mumbai**	**Mumbai**	**Dhaka**
7	**Kolkata**	**Kinki M.M.A.**	**Karachi**
8	Los Angeles	**Beijing**	**Al-Qahirah**
9	Seoul	New York	**Lagos**
10	Buenos Aires	**Al-Qahirah**	**Mexico City**
11	**Al-Qahirah**	**Dhaka**	**Sao Paulo**
12	**Delhi**	**Karachi**	**Kinshasa**
13	**Rio de Janeiro**	Buenos Aires	Kinki M.M.A.
14	Paris	**Kolkata**	New York
15	**Moscow**	**Istanbul**	**Kolkata**
16	Chukyo M.M.A.	**Chongqing**	**Guangzhou**
17	**Jakarta**	Rio de Janeiro	**Chongqing**
18	London	**Manila**	Buenos Aires
19	**Manila**	**Lagos**	**Manila**
20	**Shanghai**	Los Angeles	**Istanbul**

Figure 3.2: Major characteristics of megacities (Source: own, based on literature review)



fragmented society, and increasing loss of governance and control (Kraas and Mertins, 2014). Moreover, these urban settlements face an increasing socio-spatial fragmentation, especially in settlements where individualized modes of transportation are encouraged.

It is expected that these characteristics influence the way in which how mobility is constructed in a megacity. I integrate the results of the literature review into three categories: (1) Nature, Theory and Methodology of megacities, (2) Institutions and governance, and (3) Socio-spatial dynamics. However, as this research project is concerned about the mobility in megacities, it is proposed another two categories which characterizes the mobility regime in these areas: (4) Mobility practices and interventions, and (5) Construction of visions, expectations, and future outcomes on mobility. With the proposed categorization, I aim to integrate research on megacities and on mobility into one coherent framework. Figure 3.2 integrates these five areas, each one corresponding to one subsection in this chapter and used for the development of a framework for analyzing the case study.

3.2 Nature, theory & methodology on megacities

The first dimension refers to the multiple definitions and approaches to megacities. As it was mentioned in the previous section, megacities should be analyzed in both quantitative and qualitative terms. In most of the cases, the inexistent proper delimitation of megacities generate a self-reinforcing effect of inaccurate research: Unclear delimitation comes along

with unclear primary sources of analysis. In certain megacities, data available is disaggregated to local or state level, but it does not comprise the total extension of the megacity. It is not surprising that most megacity studies base their findings on approximations which are developed as data is lacking or inaccurate.

Defining a megacity by its number of inhabitants may be misleading. Cities legal and administrative definitions vary across regions, as well as their statistical measures. These characteristics make it difficult to obtain reliable data from which a megacity can be defined. For example, Los Angeles (legally defined) has only 3 million inhabitants, but its population may increase up to 18 million if we consider the counties integrating Greater Los Angeles. The Indonesian megacity of Jabotabek has three times the population of its central city, Jakarta. Moreover, integrating multiple urban dynamics and densities into one city vision can also be misleading. For example, the densities of the megacities shown in table 3.3 may vary dramatically, from 360 inhabitant by km^2 (Chongqing), to 3,198 (Los Angeles), and even up to 11,291 (Delhi). Finally, new urban geographies make difficult to delimit these cities, as urban dynamics may go further traditional administrative boundaries (Soja, 2000). Certain cities face a constant interaction and dynamics with their surroundings which, depending on how they are measured, can be considered the metropolitan areas or adjacent cities.

Moreover, the incapacity to find a standard delimitation of megacities increase the complexity of analyzing these urban areas. To some scholars, the emergence of megacities can be comparable to a metropolitanization stage of an urban settlement, to the incorporation of the city into global urban networks (incorrectly attributing the concept of 'megacity' as a 'global city'), or to the emergence of city regions. However, these definitions may not be accurate and simplify a complex urban phenomenon of large population and infrastructure. Megacities should not be understood as a basic phenomenon, but more as a complete unit of analysis for policy interventions. It also reflects the need of understanding how spatial processes happen between vast land areas.

Next to the methodological challenges of megacities, megacities also grow in different forms and time frames, largely dependent on socio-historical contexts and, more especially, economic conditions. Most cities' development depend on strong economic growth (especially, relative to the rural areas), which generates the process of urbanization in cities. However, technologies available in a specific period of time also contribute to shape the built-environment of cities (i.e. transportation, water, or energy technologies). Other cities are shaped by the availability of land (i.e. in one extreme, Los Angeles, and in the other, Tokyo).

In our case study (Mexico City), it should be noticed that Latin America has its own specific urban development characteristics, as it has been urbanized for a longer time than other developing regions. In comparison to Asia and Africa, Latin America is a primarily urban region since the 1960s (UNDP, 2014b). The region is the one of the most urbanized regions in the world (80%, and higher than Europe (73%)) (UN Habitat, 2009). The urbanization of the region came in the second part of the twentieth century, as the economic

boom of Latin America encouraged internal migration to cities.

Cities in Latin America have been shaped in recent years by a series of economic crises since the 1980s. Especially after rocket rising debt levels in this decade (infamously known as 'La década pérdida', or The lost decade) and the structural adjustments programs taken place, economies stagnated. This external condition have a direct effect on cities, by the reduction or deterioration of urban services, increase of informality (Klak, 1990) and stagnation of quality of life (Astorga et al., 2005). Other notable consequence of the crisis is the major role that IFI took in the development of programs, including mobility.

The first dimension (Nature, theory & methodology of megacities) is the shortest to explain but one of the most difficult to overcome when analyzing these settlements. In essence, this dimension comprehends the basic concept of a megacity: Each settlement should be observed as one complete unit of analysis. Nevertheless, it is frequent to observe lack of appropriate and accurate data of these settlements, as in academic and policy megacities are still framed as other type of urban agglomerations, such as metropolitan areas, global cities, or world cities. Moreover, as cities locate in more than one administrative boundary, an integrated vision of the settlement may be hindered. Additionally, it is necessary to evaluate the context dependent development of these settlements, as socio-economic conditions largely shape the extension, dynamics, and delimitation of each megacity.

3.3 Institutions and governance

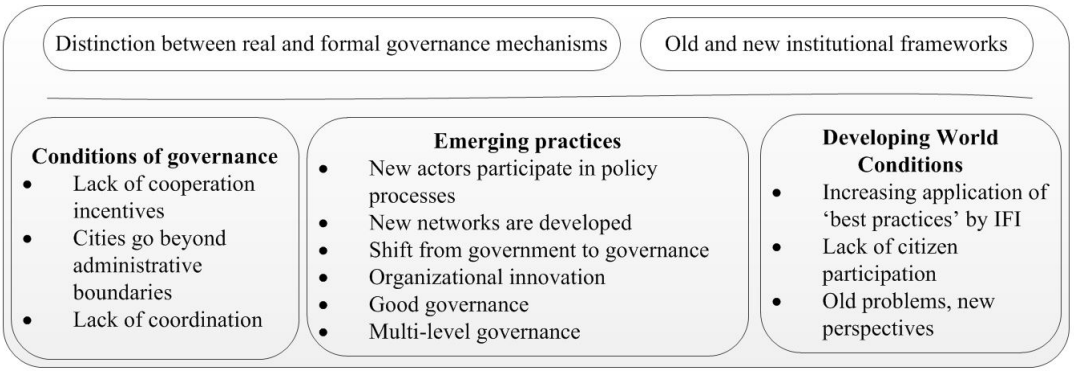
As any other settlement, megacities should be governed. Governance and institutions in these settlements are some of the most controversial areas in megacities practices. Most of the current institutions to govern these cities were built before they reach the population threshold to be considered megacities. Therefore, most megacities face challenges as their institutional and governance framework do not correspond to the complex reality of cross-administrative and geographic boundaries inside the urban area.

Megacities are located in more than one local administrative boundary. For example, Mexico City is located in one federal district and two states, with sixteen boroughs and fifty-four municipalities, respectively; and Shanghai, on one federal district, fourteen urban and suburban districts, and two rural districts. In most of the cases, the legal frameworks of different government levels are not harmonized and contradictory. Additionally, institutional and political incentives may operate in different ways in each jurisdiction, making it difficult to coordinate policy interventions among them. Underlying political conditions and structures may hinder cooperation among actors in developing countries (Carothers and de Gramont, 2011).

Figure 3.3 shows the relevant features on megacities governance. On the left side, two major concerns in megacities governance are stated: The role of real and formal governance mechanisms, and the development of novel frameworks. On the right side, the conditions

of megacities governance are stated.

Figure 3.3: Major characteristics of megacities governance (source: own, literature based)



To deal with the institutional fragmentation, two types of arrangements have been followed in practice: supra-municipal governments, as a virtual 'fourth level of government', or by inter-municipal or state coordination institutions (Negrete Salas, 2010; Moreno Pérez, 2006). The former refers to the creation of an authority that fits the city size, as the Île-de-France region and the city of Paris. The later refers to the creation of institutional authorities such as the metropolitan commissions that coordinate authorities among levels. These authorities can be either functional (limited to specific services) or regional (participation of municipalities and others levels of government).

Next to the spatial and administrative dimension of governance, a reconfiguration in decision making and emergence of new actors affect the governance of urban areas. Emergent actors and networks of governance have a significant higher role in decision making than before (Sassen, 2002). This process has two major outcomes: On one hand, actors as financial institutions or civil society organizations have a stronger presence than before. As result of this process, governmental institutions have shifted from decision-makers to decision-enablers (see Kraas and Mertins, 2014). This shift has also increased the participation of city governments in decision making arenas that were traditionally for national governments, such as international relations.

On the other hand, to target the new governance challenges, new paradigms and innovation in governance practices have taken place. The use of governance by networks has become an accepted practice (Swyngedouw, 2010). According to Swyngedouw (2010), this paradigm has risen in recent years as a suitable alternative to the old 'governing by government paradigm'. However, the network paradigm has tacit rules and regulations that make its implementation difficult. Additionally, policy by networking may have an unintended effect of conservatism if networks are too narrow (Hisschemöller et al., 2006). Some scholars have suggested that ensuring diversification of actors is necessary for governing adequately a megacity (Narang and Taube, 2014), as well as guaranteeing the internal, vertical, and horizontal dimensions of governance inside the megacity (Prud'homme as cited in Narang and Taube, 2014). In the same way, Castells (1987) stressed the importance of organizational innovation to enhance governance in mega urban areas.

A final dimension is the institutional reforms that have implemented in the developing world in the last decades. These reforms have been primarily supported by institutions as the World Bank (WB), and the Organization for Economic Co-operation and Development (OECD). They have focused essentially in efficiency increase, enhancement of 'best practices' and 'good governance'. Public service and processes should be accountable, transparent, legal, responsive, equitable and inclusive, effective and efficient, and participatory (GGG, 2014). Specific policy actions to achieve good governance in urban areas are: (1) legislation that strengthen governmental structures at urban or wider regional level; (2) metropolization of urban public finance; (3) local government modernization; (4) increase of transparency and accountability; (5) better frameworks for long term planning; (6) "people-centered" demanded drive strategies; (7) enhancement of local democracy; (8) and governmental promotion of initiatives and partnerships with third parties (OECD, 2000). However, these measures have been contested in certain contexts. For example, Zhao (2009) observed that the decentralization of tasks to municipalities has impacted negatively as development management shifted from an holistic to a fragmented view of the city. Additionally, several concerns have been raised about the lack of citizen's participation (see Brenner, 2000; Harvey, 2008).

This one-size-fits-all vision contrasts with specific and path-dependent characteristics of metropolitan governance in the developing world. Some developing countries' governance have primarily based in autocratic and centralized institutional mechanisms (i.e. East Asian countries), while other countries have developed a pattern of democratization in recent decades (i.e. Latin America after the 1980s). These specificities may sharply diverge in how governance is implemented and in their results. For example, metropolitan governance in China has been a top-down, state-objectives oriented approach (Ye, 2014), while in Mexico one of the key concerns is enabling institutional collaboration between different political parties and visions, hindered mostly by electoral or traditionally based decision making. I do not advocate for any of these approaches in advance, but it is important to keep in mind that the approaches in city governance are largely shaped by contextual factors.

A common ground in governance analysis is the need for mechanisms dealing with all the factors stated above. Multi-level governance has been observed as a suitable solution for this complexity. Multi-level governance is able to cope with different levels of government and actors of different nature (Marsden and Rye, 2010), the increasing complexity of overlapping governance networks and levels of decision making, and the establishment of coordination, steering and networking strategies (Bache and Finders as cited in Marsden and Rye, 2010).

Besides the specific urban governance challenges, other type of challenges can be observed derived from technological governance literature. Main areas of current research includes problem framing and agenda setting of urban issues (see Zahariadis, 1999; Hisschemoller and Hoppe, 1996), long term policy processes (see **?**), rationality of individuals and organizations (Ostrom, 2007), process of beliefs in policy outcomes (see Sabatier and Weible, 2007), among others.

Megacities in developing countries face the effects of emerging informal organizations

and institutions to cope with this development. Huriot and Bourdeau-Lepage (2006) have observed that the informal sector and its institutions have a negative effect on its economic performance. Other scholars have argued that this sector and its institutions have risen as a way to deal with the incapacity of the state. Therefore, informal settlements can be seen as a solution to deal with inadequate urban housing policy; informal public transportation, to deal with inefficient routes and supply; and even local water management institutions, to deal with the scarcity of this liquid in certain urban areas.

From this dimension, several characteristics were possible to map in the current literature. Based on current experiences in megacities, it is adequate to suggest that the large extension of these settlements generates an institutional fragmentation, as well as lack of effective governance. Without effective governance, tacit/informal institutions emerge, services are inadequate, and the development and planning of the city is constrained. The governance challenges are intrinsically related with the elements of the next dimension: Social and spatial.

3.4 Socio-spatial dynamics

A third dimension to be considered is the socio-spatial dynamics. Urban growth and management are inherently related to land use and to social dynamics: As services are spatially located inside the city, land value increase in better placed regions than in those without adequate services; the increasing value of specific inner urban areas generates gentrification processes moving poor people to the outskirts of the city; the deployed infrastructure can be constrained by economies of scale, densities, and power parity of people, making it impossible to offer services in certain areas (i.e. subways or fiber cable in low density and income areas).

A first element to consider in developing countries megacities is the weak framework for planning and land control in megacities. This weakness generates a negative incentive for increased land use and natural resources (Kotter, 2004). Cities may become overurbanized on ineffectively planned, generating an underprovision of basic services or spatial growth in areas where the growth should not be encouraged, such as preserved environmental areas (see Whermann, 2014). For example, informal settlements can be localized in legal protected areas, basic services as waste or water may be non-existent, or services are less cost-effective due to urban sprawl. Megacities in developing countries are, in words of Kotkin (2011), “a tragic replaying of the worst aspects of the mass urbanization that occurred previously in the West”.

This spatial growth generates spatial and population dynamics difficult to reverse. Cities may be over-urbanized and urban sprawl may correspond to ineffective mechanisms to contain the urban development process. It is not surprising that the overall quality of these cities seems to be declining since the 1970s in these countries (Cohen, 2006), especially considering the lack of long-term visions for managing spatial growth. Moreover, in these

cities evidence shows an increasing level of inequity and gentrification processes that deepen the social gap and increase the negative effects of urbanization (Etienne et al., 2008). For example, in Mexico City it is possible to find municipalities with HDI levels of the Netherlands (0.91) and Jamaica (0.7). The societal fragmentation have generated 'walled cities' high-income neighborhoods in which only its inhabitants can access its public places and services, as in the case of Sao Paolo, Buenos Aires, or Johannesburg (Borsdorf and Coy, 2009); while poor neighborhoods may not have even the basic infrastructure. Societal fragmentation comes with spatial fragmentation. Both low- and high- income regions are clearly differentiated. In these cities it is evident that quality of public services may vary across the city (Balbo, 2003). In low-income areas, illegal economic activities, criminality, and unauthorized use of public space have a negative effect in the quality of life of its inhabitants (Borja, 2003); while higher-income regions may restrict the accessibility of non-motorized ways of transportation by its built environment. Moreover, Kotkin (2011) suggested that these areas are increasing in the developing world, in clear opposition with the popular belief that economic growth brings prosperity.

Another element to consider is that, according to the reviewed literature, mixed land use, medium to highly densely populated areas, and polycentric design should be encouraged to make megacities more sustainable. However, this approach may face difficulties in practice in developing countries. First, a primary city dominance effect occurs in this regions, referring to a disproportionate centralization of activities in one city in comparison to other surrounding urban settlements. Economies of scale and accessibility to labour force in the central regions may be a strong incentive to hinder development of surrounding cities. With a large centralization of activities, the quality of the labour force is highly localized in primary cities. Moreover, unplanned urban growth may limit the possibility to densify existing areas, as services and infrastructure may be no technically and economically feasible.

Apart from the societal and spatial fragmentation of cities, the megacities duality has raised concerns about its impact on economic terms. Cities may not continue expanding endlessly, as policies encouraging more suburbanization will only reinforce the spatial segregation and negative effects of urban sprawl. Recently, cities in developing countries have pursued a policy of building a 'new city over an old one' (Borghuis, 2013). The rationale behind this idea is taking advantage of what has been already been built and increase its functionality. A malfunctioning city has a reduced level of growth in comparison to fully planned cities. Previous findings suggest that inefficient transportation systems limit labor movement, poor air quality have a direct effect on health costs, and informality can increase rates of crime and violence. Cities become less competitive (of vital importance in a globalized world), reducing investment and capital flows to their regions (see Bagwell, 2008).

In most (if not all) megacities reality outpaced the effective governance, development, and planning mechanisms. This is especially present in developing countries, where growth have surpassed their institutional capacity to deal with it. Many of the characteristics described by Kraas and Mertins (2014) in developing countries are the result of this gap.

Developing countries have had a more abrupt development than developed countries. In developed countries, the dynamics of urban growth has been more stable and planned that its counterparts in developing countries (Henry as cited in Huriot and Bourdeau-Lepage, 2006). This unstable and abrupt growth has a negative effects in the built environment, which is difficult to reverse.

The economic performance argument has been addressed by international financial institutions (IFI), by a number of policy 'recipes', which will be discussed later in this report. Many policy 'recipes' encouraged by IFI transform rights to services, which has a negative effect on low-income strata as their purchase capacity is low and reduce urban policies to technocratic interventions (for some examples see Balbo et al., 2003). Therefore, a deeper sociological and human rights debate has risen in recent years, as a legitimate claim of urban dwellers and social groups (Brown and Kristiansen, 2003).

The later approach has been supported by neo-Marxists scholars and by organizations working on social development. First, neo-marxists scholars argue that exchange and capital value of urban space has been a predominant design in cities, at the expense of its use value. This has resulted in a reduced capacity of citizens to intervene in the governance and policy processes of their own cities (Purcell, 2002). Moreover, Harvey (2008) observed that the quality of urban life has become a commodity only for those who have money. Social development organizations, such as UNESCO or UN-Habitat, have also raised the attention about an inclusive and socially conscious urban development (Brown and Kristiansen, 2003). It is not the scope of this paper to analyze the arguments between predominantly technocratic and human rights approaches. However, it should be noted that the contrasting positions are still present in today's debate about social inclusion and service provision in urban settlements.

Some specificities of Latin America are an increasing physical expansion that outpaced capacity of urbanization (Mexico's urban physical expansion is in a 4-to-1 ratio in comparison to its population growth in the last thirty years (UNDP, 2014b)); and that the rate of urban growth is still high, but it has dramatically been reduced since the 1980s. Additionally, urban historical development was highly concentrated in a reduced number of cities. It created a *primary city* phenomenon, with large and dominant urban centers in Latin America, concentrating most national population and economic activity (UN Habitat, 2009). The current trend is urban development in smaller cities, but without the growth rates previously seen (It is expected a 0.8% urban growth from the 2015 onwards) (UN Habitat, 2009).

The incapacity of institutions to deal with growth is not exception in Latin America. Large parts of cities in this region were built as illegal settlements. In Mexico City, more than 60% of urban housing development is located in irregular zones (Schteingart, 2010), and *Favelas* are present in more than one third of Brazilian cities (Balbo, 2003). In addition, the region cities have the highest income inequality in the world (UN Habitat, 2009). Since the 1980s, Latin America countries have faced serious economic and financial constraints. Especially after rocket rising debt levels in this decade (infamously known as 'La

década pérdida', or The lost decade) and the structural adjustments programs taken place, economies stagnated. Some of its effects were the reduction or deterioration of urban services, increasing informality (Klak, 1990) and stagnation of quality of life (Astorga et al., 2005). Another notable consequence of the crisis is the major role that IFI took in the development of programs, including mobility.

This dimension advocates for the relation between space and social processes. On one hand, land is a valuable and scarce resources in megacities. This scarcity generates incentives for gentrification and splintered urbanism which is present in most megacities. On the other hand, social dynamics, economic processes, and mobility patterns are interrelated with the urban built environment. Policy interventions in any field are largely constrained by how the city was built and how it impacts its functionality. Socio-spatial dynamics are difficult to reverse, and reinforces processes of exclusion/inclusion, segregation and inequity that affect directly how mobility strategies should be implemented. The first three dimensions were conceived from literature on megacities. The following section relates these dimensions to our field of study, mobility.

3.5 Mobility in megacities

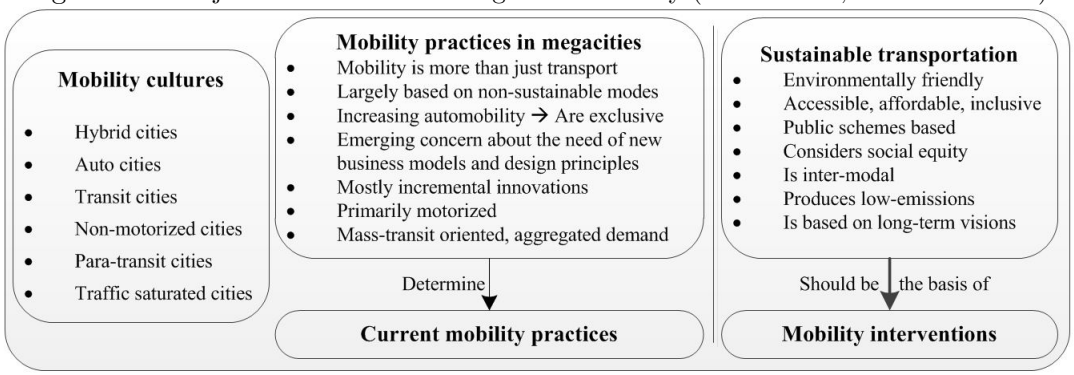
Mobility plays an essential role in megacities. Transportation options and their deployment have a strong connection on how cities are spatially developed, how people access products and services in the city (Olvera et al., 2003); also, it is an essential element for interaction and social mobility, and offers the possibility for movement to labor (see Harvey in Hubbar, 2006). The most important elements to consider in megacities mobility are shown in figure 3.4. Two major elements are considered: First, the link between a path dependent growth (income, densities, built environment) with how people move in the city. Second, the emerging practices and the sustainability paradigm in the mobility domain. Both elements are discussed in this chapter.

To present the findings in this dimension, this section is subdivided into Mobility practices and Mobility interventions. The former encompasses what is already present in megacities, while the later refers to current mobility interventions in this domain. As mobility practices are largely path-dependent, I attempt to provide a general overview of why this is the case, but the detailed description can be found on chapter 4, using Mexico City as a case study.

Mobility practices

As it was mentioned above, there is enough evidence to suggest that the specific spatial patterns and development of megacities affect the mobility dynamics. How people move in a megacity is largely shaped by multiple factors, such as access to fuels; inhabitants perception

Figure 3.4: Major characteristics of megacities mobility (source: own, literature based)



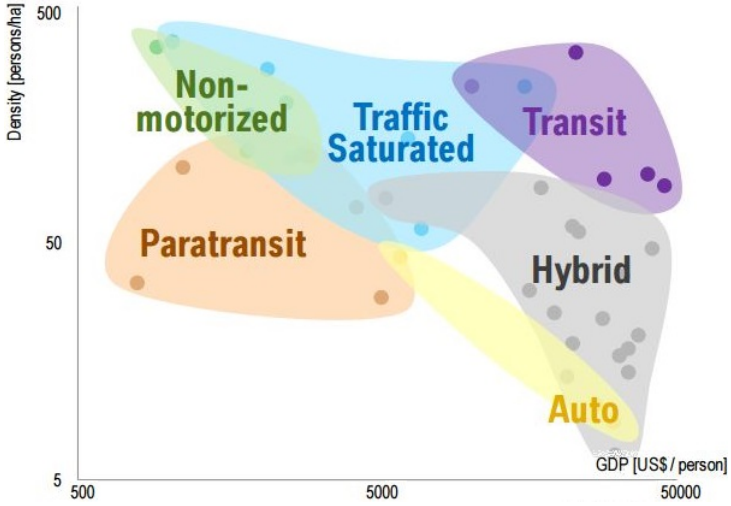
of private motorized transportation; infrastructure; social, economic and political views on mobility; among others. Tangible (e.g. built environments, transportation networks and urban design) and tacit (e.g. public and political discourses, image and reputation of the city, individual travel preferences, and the experience of travel) elements define how people move inside them (Kuhnimhof and Wulfhorst, 2013). Mobility in megacities is path dependent to previous urban design and development. Kuhnimhof and Wulfhorst (2013) observed six paths of mobility patterns ('mobility cultures', in their words) that define mobility in megacities. The types of cities based on their mobility, as suggested by Kuhnimhof and Wulfhorst (2013), are:

1. Hybrid cities, with dense urban centers and vast surrounding suburban areas. City centers have adequate conditions to implement efficient transportation systems, while the suburban areas are sprawled encouraging car use.
2. Auto cities, which have a low density population and commercial areas and residential areas are separated. Mobility needs are satisfied primarily by car use. Density and car use make them energy intensive, with a high pollutant levels. City sprawl is encouraged as a design principle.
3. Transit cities, with high density and efficient public transportation. Public transportation fulfills large part of mobility needs of its urban dwellers. Car use is discouraged, making them low in emission and energy use.
4. Non-motorized cities, in which the primary modes of transportation are non-motorized, as cycling or walking. However, increasing accessibility of cars to population is over stressing and congesting them, as infrastructure is not suitable for increasing car use.
5. Para-transit cities, with semi-formal and semi-organized transportation systems, mainly as the result of the governmental incapacity to provide reliable transportation means. In comparison to transit cities, public transport may be deficient and chaotic. Car ownership is relatively low.
6. Traffic saturated cities, in which there is a mismatch between the degree of development in transport infrastructure and the existing demand. (Priester et al., 2013; Wulfhorst et al., 2013)

Figure 3.5 shows a cluster analysis made by Institute for Mobility Research (IFMO) on megacities culture and population density. As can be seen, transit, auto and hybrid cities

are highly correlated with higher income, while non-motorized and para-transit on lower income. In terms of density, non-motorized, traffic saturated and transit cities are positively correlated with higher densities. Latin American GDP is moderate, therefore the region is expected to experience more non-motorized, paratransit and traffic saturated mobility cultures.

Figure 3.5: Cluster of cities based on their mobility cultures (source: IFMO)



This type of different urban mobility cultures could be observed as the result of divergent historical development of cities. Japan, which cannot rely on oil-based solutions due to lack of access to it, developed a strong rail oriented motorized transit system. Nowadays, Japanese cities are considered transit cities. In China, lack of urban planning and low access to cars, promoted the use of highly concentrated, bicycle-friendly cities. This development sharply contrasts with motorization in recent years, but Chinese cities are still considered non-motorized urban settlements. In Jakarta, policies encouraging car use and underinvestment in public transport resulted in a highly saturated traffic city. In Mexico City, the underinvestment in public transportation has resulted in an increase of para-legal transport solutions, and the motorization pace was not sufficient to allow widespread access to car use, making it a para-transit example (see Hook and Replogle, 1996). Moreover, this dependency on historical circumstances may indicate that transportation solutions should be context aware.

Transport is the most important infrastructural concern in megacities (Siemens, 2012). Car ownership and vehicular travel has increased in the last century, and it is expected to continue growing (Daly, 2007), especially with low-cost options (e.g. Tata Motors in India). Increasing car rates increments road congestion and generates negative externalities in urban spaces. In some megacities, mobility per resident has declined more than a half in just one century (Moavenzadeh and Markow, 2007). Additionally, cars have ruled out other modes of non-motorized and more environmentally friendly transportation modes (Cox, 2010).

Increasing automobility face both technical and economic constraints. On the technical side, efficiency gains may not be enough to reduce sufficient emissions to mitigate climate change. Additionally, in the following decades we may have limited supplies of fossil fuels. Access to automobility depends on continued strong economic growth (Daly, 2007). This may not happen, as limitations to growth are becoming evident (Moriarty and Honnery, 2008; Meadows, 1972; Jackson, 2011). Evidence indicates that current mobility regimes in megacities are not sustainable in the long term. Car use is positively correlated with higher incomes and with population growth if no restriction to automobility is encouraged (Emberger et al., 2010). In developing countries, megacities infrastructure constraints may not cope with more car journeys. Furthermore, evidence suggests that increasing car use makes public transportation less efficient and more time-consuming if the space is shared with private cars (Kutzbach, 2010). In the case of Sao Paolo, public buses average speed is 15 km/hr, while the car is 25 km/hr (Kutzbach, 2010). In the opposite direction, successful policy interventions in mobility in developing countries have relied in public transportation systems and low motorization, as the cases of Singapore and Hong Kong (Kutzbach, 2010)[1].

This type of greener alternatives are divergent of the technical and non-technical components of current mobility systems. From the technical side, infrastructure is one of the biggest constraints in development of greener transportation modes. Most of the developing countries megacities are locked-in in spatial patterns that enhance car use (see The New Climate Economy, 2015). On one hand, cars became a dominant car principle in urban planning, which favoured urban sprawl (being LA the most representative case). On the other, unplanned growth does not contribute to the development of high density areas; resulting in inadequate transportation services due to the lack of geographical, spatial, and economic conditions. These infrastructure constraints reinforce the use of private, motorized transportation modes (Zhao, 2009).

However, infrastructure is not all. It is necessary to understand that mobility is not just a transport studies domain, but a more general societal concern (Banister, 2008). Conventional transport studies has seen mobility as a derived demand of the activities at the destination place, hence travel should have minimal financial and time costs (Banister, 2008). There are other reasons why people travel and how mobility should be encouraged. For example, traveling by car can also be a leisure activity, or bringing commercial services closer to residential areas may encourage pedestrian routes which can also be considered a leisure activity. However, most policies still target mobility as transportation (mostly in a supply-demand perspective, see following section). For example, in developing countries mobility is primarily targeted by transportation of communications ministries, without a multidimensional perspective. Moreover, incompatibilities among different ministries and levels of government may hinder innovations in the transportation sector (Hull, 2008).

Moreover, radical innovations may be constrained by legal and administrative aspects. For example, it has been argued that Uber transportation service is an illegal service in Mexico City based on current legal dispositions, and has been exploited by incumbent

[1]Now Singapore and Hong Kong are considered developed countries. But at the time of the implementation of their transportation policy they were considered developing countries.

providers of taxi. Bicycle schemes or big data solutions need new business models to make them sustainable in the long run (UITP, 2011). Breakthrough innovations may clash with the inertia of public organizations, which may not be able to cope with new technologies and required expertise due to lack of incentives (see Hartley, 2005).

New design principles should guide policy interventions in the mobility domain. A major concern in megacities mobility interventions is inclusion. Demographic and social conditions largely affect mobility patterns (Litman, 2012). For example, Schteingart (2010) found that ethnicity and gender have a major impact in Mexico City's inhabitants' movement. Mobility in megacities can be observed as a social demand of low income classes, which may hinder their participation in economic and social activities (Alcántara Vasconcellos, 2010).

Even though there is no current established path(s) to sustainable urban mobility, it is possible to map its main characteristics based on scholar and private enterprises perspectives. Guiding principles in sustainable mobility are accessibility, environmentally efficiency, reliance on public schemes of transportation, and social equity (Nicolas et al., 2003). Additionally, there is a strong focus on inter-modality, (intelligent) transport systems and vehicle usage management, and reduction of harmful emissions (Moavenzadeh and Markow, 2007), with a long term vision to satisfy increasing future demand (Kazmil and Demzee, 2014).

Scholars have suggested a strong relationship between sustainable mobility and rehabilitation and recovery of urban spaces. Non-motorized infrastructure contribute to the development of more sustainable patterns of mobility and inter-modality. Rehabilitation of public spaces encouraging this infrastructure -trams, pedestrian walkways, bicycle paths, and boulevards- can encourage this practices (Negulescu, 2014). Moreover, mobility and space rehabilitation may have a positive effect in social interaction and inclusion, such as the cases of Mexico City and Bogotá demonstrate. Specifically in Bogotá, Transmilenio Bus Rapid Transit (BRT) system is considered a useful instrument for mitigating income inequalities on the long-term (Hörmann (2008) as cited in Kraas and Mertins, 2014).

Conditions of mobility in developing countries' megacities

Mobility constraints are deepened in developing countries. According to Gakenheimer (1999), in these countries mobility and accessibility are declining, but they present a rapid pace of motorization. This paradox is the result of increasing congestion, declining mobility for public transport users, and lack of infrastructure. Additionally, cities in the developing world suffer from limited agreement on planning approaches, scarce capital, and inadequate infrastructure. Land use policies may not be enforced in the developing world, due to the lack of capacity (Zhao, 2009).

Even though mobility is reducing, users of public transport have reduced mobility and higher travel times in comparison to car owners, as transportation policy has primarily emphasized road expansion rather than public transit systems. In developing countries

where the social gap is considerable, this emphasis in private mobility has had a significant negative effect on poor people, by limiting their mobility capacity (see Illich p. 21-26 in Cox, 2010). However, Gakenheimer (1999) believes that developing countries have advantages in mobility innovation. In these countries, there exist fewer legal constraints, that may limit the responsibility of companies in the case of malfunctioning technologies. The weak legal framework in these countries may inhibit legal action for liability and responsibility against companies offering technological services. Additionally, the limited agreement on planning approaches may foster innovation in the area. Other advantages include cheap personnel costs and stronger central authorities.

Gakenheimer (1999) declares that Kuznets inverse "U" shape curve is an adequate statistical descriptor of motorization in world history. Attenuation of motorization occurs after per capita income reaches $21,000 USD. However, the majority of developing countries are distant from this value, suggesting that reduced motorization may not come in the short term without policy intervention.

Motorization has been recently simulated by Kutzbach (2009), and differs from other simulations as it includes parameters that are present in developing countries and are not considered in other studies. These include lower incomes and economic inequality. His findings suggest that local characteristics, road congestion, and urban policies have an impact on how people mobilize. This finding contradicts the suggestion of Gakenheimer as aggregate levels may not solely explain patterns of mobility, but also need to consider specific, local conditions. Kutzbach's study reveals that income inequality have a positive effect on car use, and that the resulting congestion of more car users on the road reinforces car ownership, as buses become less effective. However, policy interventions such as car tolls or reserved bus lanes, can reverse this situation.

However, certain interventions, especially those requiring state-of-the-art technology, may not be affordable to cities in developing countries. Berkhout et al. (2010) claim that innovations should not come only from industrialized countries, but need to be generated also in developing countries. Investment in vehicle to vehicle (V2V) or to infrastructure (V2I) may be extremely high as technological solutions need to be imported. This challenge requires creative and novel approaches. For example, the city of Singapore has been able to retrieve real-time congestion information by monitoring only taxi operators, and by using traditional radio frequencies to reduce bandwidth cost (Chin and Lee, 2009). For example, since the 1970s, a new transport solution emerged in Brazil, the Bus Rapid Transit (BRT). BRT are a low cost solution, in which buses have dedicated lanes and stations. In a nutshell, it is a tram or subway system, but with buses. BRT can reach 100 times more than a subway system at the same price. Additionally, Wright (2001) stated that next to the functionality of the BRT, this type of transport system allows the rehabilitation of urban space, social inclusion, and non-motorized mobility. BRT allows affordable mobility in cities with low population density and redefining routes as a city expands.

In addition, technical interventions may be complemented by non-technical or administrative ones. In South East Asia, establishing quotas for new car purchases, and pricing

roads based on the total number in use, can reduce or modify car journeys (Lew and Leong, 2009). Nevertheless, these may have negatives effects if inadequately implemented. Mexico City's program Hoy No Circula, which limits the days per week a car is used, only generated a second-hand market with older and more pollutant automobiles; or Jakarta's program to promote car sharing created a market of people offering free rides to avoid fines (Houben and Calabrese, 2003). Hyard (2014) suggested that non-technical innovations may be as effective as technical ones, but they are less visible to the public.

Although the definition of sustainability has gained a wide consensus in recent years, the meaning for actors may vary across regions. The study of Rodrigues de Silva et al. (2008) found that the concept stakeholders give to sustainability varies according to local conditions. By organizing sustainable mobility workshops in Brazil, the authors noted that the economic, social, and cultural differences among regions shape how sustainability is addressed.

Furthermore, requirements to achieve sustainability may vary between developing and developed countries. Kazmil and Demzee (2014) suggest nine guiding principles to achieve transport sustainability in cities of developing countries. Some of these are: defining responsibility and accountability in the transport system, appropriately assigning risks and responsibilities between parties, guaranteeing sufficient resources for the system, and guaranteeing contractual conditions based on performance outcomes. Strategies encouraging sustainability in megacities include focusing the transportation strategy on both demand and supply, and improving its performance and increasing cities' management capabilities (Moavenzadeh and Markow, 2007).

Montezuma (2003) observed that urban mobility systems are not linked with the urbanization process in cities in developing countries. This has led to a paradox in which (in)formal public transportation systems have been established (many of them without serious planning strategies), but cities are not compact and reflect low densities. This situation creates inefficiency in transportation systems, spending higher resources and spaces to satisfy the population mobility needs. Even though there is a tendency for formalized transportation services, during the last decades transportation was developed in a semi-informal or informal fashion. Different developing world regions have different characteristics in the field of mobility. For example, Wright (2001) observed that in Latin America vehicle ownership is three and four times that of Asia and Africa, respectively.

Mobility interventions

This section comprises the mobility interventions which are implemented in urban areas. Literature targeting specific actions to enhance sustainability come from varied actors, including financial institutions, national governments, international organizations, and scholars. It is possible to observe a variety of approaches to mobility in megacities, but the interventions are primarily based in guiding principles and four types, described below.

In recent decades, global financial institutions have played a key role in transportation policy. Institutions such as the Organization of Economic Development and Cooperation (OECD) and the World Bank (WB) have set a number of policy recommendations that have been general guidelines on how to deal with transport. Specially, the World Bank and the system of United Nations regional banks have become a major financier of transport projects. They have proposed a set of policy recommendations that have been general guidelines for mobility.

One general concern is affordability, especially in those countries that have a major need to upgrade their transportation systems. Affordability is defined as "the financial cost of journeys [that] put an individual or household in the position of having to make sacrifices to travel or the extent to which they can afford to travel when they want to" (p. 5). A report commissioned to Carruthers et al. (2005) by The World Bank analyzed how affordable is public transport in developing countries. In these countries, poverty and other dimensions of social exclusion (access to jobs, schools, health facilities, etc.) are vital for the access to transportation to the lowest income strata. Three problems can be observed in these countries megacities:

1. Demand of public transportation in these cities exceeds by far supply. However, public transport fail to meet the aspirations of it citizens.
2. Urban growth increases transport costs, which affects heavily the urban periphery, were the poor strata are traditionally located.
3. Urban growth has perverse distributional effects. It generates a gentrification process, and motorization makes the poor poorer, by limiting their access to mobility (Carruthers et al., 2005).

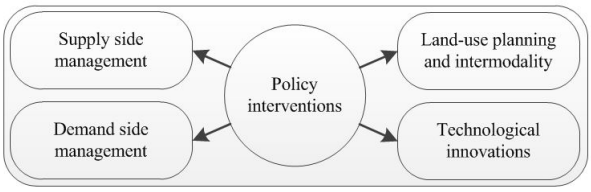
Additionally, accessibility, acceptability and availability of transportation should also be considered. Other findings suggest that: private ownership of transportation may not result in a better service; the costs of traveling from the poor periphery to business centers could be so high that it may discourage labor movements; urban expansion and modernization is affecting how people mobilize, reducing pedestrian and bicycle travels; and certain policies, such as concession fares, may not be suitable for these cities as the number of self-employed and informal workers is high.

In megacities of developing countries, several trends of mobility can be observed according to Taiyab (2008). These are highly relevant as they are present in the case study. Firstly, more people are buying personal vehicles, especially because inefficient public transport and lack of infrastructure; secondly, safe and convenient public transportation demand is growing, but Taiyab suggested that previous transportation operators generally oppose to this kinds of measures; thirdly, clean air and fuel efficiency are the two major concerns driving technological change; fourthly, creative measures to deal with traffic had been implemented in developing countries, sometimes without being a success; and fifthly, global civil society is becoming increasingly active in this domain, looking for sustainable and equitable solutions.

However, which are the specific policy actions in the transportation domain? To summarize them, four categories are established: Supply side management, demand side man-

agement, land-use planning and intermodality, and technological innovations. The four types of interventions are shown in figure 3.6, and are adapted from previous research by Moavenzadeh and Markow (2007).

Figure 3.6: Four types of policy interventions (source: own, based on Moavenzadeh and Markow (2007))



Supply side management

Supply encompasses infrastructure, modes, capacity, frequency, and coverage of transportation (Rodrigue and Notteboom, 2015). Supply can be improved either by construct new of upgrade infrastructure. Examples of these include new roads, transit facilities for cyclists of pedestrians, restrictions on parking supply or zones to vehicles, or high occupancy lanes. Road pricing in Singapore, high occupancy lanes in California highways, and restricted vehicle zones in London are examples of successful supply side interventions.

Supply side solutions have certain limitations. On one hand, infrastructural investments may not bring revenues to governments. For this reason, the public sector have tended to collaborate with private investments through Public Private Partnerships or concessions, among others. These measures may have reluctance of local population and political opposition (Litman, 2005). On the other, supply oriented policies are temporary: Upgrade will not create greener transportation schemes, but an increase in capacity that later will not cope with demand.

Demand side management

Demand side management aims to maximize the efficiency of transportation by discouraging unnecessary journeys by private vehicles and promoting more effective, environment-friendly and healthier modes (Broaddus et al., 2009). In comparison to supply management, demand measures can have a more significant effect on the cumulative impact of transportation (Moavenzadeh and Markow, 2007). Successful demand side management actions policies include Singapore's electric toll system during rush hour, Bogota's monthly no vehicle day, or car quotas in South East Asia. However, if improperly implemented, these measures may have an insignificant or even a counterproductive effect, such as in Jakarta's restricted zones for vehicles with only one passenger during rush hours, or Mexico City's Hoy No Circula.

Demand side measures can create incentives to more efficient and cleaner modes of transportation, or discourage more pollutants one. More efficient transportation modes can be encouraged by subsidies, tax exemptions, or financial retributions. Discouraging measures include limiting the number of days a car can be used, establishing quotas for automobile purchases in a certain period of time, restricting or pricing the vehicle use during rush hours, or taxing fuels. For increasing its effectiveness, a broader policy that encourages multiple options of transportation is recommended (Broaddus et al., 2009). For example, discouraging car use by taxes will not be effective if there are not alternative options of transportation.

Land-use planning and inter-modality

Land use policies are vital to achieve sustainable transportation in megacities. There is a widespread consensus that land use may be used to reduce urban sprawl, enable pedestrian routes and intermodality, and increase population density. This type of development, also called Transit Oriented Development (TOD) offers neighborhoods the possibility of alternative suburban living and neighborhood revitalization, and increasing pedestrian or non-motorized mobility (Moavenzadeh and Markow, 2007). Higher densities in urban settlements allow making public transportation affordable, and reducing energy consumption (Zhao, 2009). In comparison, urban sprawl increase car use and distance traveled.

Land use policies that encourage medium to high density and mixed land zones reduce the distance traveled and encourage non-motorized transportation modes. They allow the allocation of private services in walking or non-motorized transportation distance from housing complexes (Belzer and Autler, 2002). They are considered to have a significant effect in the long term, rather than being a short term strategy (Broaddus et al., 2009). It also contributes to upgrade the economic, social and environmental dimensions of the cities (Moavenzadeh and Markow, 2007).

Land policies should be complimented with multi-modality. It allows users to shift between different modes of transportation to reach their final destination. Multi-modality goes hand-by-hand with rehabilitation of urban space, increasing the quality of life in the areas where it is practiced (Negulescu, 2014), and can reduce car use. In addition, there are emerging individual public transportation modalities that compliment current transportation systems. Evidence suggests an increasing complementary between individual public transportation systems, as car or bicycles sharing schemes, with traditional modes of transportation as trams, subways or buses (Borghuis, 2013).

One of the most successful interventions in multi-modality are the bicycle sharing schemes. They have been implemented in more than 500 cities in the last twelve years, but face two major issues: topography and climate may not be appropriate for bicycle schemes; and that the bicycles and infrastructure may face risks as vandalism and theft (Midgley, 2009). However, technological innovations may reduce these risks; and there are

contradictory findings of almost non-existent theft and vandalism cases, such as Mexico City's Ecobici (Delgado and Graizbord, 2014).

Technological Innovations

Certain technological innovations are promoting more efficient and greener transportation modes, but do not fit into any of the first three categories. These are not modifying neither side nor demand side technologies, nor affecting multi-modality or land use. Moavenzadeh and Markow (2007) called them "Advanced Technologies". Navigation assistance, synchronized traffic signal control and automated red light enforcement are some examples. These technologies may rely on wireless or satellite communications, such as Vehicle-to-Vehicle (V2V), Vehicle-to-Infrastructure (V2I), and Global Positioning Systems (GPS). They can have a really high cost of deployment, and legal, institutional and organizational issues surround their possible applications (see Peirce and Maur, 2007; Moavenzadeh and Markow, 2007).

In addition to these technologies, it should be noted that alternative fuels have increasingly gained attention to increase car efficiency. However, alternative fuels may have a null o minimal effect on other mobility concerns, such as increasing congestion and health benefits. In addition, not all fuels are compatible with present engines, and some require a large investments in infrastructure.

This dimension includes the most relevant concerns in mobility practices and interventions in megacities. Regarding mobility practices, and as it was sustained, most practices are shaped by tacit and tangible factors. Moreover, there is a tendency of increasing automobility, which is suggested it cannot be maintained in the long term. Additionally, mobility is constructed upon the legal and administrative dispositions in the megacities. Regarding mobility interventions, it can be observed that there are general concerns regarding the conditions of mobility in developing countries that need to be considered for mobility interventions. In addition, design principles (such as affordability, accessibility, and availability) emerge as guidelines for successful mobility interventions, drawn into four categories: Supply side management, demand side management, land-use planning and intermodality, and technological innovations. The next section deals with the final dimension, regarding future outcomes, visions and expectations on mobility.

3.6 Visions and expectations on future megacities mobility

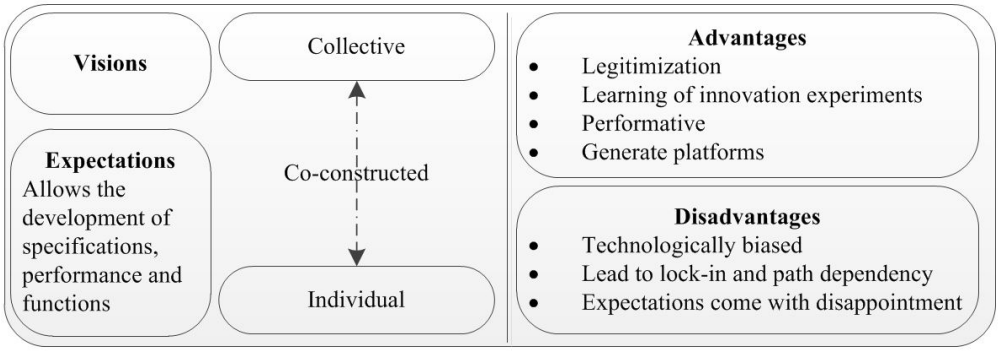
The previous sections of this chapter have focused on past and present dimensions of megacities mobility. There is a final dimension, which is concerned about how current decisions and actions are taken based on possible futures. The role of expected returns of policies play an essential role in explaining which decisions are taken. Innovation studies have in-

tegrated this study of future outcomes under two concepts: *visions* and *expectations*, both being *representations of the future*. Unfortunately, both terms remain poorly defined and differentiated. To target this inconsistency, the following definitions are proposed:

- *Visions* are "collectively held and communicable schemata that represent future objectives" (Berkhout, 2006), while
- *Expectations* are beliefs of future specifications, performance, and functions which contribute to the fulfillment (or not) of a future vision.

By these definitions, I attempt to separate a more abstract term (*visions*, i.e. urban sustainable mobility in 2027) of more tangible ways about the future (*expectations*, i.e. roles and standards, regulatory frameworks, functions on different artifacts in the process, sectoral goals, etc.). This distinction is also suitable for differentiating the rhetoric and discursive dimension of sustainability from its operational dimension, the later requiring factual compromises of stakeholders and policy actors. Figure 3.7 shows a schematic and summarized view on visions and expectations, that will be discussed in the first part of this section.

Figure 3.7: Visions and expectations.



Why are visions and expectations relevant for this study? Innovation is an uncertain process. It is not possible to determine *ex ante* innovation outcomes. Uncertainty comes in a wide range of elements, such as incapacity to map results in advance, technological competition, or broader changes in reality -what transition studies conceptualize as 'landscape'-. Study on visions and expectations are suitable for dealing with this uncertainty, because they provide sufficient elements to cope with unclear scenarios. In the case of mobility, visions and expectations can provide guidelines for future actions, establish shared schemata between relevant stakeholders, and, in general, reduce the level of uncertainty surrounding innovation and mobility.

Visions and expectations emerge from a process in which they are proposed, discussed, and negotiated between stakeholders. Moreover, as visions and expectations are negotiated, they tend to be shared by a large number of individuals. By the definition proposed, visions can only be collective, but expectations can be either individual or collective. Considering a collectively shared vision, the expectations may differ; for example, regarding a vision of a carbon neutral city in 2020, the functions (such as role of non-motorized transport),

specifications (regulatory frameworks), and performance (value of data analytics to reduce congestion) may not be shared among actors. Visions can have positive effects if they are flexible, to allow the appropriateness of meanings of future outcomes. This flexibility allows to target larger audiences, making more actors believe in a shared future. However, if this flexibility goes beyond a certain threshold, it can reduce its quality, and generate multiple and contrasting expectations. Collective representations of the future are co-constructed, as there is a two way direction influence, design, and adaptation. Previous findings suggest that expectations have a positive effect of coordination, organization, and tasks distribution (van Lente, 2012).

To collectively share visions and expectations, mechanisms of collaboration should be established. Collective expectations and visions are negotiated among different actors by cooperation and/or confrontation of meanings. They may shift over time, being less realistic in an early stage and more rational when mature. Moreover, these mechanisms also allow to develop rational individual expectations, as they cannot be conceived without access to relevant information from other actors. They allow the representation of sectorial interests in future outcomes (see Berkhout, 2006). These mechanisms allow the development of expectations: specifications, functions, and scenarios of a certain technology (Van Lente, 1993). In addition, they allow the coordination of small-scale experiments, from which valuable knowledge can be obtained (Berkhout, 2006). The expectations tend to be rationalized over time, as more information is available and the limitation of possible future outcomes becomes evident. Moreover, they are largely influenced by pre-existing conditions or inertia of current structures.

These representations of the future are beneficial in multiple ways. They provide legitimization to projects. Legitimization increases support (both in number and in quality) while also allows changes to happen. Berkhout (2006) found that they allow the creation of narratives and obtain resources. Visions and expectations can also contribute to learning of innovation experiments and as heuristics for finding solutions. Berkhout (2006) has suggested that they provide the possibility to map possible solutions to a given problem. Moreover, they may be performative. This means that they *do* something in reality (such as Moore's Law in the semiconductor industry). Collective and individual expectations can become 'self-fulfilling prophecies'; as they have a positive effect for getting to desired outcomes. Shared expectations can establish guidelines of performance and progress evaluation, or 'expected outcomes'. Higher expectations will be related to tougher evaluations (see Konrad, 2006).

Not much has been written about the limitations of visions and expectations. Visions in an early stage are technologically biased, neglecting cultural and organizational factors that affect future outcomes (Borup et al., 2006), such as the technologically pushed vision of smart cities in countries with inadequate Internet connectivity. One of the potential risks of them are contributing to an early lock-in and path dependency (Konrad, 2006). Expectations can be created over a specific technology, that later may be less efficient than alternatives. As a social construction, expectations may be over-inflated, resulting in a long-term incapacity to reach the expected future. Moreover, Borup et al. (2006) suggested

that disappointment comes hand by hand with expectations: Higher expectations may lead to higher disappointments, and vice versa. High expectations are able to mobilize more resources than rational, discrete expectations. Finally, visions and expectations have not been studied in complex interdependent and functionalist scenarios, where agency of actors creating and supporting them is limited. Visions can contain implicit or explicit ideological assumptions (Berkhout, 2006), which can result in framing a problem under a specific scope (e.g. automobility can be observed as a concern of transportation or of energy security).

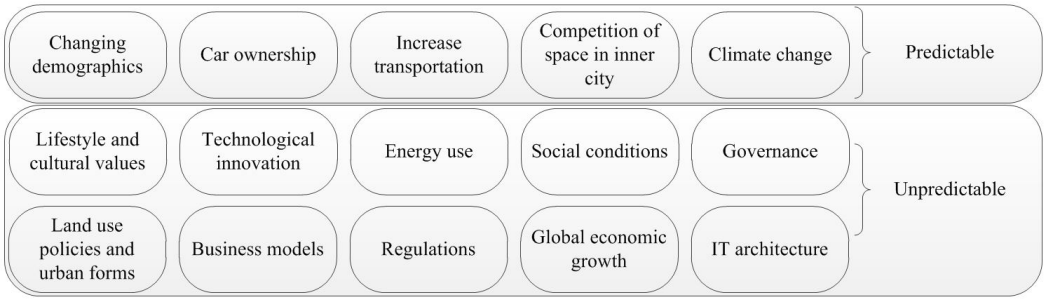
As can be observed, one of the most relevant characteristic of visions is that they allow to map possible futures and give direction to innovation. They allow the creation of a 'possibility space' of futures (Berkhout, 2006). The *possible* future given a vision can be contrasted to its likeliness to occur, or is probability. Expectations are useful to map *probable* futures as they are related to future functions, specifications and performance. For example, envisioning a megacity inclusive mobility regime in ten years will only be probable if the expectations are likely to occur in this time frame. In this example, the expectations of car ownership or public transportation, reduction of income inequality, or access to services, among others, will determine the probability of a vision to be accomplished.

But, which are the elements that should be considered to evaluate the likeliness of a expectation to occur? In the rest of this section, I discuss the elements that were found in the literature, including the most relevant trends and considerations in policy interventions in megacities mobility. The elements that should be taken into account when evaluating future mobility, can be divided in two major categories: (1) Those which are certain to occur, and their effects can be forecast in advance; and (2) those which are likely to occur, but not clear forecast can be made at the present time. The former encompasses elements such as increasing effects of climate change, changing demographics with older population, and constrained resources; while the later includes the role of the car, the density of urban areas, and the global economic growth.

Figure 3.8 shows the most relevant elements to be considered in generating future visions and expectations in megacities mobility. As can be seen, most of the elements remain unpredictable. The predictable elements are changing demographics, with an increasing number of people over 60 years old; more people will have access to cars, especially with low-cost alternatives such as Chinese Zotye or Indian Tata brands (car ownership is not equivalent to its use); a larger demand of transportation services; a growing competition of land in inner areas of megacities; and an intensification of climate change effects (see Glaister and Box, 2014; Forum for the Future, 2010).

Ten factors were observed that remain uncertain in future urban mobility: (1) lifestyle and cultural values shaping mobility, (2) technological innovation, (3) energy use, (4) social conditions, (5) governance, (6) land use policies and urban forms, (7) business models, (8) regulations, (9) global economic growth, and (10) IT architecture. Each requires a brief explanation, described below.

Figure 3.8: Major certain and uncertain elements shaping mobility (source: own, based on literature review)



First, mobility depends largely on *lifestyle and cultural values*. Consumers are those who decide how to transport. Cars have a cultural and status value that no other transportation method has, and it is unclear if it will remain in the following decades. Encouraging greener transportation modes is not just a matter of supply a demand, but rather a change in user behaviors (Fishman, 2012; Forum for the Future, 2010; UITP, 2011). If urban dwellers prefer more customized mobility services, it is likely that private modes of transportation expand. UITP (2011) pointed out that multiple types of users exist in mobility services, making inadequate a one-size-fits-all solutions.

The second element is *technological innovations*. They have an essential role in future mobility. It is unclear if incremental or radical innovations will shape mobility systems. Efficiency gains in fossil fuels can increase motorization, but efficient and competitive radical innovations may create new mobility alternatives. Other technological options, such as the bicycle, have re-emerged in urban areas in recent years. However, technological innovations in fields with no relation to transport can affect mobility. For example, food shopping behavior may be changed by incremental gains in refrigeration services, or data analytics. ICT -which will be later explained- can promote more efficient ways of transportation, such as car sharing or commuting. This element is largely affected by the infrastructure and accessible know-how (Glaister and Box, 2014; Fishman, 2012; Forum for the Future, 2010; UITP, 2011).

The third element is *energy use*. The use of energy is expected to grow in the following century. However, it remains unclear how intensive and which will be the sources to satisfy these needs. Cheap and accessible fuel is correlated with increasing mobility. In the case of scarce energy, population will necessarily reduce their mobility distances by either minimizing consumption or by the use of non-motorized transport (Wegener, 2013; Forum for the Future, 2010; Fishman, 2012).

The fourth element is *social conditions*. Most of developing countries have a considerable inequality gap. This gap represents lack of access to services and jobs in megacities. In this context, car use represents a pattern that excludes the poorest to the services offered by the city. Exclusive ways of transportation may generate social unrest and protest, which may polarize society. Providing more inclusive ways of transportation should be a must,

but this may not happen.

A fifth concern is *governance*. Should the approach be bottom-up or top-down? Evidence suggests that bottom-up approaches may seem a more legitimate process for urban inhabitants than top-down approaches. However, policies push-and-pull policies may be encouraged from higher institutional levels (.e.g taxes to fossil fuels or road access). In a hypothetical scenario, localities may be in favor of car use as a medium of transportation, but central government may be encouraging public transportation to increase efficiency of mobility modes. Additionally, in developing countries institutions may deal with powerful actors operating against the law or using nepotistic political structures (Coy and Töpfer, 2014; Werhmann, 2014). Reducing the power of these structures may involve a central effort which may only be done by powerful-central governments. Also, public debate seems necessary for legitimacy and is essential in democratic processes. However, this debate may not occur, especially in countries with a short tradition of public participation and democratic values (Glaister and Box, 2014; UITP, 2011; Cascetta, 2014; Forum for the Future, 2010).

A sixth uncertainty is *land use policies and urban forms*. Land use may be efficiently used if mixed land-use and high densities are established. However, this may not happen in areas out of control of planning strategies in developing megacities. Cities also need to manage high levels of spatial inequity and segregation, which rely on specific urban forms. Multi-modal mobility need certain physical characteristics that require adaptation of urban forms. However, this is not happening in all cities and may limit public transportation mobility. Moreover, citizens' housing preference in suburbs or downtowns influence price of land and mobility services provided (Cascetta, 2014; Forum for the Future, 2010).

Business models and strategies are under uncertainty, as it is still unclear how companies should address new mobility services. No clear incentives for business innovation has been established in the majority of megacities. Business models are unclear: Does companies need to target services to cities, customers, or third-party companies offering mobility services? How do prices should be established? Is it advisable to monopolize services to guarantee economies of scale or enhance competition? These are some of the questions making business in urban mobility uncertain in the following years. Business strategies as shared logistics and e-commerce may reduce mobility needs (Fishman, 2012; UITP, 2011).

Eighth, *regulations* play a key role, by generating incentives and limitations to specific forms of mobility. However, it is impossible to forecast scenarios in how incentives on fuels, transportation, and business models are going to look like in the following decades. An inadequate innovation regulatory framework hinder innovation, or may not even consider radical innovations in transport. Especially when considering about smart solutions to mobility, liability and legal responsibility legal frameworks are still in an emergent face, without a clear direction (Glaister and Box, 2014; Fishman, 2012; UITP, 2011).

A ninth element is *global economic growth*. Countries are facing difficulties to have an economic growth in accordance with its needs. Moreover, in the last years it has been experienced several economic crises that have impacted long-term economic recovery of

countries. Cities may become highly volatile places, especially if this economic growth has an impact in their coordination capacity described by Sassen (2002). Global growth may not be sufficient to deal with economic inequalities in the developing world (Cascetta, 2014; Forum for the Future, 2010). Global economic growth can impact the access to private modes and greener modes of transportation. Higher income can also increase access to greener motorized ways of transport (i.e. changing and old pollutant car to a mix-fuel car), and in megacities is correlated with car ownership. As soon as people have an access to car, they will acquire it.

Finally, Information Technology is essential in future scenarios. It is certain that *IT solutions* will play a bigger role in future mobility, but the *how* is still unclear. Services can just only be integrated in platforms enhancing smart decisions of transportation. But IT can also foster other innovation in the field of supply and demand management, such as in the field of predictive analytics or process and data mining. The ICT gap in the developing world is closing more quickly that physical forms of mobility (WBCSD, 2007). If this trend continues, IT may offer solutions that transport technology may not be able to offer (Glaister and Box, 2014; Forum for the Future, 2010; Fishman, 2012; Borghuis, 2013).

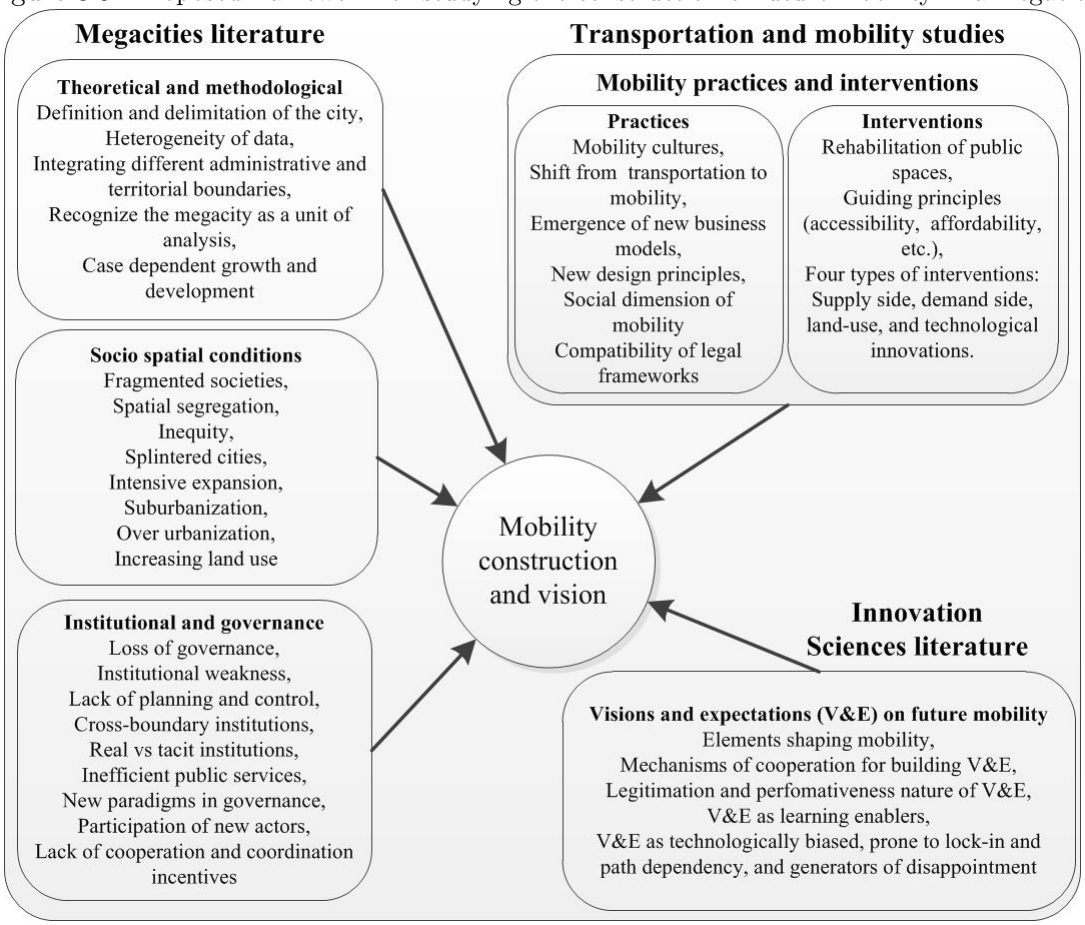
As this section showed, visions and expectations may be established to enhance legitimization, access to resources, and evaluation of policy interventions. They may be beneficial in multiple ways, but it can also generate negative effects is inappropriately established. Differentiating between probable and possible futures is also a relevant point to consider, as the probability is largely shaped by the fifteen elements described in the second part of this section. To finalize this chapter, the proposed framework is presented in the following pages.

3.7 Summing up: Proposed framework

As it was mentioned previously, a framework was developed for analyzing mobility in megacities. This framework is intended to integrate the findings of literature review. It comprises five dimensions: (1) Theoretical and methodological (2) Institutions and governance, (3) Socio-spatial dynamics, (4) mobility practices and interventions, and (5) Visions, expectations and future outcomes on mobility. Each one corresponds to one section in this chapter. Figure 3.9 shows the complete framework. As can be seen, out of the five dimensions, the first three correspond to findings in the megacities literature, the fourth to transportation and mobility studies, and the last one to innovation sciences literature.

The **theoretical and methodological dimension** contains the findings of section 3.2. It was found that one of the major issues in analyzing megacities is that sources of data are heterogeneous and diverse. Methodologically, it is suggested to consider megacity dynamics outside traditional administrative and territorial boundaries, and to include the interaction between a megacity and its surroundings. This difficulty in delimiting the city comes with heterogeneous data, which may provide misleading results. These issues are also present

Figure 3.9: Proposed framework for studying the construction of future mobility in a megacity



in primary documents, as it will be observe in our case study. The second element in this dimension is related to the characteristics and conditions of megacities. A megacity should be understood as a basic unit of analysis, and should not be compared with metropolitan areas or global cities. Moreover, each megacity growth is the result of different historical circumstances and levels of development. Moreover, geographical or environmental conditions which are unique should be included in this dimension. A final consideration are phenomena present in the case study but with no relation to megacities dynamics. For example, level of urbanization, migration, or dependence on international institutions. All these specificities cannot be enlisted in advance, as these are highly dependent on which city is studied.

The second dimension is **governance**. Governance is highly dependent in historical context and institutional arrangements of the case study. Two major elements should be included in an analysis of governance: How is the city really governed and under which legal, administrative, and institutional frameworks does this occurs? Understanding governance requires to map formal and informal mechanisms shaping institutional practices in

the megacity. Apart from established governance roles (such as majors, ministries, etc.), it is proposed to find informal actors with negotiation and mobilization power in these settlements, as para-legal organizations or groups. The emergence of these actors will be crucial for understanding our case study. Moreover, it should be complemented by analyzing the cooperation and confrontation mechanisms they use in megacities. For example, para-legal institutions may cooperate with formal actors by patronage systems, corruption, discretionality or nepotism. As an outcome, it is possible to distinguish between *de iure* and *de facto* governance. It should also be considered the novel institutional frameworks of cooperation. This element refers to the evaluation of mechanisms of metropolization and the emergence of new actors. On metropolization mechanisms, it is necessary to evaluate if these are general or topic-specific, as well as if virtual levels of government or inter-municipal or state coordination are established. Considering the emergent shift from government to governance, new actors in policy making should be included in the analysis, such as civil society, novel financing actors for infrastructure development, or organized interests.

The third dimension corresponds to the **socio-spatial conditions** in megacities. It considers the existing built environment and spatial conditions of megacities. This category encompasses the geographical development and consequent *lock-in* of spatial forms. Cities are 'trapped' in spatial patterns difficult to reverse and which condition the social interaction, economic activity and infrastructure development. It also refers to the processes happening in the city and its surroundings, including people and goods circulation, patterns of movement, environmental and infrastructural stress, among others. Moreover, it is important to mention that cities can reproduce, via their built environment, social dynamics and segregation between groups inside the city.

The fourth dimension corresponds to the **mobility practices and interventions**. It is necessary to differentiate between (1) practices and (2) interventions in this domain. (1) Practices encompass urban mobility cultures, path dependent structures and inertia, development trends, and available technology. Urban mobility cultures, as described by Kuhnimhof and Wulfhorst (2013), refer to the tacit and explicit elements shaping how people mobilize in a city. Path dependent structures and inertia relate past policy interventions with present mobility. Development trends refer to aspirational and economic constraints in making mobility practices. As it was mentioned earlier, automobility is still an aspirational component in the developing world, but requires increasing incomes to be sustained. In this respect, it is necessary to contextualize user preferences in present and future mobility. Finally, it also should be considered the available technology at present time in megacities.

Next to mobility practices, (2) mobility interventions should be evaluated. On one hand, it should be evaluated if the interventions are sustainable. For example, by considering if the guiding principles of affordability, accessibility, acceptability, and availability are taken into account, or if reduction in emissions is being considered. The sustainable paradigm may not be compatible with development trends. In addition to evaluate the sustainability of mobility interventions, it is appropriate to evaluate what type of interventions are: Are they supply or demand oriented, related to land use and inter modality, or rely on technological innovations? As it was mentioned earlier, each type has its own limitations.

The first four dimensions refers to past and present actions. However, a final dimension should be considered: **Future outcomes, visions and expectations**. How mobility is envisioned in large metropolis? It may be appropriate to start individual and collective visions on future mobility, and ask if they are compatible and how they influence each other. Moreover, this dimension also includes the analysis of collaboration platforms in which visions and expectations are negotiated and developed. These platforms generate collective visions and expectations (according to the definition stated on section 3.6). Moreover, the development of expectations generates specifications, performance and functions which can be later used for learning and rationalize expected outcomes, as well as for dealing with the uncertain factors described in figure 3.8. However, mapping the cooperation mechanisms for the construction of visions and expectations may not be enough. It is also suggested to link the cooperation outcomes and proposed visions/expectations with the uncertain factors described on the previous section (which are condensed in figure 3.8). Is it possible to observe strategies to cope with the certain and uncertain future events? Moreover, how are the perceiving future outcomes? These questions may be appropriate for developing recommendations about strategies on envisioning of megacities mobility.

Chapter 4

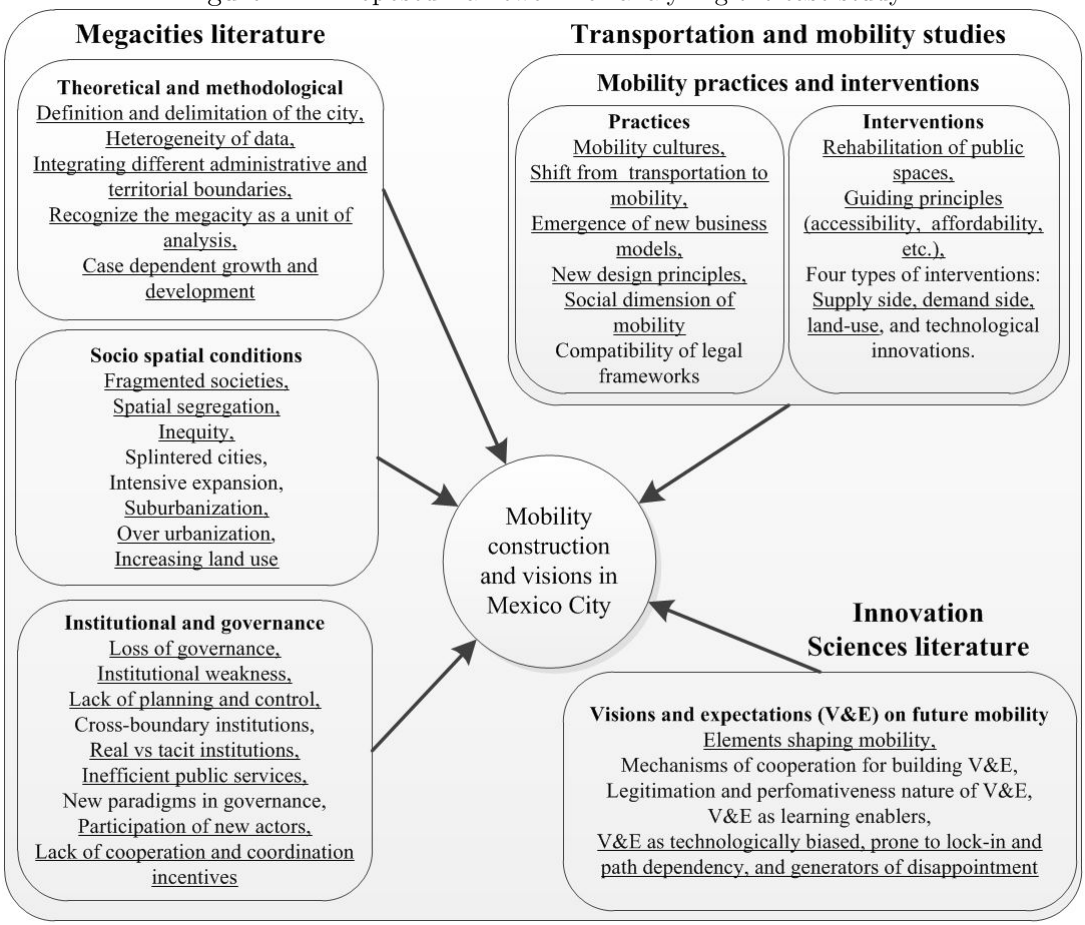
Mexico City: Case study

Mobility in Mexico City megacity is highly complex: It is a 22 million inhabitants urban settlement sprawled in three states and more than seventy municipalities, without effective mechanisms of metropolitan governance and coordination, and a weak rule of the law and institutions (as suggested by interviewees, see Negrete Salas, 2010). The city is a place of multiple, and even contradicting, socio-economic realities that shape every day mobility patterns and limit integrated transportation solutions to mobilize the large proportion of commuters traveling large distances to access the educational, commercial, and jobs that the city offers. Moreover, the city transportation dominant designs and strategies have shifted over time, reducing long-term visions and strategies that a city of such large proportions needs to fulfill. This can be observed in multiple reconfigurations of urban space and mobility options in the last fifty years in the city.

In this context, recent strategies to enhance more inclusive and sustainable mobility interventions have been pursued. As this chapter shows, these interventions have been highly contested by multiple actors in the megacity, and their effects, limited. The lack of evaluation and coordination mechanisms to define future alternatives to mobility are limited or non-existent, hindering the potential of transportation investments. However, certain elements were found during this research pointing out to a slow, but novel shift, to sustainable solutions in the megacity which may contribute to provide an inclusive mobility regime. Nonetheless, the incentives to encourage mobility in the megacity differ from the literature available in megacities mobility, and will be discussed later in this chapter.

Using primary source documents and interviews, I attempt to provide a general overview of how the mobility in Mexico City is being constructed since 2007. To structure the findings, this chapter is divided into sections corresponding to each of the dimensions in the framework proposed in the section 3.7. The framework can be observed in the figure 4.1. The most relevant features found in each dimension are underlined, as can be seen in the figure. The following sections the insights and findings are discussed.

Figure 4.1: Proposed framework for analyzing the case study



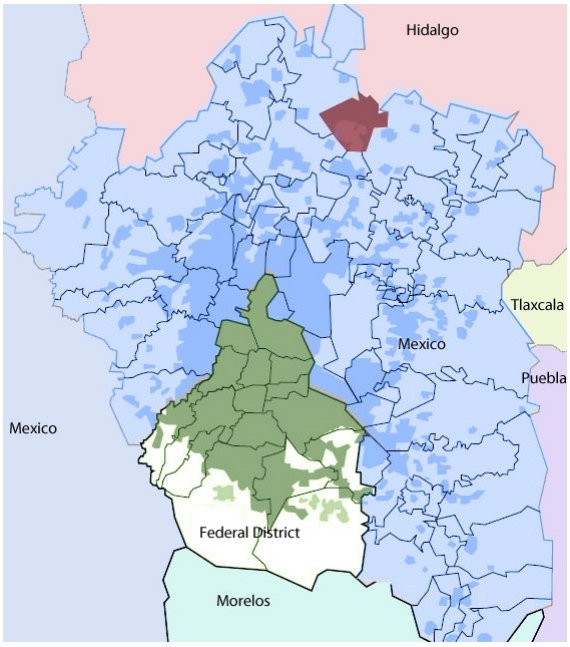
4.1 Theoretical and methodological dimension

Mexico City, by all perspectives, can be considered a megacity. With almost twenty-two million inhabitants and an extension of 4,250km^2 (The World Bank, 2011), the city faces important sustainability challenges not just in the field of mobility, but also water, waste, among others. Its metropolitan area is formally composed by 76 municipalities, from which 52 are considered to be totally integrated to the urban dynamics of Mexico City (INEGI, 2005). It is administratively divided in one capital district with semi-autonomous functions (Federal District (DF)), one state (State of Mexico)[1] and the municipality of Tizayuca, in the state of Hidalgo. In addition, the peripheral cities of Puebla, Toluca, Querétaro and Cuernavaca have a constant interaction and are influenced by the megalopolis dynamics (Garza, 2010). Figure 4.1 shows the dimension of Mexico City metropolitan area encompassing the Federal District (green), the State of Mexico (blue) and Tizayuca (red). The

[1]Mexico can refer either to the country (México) or a state of the country which is part of Mexico City megacity (State of Mexico). To avoid any ambiguity, I will always use 'federal or national government' to refer to the country, while 'Mexico' or 'State of Mexico' to talk about the state.

state of Tlaxcala, Puebla and Morelos are also shown.

Figure 4.2: Extension of Mexico City Metropolitan Area (source: edited from Eibenschutz Hartman (2010).



Mexico City is still analyzed as a metropolitan area and not as a megacity. Not surprisingly, and according to megacities conditions mentioned in the previous chapter, a reduced number of actors understand Mexico City as a megacity. Formally, it is considered a metropolitan area for the Mexican statistics institute, INEGI. Most data available still do not target the megacity as a unit of analysis. Public institutions also consider Mexico City as metropolitan area. The concept of megacity is used more frequently in consultancy and business.

Considering Mexico City as a metropolitan area rather than a megalopolis simplifies a complex reality of the urban area. Metropolitanization criterion delimits a city based on the functional and geographic interaction between central and external municipalities (INEGI, 2005). This oversimplification puts 'on the same box' diverse realities, such as Ciudad Juárez (1.2 million inhabitants, one municipality, and integrated with El Paso, Texas), Ocotlán (124 thousand inhabitants and two municipalities in one state), and Mexico City (21 million inhabitants and extended through 76 municipalities in three states). Considering that this delimitation is also used by the National Statistics Institute (INEGI), it is an alarming aspect that do not give the proper dimension of the megacity.

Not considering the megacity as unit of analysis also generates inconsistencies of data. In the metropolitan commissions, only two out of the three states comprising the metropolitan zone are included; while in the megalopolis commissions, the three states plus Tlaxcala, Puebla and Morelos participate. However, the origin-destiny survey only considers 52 out

of the 76 municipalities and boroughs in the urban settlement. According to an interviewee working on geographical urban systems, the data used for the survey does not match with the basic district levels used in national statistics, even though the same institute is responsible for both sources of data. In short, matching data, metropolitan mechanisms, and unit of analysis is a complete disorder. However, this is not a surprising finding based on the reviewed literature about megacities.

Moreover, we should consider the specific circumstances in which Mexico City developed. Mexico City grew in a small period of time, primarily after the 1950s. In 1950, only counted with 3 million inhabitants (CONAPO, 2010). The growth in the following decades is primarily explained by internal migration, as the city became the industrial, economic, and financial heart of Mexico. However, since the 1980s the spatial and demographic expansion decelerated, due to complex factors, including economic crises, decentralization and de-industrialization (Hibler, 2012).

Mexico City is located in a basin 2,240 Meters above sea level (MAMSL), which is composed by four valleys (Mexico, Cuautitlán, Apan and Tizayuca), and is surrounded by mountains with an average height of 3,200 MAMSL. These geographical conditions have a negative effect on the environment. Combustion engines are less efficient and generate more pollutants, and oxygen levels are 23% less than at sea level (Soto, 2000). The surrounding mountains do not allow the dispersion of the air pollution, and facilitate thermal inversions that concentrate pollution on the basin. Furthermore, Mexico City is built over a diverse types of terrain, from lacustrine to volcanic rock, which makes difficult to provide infrastructure.

In the last decade of the twentieth century, the multi-dimensional and complex problems that Mexico faced became evident. In 1992, the United Nations (UN) declared Mexico City the most polluted city on the world (O'Connor, 2010); the lack of access to transportation in the Mexico City Metropolitan Zone (ZMCM) became evident, and other indicators reflected the reducing quality of life went up. Other circumstances, such as recurrent economic crises, environmental unsustainable practices, and the process of democratization shacked the foundations of urban development in Mexico City.

4.2 Institutional and governance dimension

A first element to consider in megacities is the institutional settings. As described on the framework (figure 3.9), megacities face in the institutional dimension several constrains: Loss of governance and control, institutional weakness, lack of planning, lack of cooperation and coordination incentives; while, at the same time, need to deal with cross boundary institutions, the emergence of new actors and paradigms in governance, and interaction between real (*de facto*) and formal (*de iure*) institutions. In this dimension, most of the characteristics where present in the case study.

The available literature targets these characteristics, but does not stress sufficiently the lack of integrated and cross-departmentalized view of the megacity on mobility. Institutionally, Mexico City still has a departmentalized view on mobility and governance. It appears that no incentives are present to allow cooperation among and between levels of governments and ministries. First, mobility planning, construction, and maintenance are responsibility of different ministries, while also it depends on the type of road, as some of them depend on the state or local government. A scholar working on geographical planning mentioned that "when considering sustainable mobility [...] the Ministry of Mobility (SEMOVI) is in charge of planning, but the construction and operation is a competence of the Ministry of Public Works (SOBSE). However, they are only in competency of primary roadways [...] while secondary and tertiary roads are in charge of local governments [...] How can be achieve a reasonable outcome with this fragmentation? This institutional fragmentation is one of the transversal issues to operate in efficient way".

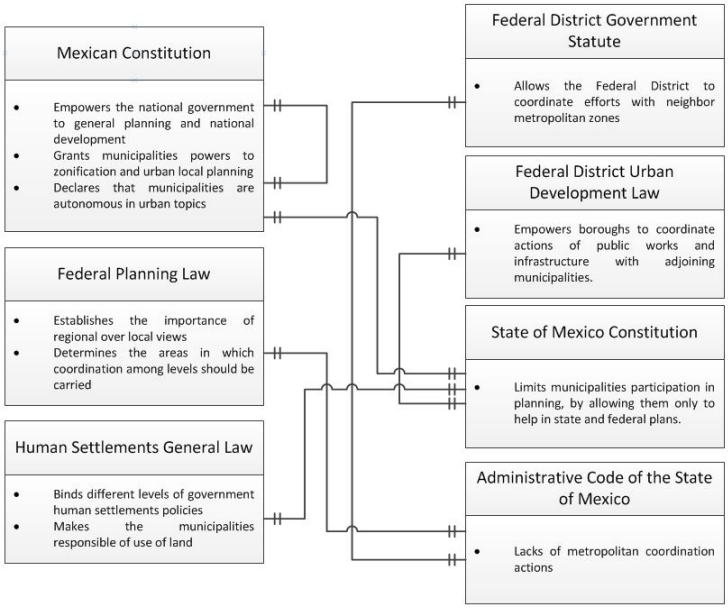
This fragmentation is not only present in the mobility domain, but it is a major concern in all policies which require coordination among different levels of government. According to the Federal Constitution, the federal government is empowered to establish a national development plan[2]. However, municipalities have a decisive role in urban planning and land use. In addition, the legal frameworks between the State of Mexico and the Federal District are not harmonized. This disorder grants boroughs in the Federal District coordination capacity with their State of Mexico counterparts, but municipalities in the State of Mexico cannot negotiate with Federal District boroughs. State of Mexico municipalities' incapacity is in harmony with state legislation but in clear opposition to federal ruling. Figure 4.3 shows the legal frameworks regulating metropolitan governance (based on Hernández and Miranda, 2009), and highlights the incompatibility of the existing frameworks. Adding to this topic, an interviewee commented "[metropolitan governance] is a real ideological and legislative challenge. The constitution stipulate that no level of government can be created between local and state level.[3]". "In this article [115 of the Federal Constitution, prohibiting an intermediary government between local and state level] we have an impediment to propose a metropolitan or megalopolitan government. [...] First we need to establish legal faculties [...] to think on a later stage about it [metropolitan of megalopolitan institutions]".

However, it is necessary to distinguish between legal frameworks for cooperation and megalopolitan political incentives. Legally, certain mechanisms for cooperation are present, such as the metropolitan commissions of the established duty of the executive branch of the government to collaborate with state and local governments. Moreover, a large number of mechanisms for financing mobility projects are present in the country, encompassing from large metropolitan projects (*Fondo metropolitano*), to road paving (*Fondo de pavimentación a municipios*), and social development related infrastructure (*Fondo de aportaciones para la infraestructura social*) (for a complete list, see ITDP, 2012). However, many interviewees

[2] Article 26 of the Federal Constitution.

[3] Article 115, I. of the Federal Constitution: "Each Municipality shall be governed by a Municipal Council [...] The jurisdiction that this Constitution grants to Municipal government shall be exercised by the Municipal Council exclusively and **there shall be no intermediate authority between the latter and the government of the State**

Figure 4.3: Incoherence between legal frameworks (source: own, based on Hernández and Miranda (2009)).



suggested that the most relevant barriers are political, rather than legal or institutional.

An interviewee with expertise on public policy and urban sociology suggested that "local bastions of power can do more than an integral territorial [and mobility] vision". This remark is in accordance with other interviewees perspectives, stressing that political rationales are above technical rationales, limiting the possibility of a fully integrated metropolitan mobility. Regarding mobility integration in the metropolitan area, "technically, it is possible [to integrate in short term], but not politically", and interviewee working for a international mobility organization suggested. Cooperation among different levels of government are hindered by different structures in each of the regions. Mexico City, as stated by another respondent: "[Mexico City] has a political structure hindering sustainable mobility [...] the State of Mexico has a different perspective in comparison to the Federal District. And as their governments are from different political parties, cooperation is complicated".

For example, in 2006 the candidate from the right wing party Partido Acción Nacional (PAN), Felipe Calderón, and the left wing candidate from the left-wing party Partido de la Revolución Democrática (PRD), Marcelo Ebrard, won the presidential and Federal District major elections, respectively. However, the presidential candidate from the PRD lost by less than 0.5% of the votes, and argued that the electoral process suffered from large inconsistencies and unfair competition. As an outcome, Ebrard did not recognize the presidential elections results and cooperation between both levels of government weakened for the following years. In addition, the State of Mexico governor came from other political party, the Partido Revolucionario Institucional (PRI). This governor, Enrique Peña Nieto, since the beginning of his term (2005) promoted himself as a candidate for the 2012 presi-

dential elections, in which Ebrard also participated[4]. In this context, any cooperation may be exploited by a political party, promoting competition rather than collaboration.

In other words, the major challenge is political willingness and coordination. Moreover, some interviewees suggested that most proposed solutions do not consider the lack of incentives for cooperation among different levels of government. "The mobility projects are technically appropriate, but when they are in hands of decision makers [...] decisions are irrationally taken. This is a complex reality that no technical report is able to show", an interviewee commented. In fact, until 1991, no metropolitan services were shared among the two governments. That year, the first subway line (A) which crossed both states was inaugurated. But this line is primarily localized on a federal way that delimits. In *stricto sensu*, only three out of the ten stations are localized in the State of Mexico territory. Until today, the only two metropolitan projects after line A have been line B, which is fully integrated to the subway network; and a suburban train. However, the suburban train project was funded and constructed by the federal government.

Another area which was found in the case study was the weak legal frameworks in which mobility operates. It was found that it occurs in two ways: On one hand, the emergence of para-legal development and provision of services, and by the incapacity of the state to make law applicable to customers and providers of transportation services. Legally, all rules of operation are established, but as an interviewee commented: "it is not only about legal framework, but also the application of the law". This may not be present in all megacities, but rather indicate that Mexico City, based on the categorization of Priester et al. (2013) and Wulfhorst et al. (2013) (see section 3.5), has a para-transit mobility culture.[5]

The institutional and legal weaknesses are not only for the mobility sector, but also applicable to other domains, especially housing. Sixty percent of the urban growth in Mexico City has been done illegally (Valenzuela-Aguilera, 2011). By illegal, I refer to informal settlements that were not planned, developed, and neither authorized. In large parts of the city, people settle in terrains, build their own housing, and on a later stage they legalize it. The most emblematic form of illegal settlements are called *paracaidistas*. This word, literally translated to English as 'paratroopers', are people who occupy land; and the same occupiers coordinate the division of land among the terrains they lodge. This action is illegal in all respects, as some of the land is in conservation areas or in terrains from which a legal demand is being settled. According to the Social Development Ministry, there are three ways in which the division of land can be illegally distributed: By fractioning land without a legal authorization, by offering land without the services that are required by law, and by fractioning land without being the legal owner of these terrains (SEDESOL, 2015). "As many people do not have access to [land and housing] markets [...] you have a city like this, in which housing is built irregularly", an interviewee, planner by profession, commented.

[4]He was not elected candidate for the PRD, but ran on the primary elections.

[5]According to the definition described in chapter 3, it has semi-formal and semi-organized transportation systems, mainly as the result of the governmental incapacity to provide reliable transportation means. In comparison to transit cities, public transport may be deficient and chaotic; car ownership is relatively low.

This condition of weakness may indicate a reinforcement between informality in different sectors. As housing is unprovided, people may settle in terrains without adequate access to services such as water or mobility. On a later stage, incentives are created for fulfilling population needs by informal modes of transportation. However, these services need to be coordinated and self-governed, mostly by clientelist structures. These structures and their leaders gain enough political power to negotiate (or skip) the law with formal institutions. According to an interviewee coordinating a sustainable urban development research program, "these leaders, on a later stage, became representatives and manage illegal invasions of land [...]". In the mobility field, a widely known case is a taxi organization called *Taxis Pantera*. This organization allows, according to an opposition political party in the Federal District (PAN), thirty thousand taxi cabs from this organization can operate without fulfilling the legal requirements (Radio Fórmula, 2015). Moreover, this organization has been widely known for negotiating their support with political parties and governmental institutions in exchange of exemptions and favorable treatment.

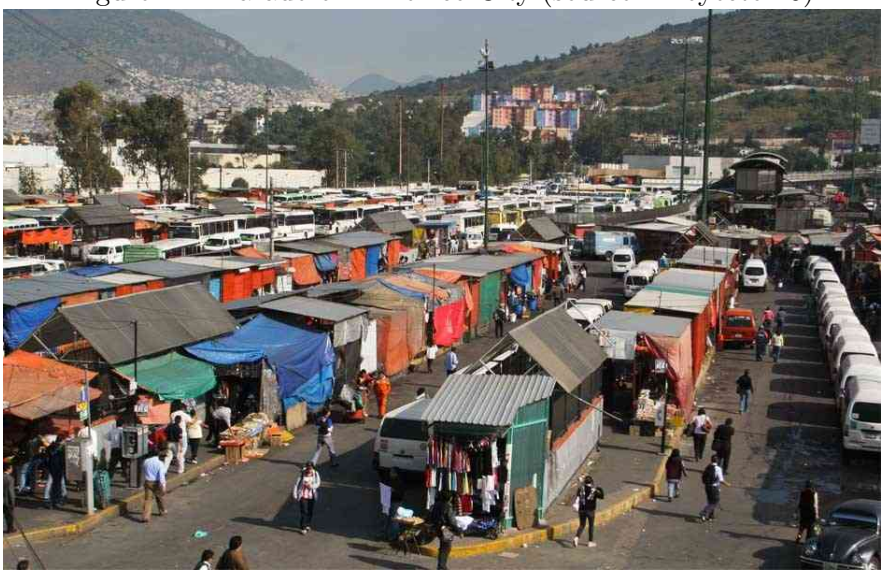
Another example of how informal institutions have a big role in Mexico City mobility is the weak control of the public space surrounding transportation areas. Considering the stress which has been given to rehabilitation of public spaces for inter-modal mobility, this should be a big concern for implementing transportation services in the Mexican capital. For example, Mexican *paraderos*[6] are taken by organized informal groups. Figure 4.2 shows an example of how public spaces for transportation are taken by informal activities of all types. It is possible to find any type of product in this area: Food, electronics, books, copyrighted materials, and transportation alternatives. There is no control in what is happening there. An interviewee (planner by profession) commented about a paradero in Mexico (Observatorio): "What is happening there? Where is the control? It can be either an [illegal] agreement of its director or his superior, or because they fear about their lives. It is a permissiveness that allows this type of activities [...] civil servants, representatives, deputies... they are [all] colluded".

However, it is necessary to stress that this weakness is not class-binding. Real-state developers and high-income individuals can also take advantage of this. An interviewee, gave a complementary perspective on this development, mentioning that real estate developers "are not illegal [...] [they develop] on the fringe of the law". Moreover, it has been documented several cases of illegal invasion in high value lands to build high income residences, such as in Chapultepec, the biggest public park in Mexico City. By the intrinsic relationship between land use and transportation, it is evident that no long-term controlled urban mobility planning can take effect. An interviewee commented, "this [uncontrolled expansion] results in any mobility project failing, as you first build and then develop [services]".

The state has generated mechanisms to cope with this increasing informality, by legalizing it at later stages. All interviewees place informality and a weak legal framework as a source of unplanned growth and unsustainable mobility in Mexico City. The participant from a Civil Society Organization (CSO) working on land use, commented: "The local

[6] Multi-modal exchange bus stops, which can also include other modes of transportation.

Figure 4.4: Paradero in Mexico City (source: Proyecto 40)



assembly is entitled to regularize finished works without legal license. Therefore, you can build gigantic buildings without any type of [urban] vision, and make the assembly regularize it without any cost". Moreover, this regularization pattern is also not only in land ownership, but also basic services. In the case of two neighborhoods in the State of Mexico, the Ministry of Social Development (SEDESOL) found that as people start inhabiting these areas, governmental services start to be provided; as in the case of Valle de Chalco, in which in only 10 years after the illegal settlements started, almost 100% and 20% of the houses had access to electricity and water, respectively (SEDESOL, 2015).

On the governance of Mexico City

The institutional and legal weaknesses in the case study have been already described, but no reference has been made over a wider, megalopolitan governance. How can we think about megalopolitan governance in such a context? Formally, Mexico City has cooperation mechanisms among different levels of government and administrative boundaries. However, by most interviewees answers, there is a large path to take to make these institutions work in practice and have a direct influence in the development of Mexico City.

Certain Mexican metropolitan institutions have been built over the past decades, especially after the evident incapacity of institutions to deal with delicate topics such as water, congestion, and pollution. Mexico had limited experience in the development of effective metropolitan strategies (Negrete Salas, 2010), and present metropolitan agencies coordinating development seem ineffective (Mario Molina Center, 2013). Before the 1990s, few attempts were made to coordinate the metropolitan governance (for a overall history of metropolitan governance see López Rangel, 2010).This is surprising considering

the size and importance of this city to the national economy. Since 1992, a number of metropolitan commissions were established to coordinate policies between different levels of government in ZMCM, in which the State of Mexico, Federal District, and the national government are involved (Comisión Ambiental Metropolitana, 2010). These include the Metropolitan Area Commission (CAM), the Metropolitan Environmental Commission (CMA), the Metropolitan Transport Commission (COMETRAVI), and the Metropolitan Commission on Human Settlements (COMETAH) (Diario Oficial de la Federación, 1999). The COMETAH is the responsible organism for coordinating actions between different levels of government. However, as a interviewee commented: "The environmental metropolitan commission, which was responsible of air quality is the only one that worked. All the other commissions are dead". A participant working on public policy consultancy commented that "unfortunately [the metropolitan governance mechanisms] reproduces old vices. There are no incentives to produce high quality sustainability mobility, and they [mechanisms] are short minded".

The expected results from these commissions were disappointing. Except for air quality commission, their results have had limited effect in the development of metropolitan strategies. For example, in the case of development of airport infrastructure in Mexico City their recommendations were never taken into account (Rodríguez Rodríguez and Miranda Guerrero, 2006). This failure can be explained by the conflicting and contested visions in metropolitan management (Negrete Salas, 2010), and the non-binding nature of the commission measures. Institutionally, metropolitan commissions exist, but in practice they do not have a real influence in city governance. How can this phenomenon be explained? Sangmpam (2007) have claimed that too much emphasis and hope has been given to institutions and good governance without focusing on political shapes. Moreover, approaches to institutionalism in Mexico and Latin America have overestimated the consequences of formal processes (i.e. elections and parliaments) while underestimating role of the state and interest groups (Weyland, 2002).

Consequently, paying too much attention in formal practices and institutions may only reproduce a false debate about institutional performance. Analysing decisions and strategies in the field of politics may give a better insight about what is happening in Mexico City. First, institutional inertia has limited the capacity of agreements of different levels of government and different political parties in contemporary Mexican democracy. In the case of Mexico City, the Federal District is governed since 1997 by the left-wing political party PRD, while the State of Mexico and Hidalgo has been held by the PRI, which has ruled both states since the mid 1930s. Moreover, during the period 2000-2012, the federal government was held by the right-wing party PAN.

All interviewees in Mexico City agreed that a metropolitan government was necessary to solve the problems of the megacity. An interviewee with expertise in governance, commented "as we do not have a city or metropolitan government, commissions are a possible formula to deal with the problems of metropolitan dimension". Moreover, it is not the inefficiency of these commissions the only topic which is of concern for the interviewees. The current metropolitan governance mechanisms lack of transparency and accountability, and they do

not consider the true dynamics at the local level.

Without a functional metropolitan governance and coordination mechanisms, thinking about a mobility policy which encompass all the megalopolitan region seems improbable in the following years. These mechanisms have been already addressed in current literature in metropolitan governance, but are not taken place in the case study. The construction of future mobility in Mexico City may come from state and local level policies which may offer suboptimal mobility solutions in urban areas, but which are more likely to occur as incentives and legal framework are not aligned between different levels and administrative boundaries of Mexico City.

Another important element to be considered -from the current literature- is the shift from government to governance and the participation of new actors in mobility policy. This is also present in the case study. However, it is still not evident if the governmental institutions are doing adequate networking with relevant bottom-up stakeholders. It seems that the process of construction of mobility is a contested process among civil society organizations. Two of the interviewees, which work in organizations working closely in policy, seems to have a more favorable vision on the inclusion of these organizations in comparison with other interviewees whom have a negative perspective on Mexico City mobility governance.

The success of certain mobility interventions as the public bicycle scheme Ecobici relied heavily on the participation of civil society and non-governmental organizations. An interviewee suggested that an essential role of novel organizations is for breaking the inertia and develop the complete ecosystem for new mobility alternatives: From business models to technical details. An interviewee commented "We [as an organization] were completely and actively involved in the first stage of Ecobici [...] But our team has worked before for a long time in this respect", and added "the challenge of innovating comes from the civil society. How you can reduce political costs, increase benefits, reduce costs (*sic*), and break the critical mass of inertia".

It is not surprising, that under this paradigm, many organizations have worked closely with the government to shift towards novel alternative of transportation. From encouraging new business models (such as Ecobici or BRT Metrobús), to more simple and basic solutions. "At the moment, there are international standards for bicycle sheds in multi-modal transfer centers" an interviewee working in an international transport organization stressed, "but the people directing these centers do not have the know-how to build these sheds". Another interviewee, from a research university, commented that their duty with state and federal government is complementary: Offering the knowledge that is not available in governmental institutions. Suggesting that local governments have frequently inaccurate and outdated information about the current built environment, the participant suggested: "We bring the analysis and knowledge [...] and novel methodologies to analyze how people move in the city that the government does not have". Moreover, another interviewee commented that they fulfill certain tasks which are essential but no governmental institution offers, such as data and indexes.

However, other interviewees were more cautious in referring to the collaboration among the urban institutions and new actors. The novelty and innovation brought by participating organizations it at the expense of legitimatizing mobility interventions which are partially successful, such as Guadalajara[7] *Macrobús* and the State of Mexico *Mexibús* BRTs. "Some organizations participated in the Mexibús, and at the end, an unfinished product is given to commuters". A public policy consultant commented "It is one of the biggest criticism I have against them [the organizations collaborating in mobility projects]. [...] They become, involuntarily, into accomplices of perpetuating a mediocre mobility policy that do not consider the specificities of the metropolitan area". Transport infrastructure, such as he subway (line 12), the Mexibús, or the Suburban rail are clear examples of this complicity. At the moment of their inauguration, they were not finished. In the case of the subway line, half of the stations are not operating since 2014 (two years after its inauguration), as ground subsidence is present.

A distinction should be made between organizations that transfer *know how* to governmental institutions and other type of organizations, which represents grassroots and local citizens. For some interviewees, mobility interventions have not been fully legitimized in civil society, and seem and imposition rather than a consensual agreement. "Local governments have not been able to make the mobility discourse attractive to the citizens". Additionally, some other organizations have been working, paradoxically, to make governmental institutions work according to law. "Our organization" an interviewee stated, "is working for generating capabilities in poor areas [...] now, when receiving a project brief, organizations in poor areas are able to have and informed decision". Recalling an experience in the poor east side of Mexico City, the participant commented that even BRT lanes were intended to be built without meeting the international standards for operation. The participant added: "When we had an interview with the local assembly (DF) president, we were asked: 'What do you want?'. We answered: 'legal certainty in land use'. And he replied 'that is impossible. Ask another thing.' We [the activists attending the meeting] just laughed, and he continued 'No, really. You are asking for an impossible'". "The government is not comfortable with dealing with a proactive society", the interviewee added.

Other relevant actors are, of course, those who finance the mobility interventions. Two major sources of financiers can be observed: Governmental institutions and international actors. Governmental institutions, primarily reproduce the vices mentioned above: Short-term visions, limited by political rivalries, and without coordination incentives. Few exceptions can be observed (as the Suburban Rail Buenavista-Lecheria), but with limited impact on mobility. Governmental programs in Mexico are primarily targeted to be fulfilled during each administration period. There are few exemptions of mobility programs encompassing more than six years, but a large part of these programs have not taken place according to initial targets and time frames. For example, the master plan of Mexico City's subway envisioned 232 km and 12 lines by 2003 (Sistema de Transporte Colectivo, 2014), but by 2007, only 11 lines and 200 km were in operation. This under construction of public transportation is also present in light rails, BRTs and other infrastructure upgrades were not

[7]The third largest city in Mexico.

completed.

However, international actors apparently seem to play a higher role in the development of transportation investment. Institutions such as the World Bank finance or reward successful mobility projects, such as upgrade or deployment of new infrastructure. However, a negative incentive occurs with this investment option, as funded organizations have limited capacity to modify and adapt their projects. "The international funders give the money and set their own rules. And they want to hear something. And it's your problem, but you need to tell what these financiers want to hear. You have little room for manoeuvre", an interviewee commented, and added "mobility solutions are not contextualized. BRT solutions are sold *as pancakes*, even though they may not be the suitable solution for the local context".

Another relevant financier, mostly related to soft infrastructure, is developed countries development agencies and embassies. Most of the policy documents available by think tanks or organizations working in transportation policy have collaborated with these institutions (i.e. ITDP, Embarq, Mario Molina Centre). "The trusts of international embassies allow to make ONG work and develop projects". But it is not only the financial support, but rather knowledge transfer among different countries. "These countries have faced similar circumstances before [...] and we can learn from them", an interviewee commented. Trusts and funds from multiple sources seem to have a direct impact in the creation of know-how in developing countries megacities.

Financiers bring not only money, but also discourses in how mobility should be created. This field has been widely understudied and seem a vital factor in understanding why cities are shifting to more integrated, sustainable mobility solutions in recent years. Discourses come along with financial resources to implement transport interventions. According to an interviewee, and in accordance with previous urban neo-marxist literature, affordability, sustainability, and accessibility have a strong relation with competitiveness. "As long as the city majors are pressed by a competitiveness discourse, they will still we worried about moving more people and in a better way", an interviewee responded. This may indicate an intrinsic relation between a social, broader goal of inclusive transportation and the economic performance of the city. Mexico City is, at the moment, a country which loses more than 30 billion pesos (aprox. 1,7 billion euros) due to inefficient transport (NOTIMEX, 2015).

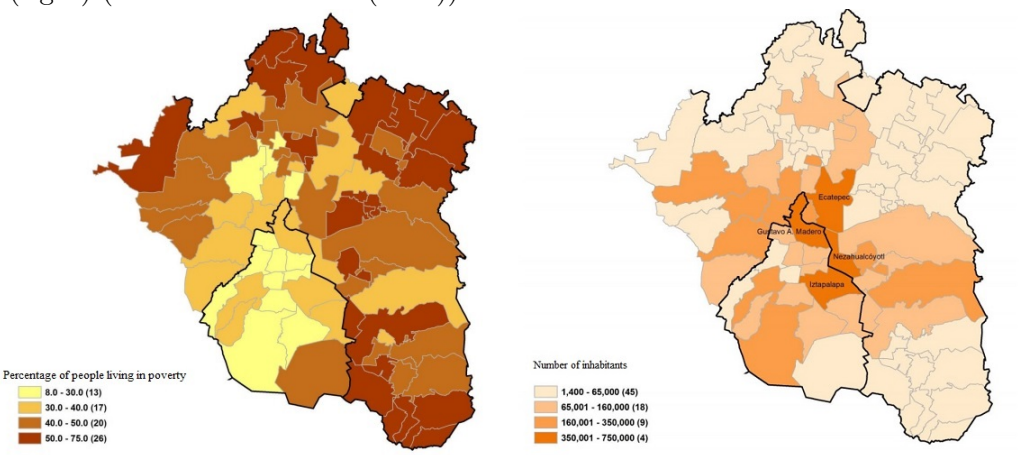
By the interviews and research on the topic, the mechanisms of participation between civil society actors and government seem unclear. Some interviewees suggested the development of collaboration platforms between organizations, while others told that they participated actively even with the reluctance of the ministries. The participant working on an organization supporting sustainable mobility interventions, commented: "We had one saying: With the ministry of communication even without her own willingness".

4.3 Socio-spatial dimension

The third dimension of the framework is socio-spatial conditions. Mobility patterns are intrinsically related to the social and spatial conditions of the city. Land use, city extension, population densities, and infrastructure have a strong relationship with transportation offered and mobility services. If elements such as housing or jobs are not properly distributed, it generates large patterns of movements which may stress (or even collapse) transportation infrastructure. Moreover, the city built environment may limit or foster the right of movement and access to the city to certain population strata (as Moses' New York bridges and other 'technology as politics' examples of splintered, fragmented urbanism).

This relation between space, mobility and society were present in the case study. It is misleading to conclude that these conditions are the result of a megacity condition. It can also be the result of the increasing social and economic segregation of the Mexican nation as a whole. The Mexican economy has been stagnated for more than thirty years. Mexico is the second most unequal country of the OECD. Evidence from this report suggests that this inequality weakens the bargain power and reproduces the social segregation of lower urban classes. This is especially important for mobility in Mexico City in which almost fifty percent of the daily journeys are made by low and low-medium income classes according to the Origin-Destination Survey (EOD). 75% of the households earning up to 4,600 MXN (270 euros) per month not have access to an automobile. According to the CONEVAL, the Mexican national evaluation institute, 34% of Mexico City residents are poor. Figure 4.5 shows two maps, indicating the percentage (left) and total (right, absolute number) of inhabitants in poor conditions. Poverty in relative terms is highly localized in the State of Mexico, while in absolute numbers it is across all over the megacity.

Figure 4.5: Figure 1: Inhabitants living in poverty by percentage (left) and in absolute terms (right) (source: CONEVAL (2010))



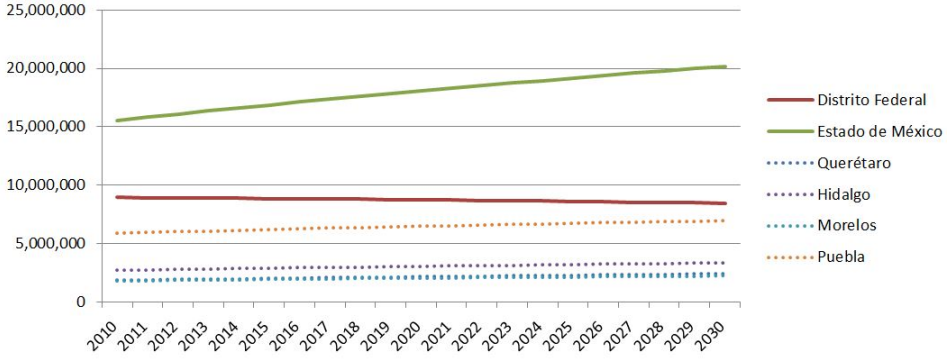
Demographically, Mexico City population is in average 26.4 years old. 26% of the people has between 15 and 29 years. It is a city in which 3 out of 5 persons are moderately or extremely poor (Boltvinink (2002) as cited in Schteingart, 2010). It is a spatially and

economically segregated city. While certain areas have a HDI comparable to Germany, Ireland or the Netherlands (Delegación Benito Juárez, 0.917) (UNDP, 2014a), Mexico City is also home of segregated, self-constructed urban settlements without access to public services (Duhau and Giglia, 2010). This is specially present in vulnerable social groups, such as indigenous communities living in the urban area of Mexico City (see Hernández Bringas et al., 2007).

Recent trends show that the Federal District has maintained its population around 8 million in the last 35 years. However the neighbor states have increased it dramatically. Especially the states of Puebla and Mexico have had a significant increase. They have almost doubled its population during the period 1980-2005 (Castro Ramírez, 2010). Moreover, it is expected that most of the population increase will happen in the State of Mexico, generating stress over land, resources and services in this state (Preciat Lámbarri and Vidrio Carrasco, 2010).

Figure 4.6 shows the demographic projections of the central region of Mexico in the period 2010-2030 by the National Population Commission (CONAPO), including the three states composing Mexico City -Federal District, State of Mexico, and Hidalgo-, plus the surrounding states of Querétaro, Morelos, and Puebla. As can be seen, the Federal District is expected to have a steady population until 2030, while the neighbor State of Mexico is expected to increase almost 25% of its population. This projection may indicate an increasing demographic pressure in this state, where public services connecting to the central part of Mexico are underserved.

Figure 4.6: Expected population growth in Mexico City and surrounding states, 2010-2030 (source: CONAPO (2014)).



Moreover, low income classes face several constrains for accessing the financial services to access for better conditions of housing or transport, especially in the form of credits. Due to lack of access, new housing is built in irregular terrains, reinforcing the development of megacities institutional weaknesses. Mexico City is spatially segregated into two areas: A high-income west side, which concentrates the major financial activities, quality housing and higher levels of development, and a poor east, mostly unplanned, with reduced levels of education (in comparison to the west), lack of jobs, and negative life conditions. The social gap is not just among urban spaces, but also between the states composing the megacity. An

interviewee who has collaborated with the Federal District and State of Mexico governments commented: "the difference between the State of Mexico and the Federal District is socially abysmal".

In the case of built environment and territory, densities and demographic characteristics may not be suitable for mass transportation. However, the socio-economic conditions urge an integral, low cost perspective for mobility. As a city primarily unplanned, the mobility solutions come later. Only one percent of the urban territory have adequate housing densities, increasing GHG emissions and limiting the connectivity of Mexico City (Mario Molina Center, 2013). Densification of already existing urban areas is perceived as a failure, generating a process of gentrification. This area was of high concern for most interviewees. All of the respondents considered that current densities were not adequate for shift from the current based automobility regime to public transportation schemes. However, it is a contested process as citizens may see as a government imposition in which citizens are not involved.

City dynamics force to think in large journeys solutions in Mexico City. Mexico City is a highly centralized urban settlement. Most of the economic activities are localized in less than ten boroughs or municipalities. Only four Federal District boroughs concentrate the highly skilled labour market, and four State of Mexico municipalities, almost all the manufacturing industry: "Employment is more concentrated than housing. Housing is everywhere. There is mismatch between both". Most of Mexico City available jobs are localized in less than eight central municipalities. This centrality, according to the interviewee, is a structural condition of the megacity. "Why do people commute? Do people do it because it is necessary? It is a structural condition. [...] People have limited job opportunities in their places they live and have the need to move [through the city]", an interviewee responded. For example, the Cuauhtémoc borough receives daily more than 400,000 workers of other localities (Ibarra, 2010), and has a floating population of 1.5 million (Delegación Cuauhtémoc, 2015). Most people move from east to west in the morning and from west to the east in the afternoon, under-utilizing infrastructure heading the opposite direction.

All interviewees suggested that land use is inherently related to mobility. An academic commented: "If you ask me what is the basic problem [of mobility], it is land use. If you are not able to deal with land use, you see what it is happening here [pointing out to the window, in an area with surrounding illegal settlements] and everywhere".

Moreover, all interviewees commented that current mobility and housing policies are market-based, which has negative incentives in allocating resources in neighborhoods with reduced land value but high mobility services. "There are some [inner] neighborhoods which are falling apart and which have a great mobility services, such as subway and primary roads", said an interviewee working on land policy, and continued: "We have proposed that these neighborhoods should be intervened. [We said to authorities] 'Recycle them. Bring them into the housing market', but that type of constructions does not generate revenues [for contractors]. [...] And in cases where building complex have been built, as it was done in central neighborhoods as la Doctores, you generate gentrification to the already existing

population".

However, large density areas are built based on areas which are commercially profitable but lack of long term planning mobility services. "In Avenida Toluca more than eight thousand apartments are being built at the same time, making the waiting time for a red light crossing more than 45 minutes", an interviewee commented. This has generated organization of civil society confronting real estate construction. In a predio nearby Avenida Toluca "one thousand seventy-two departments are being built, but the norm establish a maximum capacity of eighty-seven houses" (Domínguez, 2015).

Related to mixed-land use zones, interviewees commented that an inadequate legal framework and an existing paradigm of zoning by sectors[8] which dates back to seventy years ago. A former public servant with expertise and career urban public works, commented: "We have make some progress, but we need to forget about the really old [paradigm of] zoning of Alemán[9], *zoning by sectors*". Another interviewee with background in geography, in the same respect suggested that "the Agrarian and Land Use Law do not allow to established mixed land use [...] in Europe [where mixed land use is allowed], you can live, work, eat, and have leisure activities in the same area. In Mexico this is impossible".

Next to the legal constrains for mixed land-use development, another compelling element is that Mexico City, according to the same interviewee, need to be understood as a series of cities which has been integrated into one megalopolis: "Mexico City is a complex set of cities: The University City is one city; the Central Market, another; the Polytechnic and the Hospital Zone, another two. They generate a vast amount of journeys. The University City is only generating 160 thousand journeys per day. [...] And, unfortunately, we do not know the [journeys] structure of these cities". The limited knowledge of journeys structure affects how to deal with large number of commuters with specific journey patterns. For example; the Central Market generates journeys in the early morning, while the University City attracts commuters in hours of high demand [7-9 am, 3-5pm], which clash with other commuters using the same infrastructure. These 'cities inside the city' are generating stress and overload of current mobility infrastructure. Moreover, municipalities resources are relatively low to deal with such a large demand of travel, making any local level effort ineffective in dealing with such a large proportion of commuters.

In addition, Mexico City faces a pronounced spatial segregation that makes transportation less efficient. Cities are more transport efficient if they have polycentric structure. However, in Mexico the commercial and financial zones, plus corporate and high income estate developments are located in the west side. Lower income social interest residential zones are located in the east. In between both zones, residential zones of all income strata are located (CAF, 2011). This results in long distance transit of lower income classes to the west, crossing through the city, and arriving in areas where auto-mobility is predominant. This, naturally, congests the transport infrastructure in peak hours.

[8]Sectorial zoning refers to explicitly limit mixed land use, by avoiding having commercial, residential, and industrial use of land in the same place.

[9]President of Mexico, 1946-1952.

Next to understanding the options of movement, it is necessary to explain the nature and patterns of mobility in Mexico City. Duhau and Giglia (2010) conducted a quantitative research explaining how different levels of income affect patterns of mobility according to the level of income. Low-income people use everyday activities as grocery shopping as a leisure activity. This circumstance may be reinforced by the increasing lack of public space in the city. In addition, it is evident that people from different income level attend different places. Only one place in the city, Coyoacán historical centre, is a place for activities to different socio-economical levels. In addition, people have limited mobility based on conditions as gender or ethnicity. For example, women in traditional families may have restricted mobility patterns as the result of domestic duties and taking care of children (Ibarra, 2010).

For these reasons, it is possible to observe a highly unequal development in Mexico City. Market oriented decisions are imposing over public and social rationality, which may a better long-term outcomes in mobility. Moreover, the institutional fragmentation and lack of metropolitan vision affects understanding mobility as a unitary concern for Mexico City inhabitants.

4.4 Mobility practices and interventions dimension

After analyzing the first three dimensions, it is necessary to evaluate the mobility practices and interventions in Mexico City. The most recent data about patterns of movement in Mexico City is from 2007. In that year, the National Institute of Geography and Statistics (INEGI) conducted the last origin destiny survey (EOD) in the metropolitan area. It was financed by the state governments of the Federal District and Mexico, and included only 52 out of the 76 municipalities that integrate Mexico City. Table A.2 (in the appendix) shows the municipalities considered for this survey.

In total, 21.9 million daily journeys are made in Mexico City. Of this number 14.8 million are done by public transport, from which 6.8 million (45% of public transportation journeys) are multimodal. Out of the 8.1 million unimodal journeys, 5.2 are made in low capacity buses and 1.3 by taxi. Even though the subway of Mexico is one of the largest worldwide, only 6.6 million inhabitants use metro as their only mode of transportation. In the opposite direction, thirty-one percent (6.8 million) of the journeys are made by private transportation. Of private transportation, ninety two percent (6.3 millions) are done by car, and half a million journeys, by bike. Only 91,962 journeys are completed in motorcycle. Other modes of transportation, such as school or work buses, represent 1.2% (273,163) of the total journeys made every day in Mexico City. In figure 4.1 the modes and type of transportation are shown.[10]

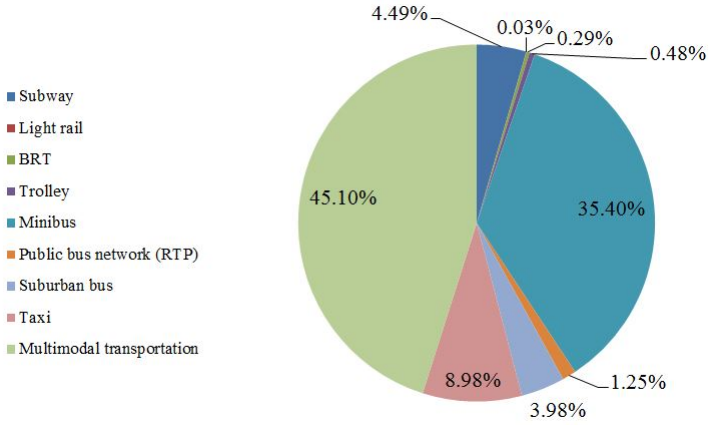
[10]The table is divided into three types of transportation: Private, public and mixed. It should be noted that the total number of journeys per public transportation mode are unimodal. Therefore, only 664 thousand journeys are made only by subway, but this number increase considerably when taking into account intermodal journeys. A detailed table can be found in the appendix.

Table 4.1: Total journeys by type and mode (source: own, from EOD (2007))

Mode of transportation	Journeys	%
Total	21,953,857	100.0%
Total public transport	***14,811,970***	***67.5%***
Public transport (unimodal)	*8,131,745*	37.0%
Subway	664,855	3.0%
Light rail	3,787	0.0%
BRT	42,633	0.2%
Trolley	71,224	0.3%
Minibus	5,243,743	23.9%
Public bus network (RTP)	185,525	0.8%
Suburban bus	589,694	2.7%
Taxi	1,330,284	6.1%
Public transport (multimodal)	6,680,225	30.4%
Total private transport	***6,806,735***	***31.0%***
Private transport (unimodal)	6,804,767	31.0%
Car	6,278,824	28.6%
Bicycle	433,981	2.0%
Motorcycle	91,962	0.4%
Private transport (multimodal)	1,968	0.01%
Mixed (public and private)	***61,988***	***0.3%***
Others	***273,164***	***1.2%***
Others (unimodal)	200,341	0.9%
Others (multimodal)	72,823	0.3%

Regarding the multimodality, the role of different transportation modes is different. Fifty percent of multimodal journeys use the subway as transportation mean, and minibuses are used in eighty percent of the journeys. Moreover, evidence suggests that multimodality among private and public transportation are almost negligible. Only 0.9% of the multimodal journeys use car, motorcycle, or bicycles, to commute. Figure 4.7 refers to the public transportation modes available in the city.

Figure 4.7: Journeys by public transportation means (source: own, from EOD(2007)).



Concerning the mobility options available, the schemes in which public transportation operate are three: Concessioned transportation to individual or companies, public service transportation, and public private partnerships. Concessioned transport includes small-capacity buses, buses, and wagons. It is estimated that 80% of its fleet exceeded its life span (Gobierno del Distrito Federal, 2010). According to the Integral Program of Transport and Roadways (PITV), the fleet should be renewed as soon as possible and other bigger capacity options, such as BRT, subways, or electric buses, should be considered. Low capacity public transportation (i.e. collective taxis and microbús) options have seen an increase in the total share of people moving every day. At the moment, more than 60% of daily trips are done by these (Negrete Salas, 2010), in comparison to high capacity transportation, as subway, BRT, and light rail. Another type of concessioned transport mode is taxis, and is a considerable source of employment for more than 300 thousand people. However, taxis contributed to 13.13% of the total air emissions, and it is still considered an insecure and outdated mode of transportation (Gobierno del Distrito Federal, 2010).

The second category is public service transportation. This included light rail, public buses, subway, trolleys and BRT. Public service transportation was (and still is) subsidized as a social policy measure (Gómez and Ramírez, 2006). By 2006, there was no integrated public transportation in Mexico City that crossed state boundaries. The exception is Mexico City subway and the suburban rail, already mentioned above. The subway network consisted of 11 lines, 193 km, and mobilized 4.3 million people every day. The public buses, also known as RTPs mobilize 639 thousand people per day. The RTP route has an extension of 3.1 thousand km. Trolleys mobilize 207 thousand people by day, using 18 lines. It had an extension of 467 km in 10 Federal District boroughs. The light rail is the smallest public service in distance and users: Only 201 km. and 65 thousand passengers. It is located in the south of the Federal District. Most of the infrastructure of trolleys and light rail is considerably outdated (Gobierno del Distrito Federal, 2010).

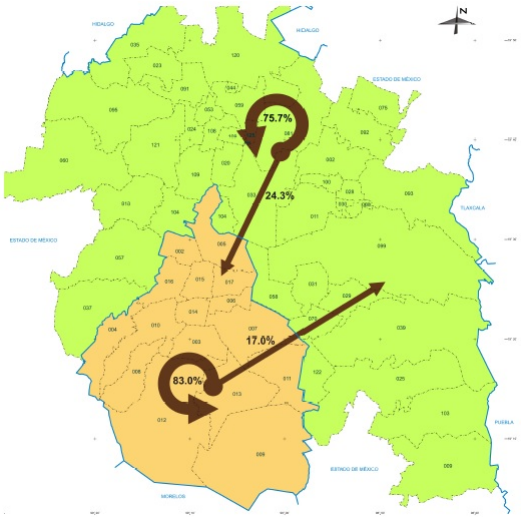
Regarding the public private partnerships, a novel public mode of transportation was introduced in 2005, the Metrobús. Metrobús allows private and public investment, and private operation under conditions that establish the government. It is a BRT that operated only one route, but have extended to five lines by 2015 in the DF, and 3 in the State of Mexico. However, there is incompatibility of payment options and no transfer station is available between both states BRT. The first route is localized in one of the busiest primary roads in Mexico City, Insurgentes Avenue. In the first year, the Metrobús transported 250 thousand passengers per day and extended 19.7 km (Gobierno del Distrito Federal, 2010). Moreover, it seems it have had two major positive outcomes: On one hand, it reduced the implementation time for mass transit solutions; on the other, the construction times and costs are minimal in comparison to the subway (Gobierno del Distrito Federal, 2010). Figure 4.7

Evidence from the origin-destiny survey suggests a mismatch between the localization of residential and work areas. The survey data does not disaggregate enough information to evaluate the distances of journeys. However, it is possible to map the total number of journeys made in districts, which are the basic unit of analysis. The survey considers 156

districts, from which 86 are localized in the Federal District. It is possible to observe that only twenty percent of the journeys are within the same district (4.4 million). However, half of internal journeys are strongly localized: 37 out of the 156 municipalities concentrate more than 50% of these internal journeys. Of the 37 districts, only two are localized in Mexico City center. Most of them are at the outskirts of the megalopolis. On the other hand, analyzing the most important destination and origin districts, most of them are from the central city. Half of the journeys are made in 49 out of the 156 districts.

The next unit of analysis is municipalities. Based on the findings of the survey, 40% of the journeys stay in the same municipality (8.8 million). In the boroughs of the Federal District, roughly one third are internal (4.5 out of 12.8 million), while in the State of Mexico it is almost one half (4.3 out of 9.1 million). Half of the trips between municipalities are done in only 18 municipalities (out of 38), reflecting the highly dynamic environment in the city. Moreover, of the 21.9 million journeys, 24% originated in the State of Mexico and finished in the Federal District, while 17% are the other way around. Figure 4.8 shows this pattern of movement.

Figure 4.8: Journeys according to each state (source: edited from EOD (2007))



According to data available by the Institute of Statistics of the State of Mexico[11], population in the Federal District are more likely to travel in the same state in comparison to people in the State of Mexico. 1 out of 30 trips are originated in DF and have as destination the State of Mexico. On the opposite way, one out of four journeys are originated in the State of Mexico and finished in the Federal District. Not surprisingly, State of Mexico municipalities in the outskirts have less journeys to the DF. Table 4.2 shows the travels by state, table 4.3 by the 15 most important municipalities in total journeys. As can be seen on table 4.3, the fifteen municipalities concentrate a large part of the total journeys, and the ratios among DF and the State of Mexico is quite high. The journeys by each municipality

[11]Dataset available at: http://igecem.edomex.gob.mx/descargas/estadistica/ENCUESTADEORIGEN/EOD2007.xls. Last time consulted: July, 2015

Table 4.2: Total number of journeys by state (source: own, from EOD (2007)).

State	To Federal District	To State of Mexico	Ratio
Federal District	10,709,884	356,431	30:1
State of Mexico	2,123,731	8,708,055	1:4
Total	**12,833,615**	**9,064,486**	**1.42:1**

can be found on the appendix (table A.3).

Table 4.3: 15 most important municipalities by number of journeys (source: own, from EOD (2007)).

State	Municipality/borough	To DF	To Mexico	Ratio
DF	Iztapalapa	2,034,447	77,209	26:1
Mexico	Ecatepec de Morelos	403,693	1,355,572	1:3
DF	Gustavo A. Madero	1,343,577	90,706	15:1
Mexico	Nezahualcoyotl	359,306	773,749	1:2
DF	Álvaro Obregón	953,410	15,905	60:1
Mexico	Naucalpan de Juárez	163,100	733,678	1:4
DF	Coyoacán	878,009	11,397	77:1
DF	Tlalpan	876,606	7,307	120:1
Mexico	Tlanepantla de Baz	203,995	630,430	1:3
DF	Cuauhtémoc	652,269	20,597	32:1
DF	Benito Juárez	626,363	12,775	49:1
Mexico	Atizapán de Zaragoza	65,918	540,670	1:8
Mexico	Cuautitlán Izcalli	66,794	521,207	1:8
DF	Azcapotzalco	503,711	36,114	14:1
DF	Venustiano Carranza	489,932	17,561	28:1
Total		9,621,130	4,844,877	

In relation to the average time of journeys, private transportation is less time consuming than public or mixed transportation. Table 4.4 shows the average journey duration in the city based on the origin and destination state. As can be seen, in average each journey by private transportation last 0:41 hours, while the journeys in public and mixed transportation last 0:58 and 1:21 hours, respectively. The only routes in which private transportation is less time consuming is on trips made from the Federal District and the State of Mexico to outside the megacity, or the journeys made from outside to the State of Mexico. This also holds for internal journeys, in which an average of 25 minutes per journey. Mixed transportation is time consuming, inside and among districts, lasting on average 0:38 and 1:23 hours, respectively.

In relation to the motives of transportation, approximately half of the journeys are made to houses (9.9 out of the 21.9 million). This means that 12.1 need to be explained according to the journey purpose. 46% (5.5 million) of these journeys are done to work, plus another 2.2% of journeys related to it. The following three activities which originated

Table 4.4: Average time by origin-destiny in 2007. (source: own, from PITV (2007))

Origin - Destination	Public	Private	Mixed
DF - DF	0:51	0:38	1:12
State of Mexico - DF	1:29	1:06	1:38
State of Mexico - State of Mexico	0:47	0:32	1:01
Average of the city	0:58	0:41	1:21

Table 4.5: Average journey duration by location and type of transportation (source: own, from EOD (2007)).

Origin	Destination	Public	Private	Mixed
Mexico City	**Mexico City**	**0:58**	**0:41**	**1:21**
Federal District	Federal District	0:51	0:38	1:12
Federal District	State of Mexico	1:35	1:11	1:44
Federal District	Outside the city	2:07	2:31	2:17
State of Mexico	Federal District	1:29	1:06	1:38
State of Mexico	State of Mexico	0:47	0:32	1:01
State of Mexico	Outside the city	1:30	2:10	3:08
Outside the city	Federal District	2:14	2:04	1:28
Outside the city	State of Mexico	1:19	2:09	1:41

journeys are study (1%, 1.9 million), accompany someone (9.9%, 1.1 million), and shopping (8.9%, 1.07 million). Leisure activities, paperwork/transactions, and eating represent less than 6%. Table 4.6 shows the major reasons of journeys in the Mexican capital. As can be seen, except from returning home, all activities are based in the Federal District. This is especially notable in attending work and study, suggesting the centralization of activities in the megacity.

Crossing activities and states, data provides us of some interesting points to stress. Most of daily journeys from the Federal District to the State of Mexico are to return home (81%). On the opposite side, only 13% of the journeys are made to return home. In all cases (within and among states) the journeys are highly concentrated for attending school or work. In terms of shopping and study, journeys from the State of Mexico to the Federal District are in a ratio of 5:1.

Regarding freight transportation, the sector face conflicting regulations and lack of public space for (un)loading products and reduced competitiveness due to the not utilized capacity in journeys. Additionally, the demand is primarily located in the Federal District. According to an study made by II-UNAM (2006), a better management (i.e. reduced access during rush hours or transport corridors) will have no significant effect in transportation congestion in Mexico City, but it will have a significant effect in emissions reduction, preservation of roads and public space.

Table 4.6: Journeys originated and received by state, according to activity

Reason	Federal District		State of Mexico	
	From	To	From	To
Work	2,892,669	3,848,205	2,692,194	1,694,424
Home	6,352,649	4,905,069	3,428,677	4,944,537
Study	986,238	1,171,813	955,081	764,903
Shopping	561,100	660,260	512,131	411,267
Leisure	330,285	363,500	282,136	231,101
Other	1,689,233	1,884,768	1,193,817	982,589
Total	12,812,174	12,833,615	9,064,036	9,028,821

Mexico transportation infrastructure is limited. Mexico City loses 200 billion pesos (around 12 billion euros) due to congestion (Medina Ramírez, 2012). According to the IBM Commuter Pain Survey: Smarter Traffic, Mexico City is the most painful city for car congestion. This survey suggested that 63% of the drivers in Mexico have cancelled a planned journey due to congestion (IBM, 2011). During rush hours (from 6 to 9, 12 to 15, and 17 to 20 hours), transportation time can double in comparison to "valley hours".

On mobility interventions

Based on the panorama described above, interventions have been done in recent years to alleviate the congestion and increase mobility in the capital. Land use policies, major infrastructure projects (as BRT, urban highways, and subways), novel individualized public transportation schemes (bicycles), and prototypes of bringing services and products closer to the people (i.e. teleworking) have been discussed and implemented in the capital, with contradicting results. A general concern among the participants seem to be a lack of data and evaluation mechanisms for the novel projects. Moreover, it is suggested that there is a strong inertia of public officers to keep traditional mobility interventions, and that certain barriers to innovation adoption are as simple as lack of computers, skills and know-how. The findings also indicate the lack of vision of the city as a whole (no networked approach to mobility). However, institutions are slowly shifting to a more integrated vision on sustainable mobility and discovering novel alternatives to current transportation problems.

Due to several factors, the transportation sector in Mexico City has reduced its capacity and efficiency in recent decades. According to Casado Izquierdo (2008), mobility infrastructure in Mexico suffer from induced demand effect, which can generate excess demand by increasing offer of infrastructure. Moreover, reduced capacity transportation modes have a negative impact of road efficiency, especially in cities such as Mexico City were the roadway infrastructure is limited (FIMEVIC, 2002). By 2007, there was no integral project management -physical, tariff, and administrative- of transportation services (Negrete Salas, 2010).

A first characteristic is that sustainable mobility has targeted primarily the central area of the city. "A special characteristic of [sustainable] mobility in Mexico City", according to an interviewee working in consultancy services, "is that when decision makers talk about the city, they are referring to its central part". Mapping the roots of this phenomenon, interviewees agreed that tax collection is a rationale behind this centrality. Inclusive mobility geography is "based on those who can afford it and those who are going to use it. Not perfect, but functional". Moreover, when I asked another interviewee about how sustainable can be the mobility in Mexico City, (s)he interrupted directly: "The answer is per capita". Most of interventions taken place in mobility are also considering just fiscal and economic terms, especially the bicycle sharing scheme, Ecobici. This service is only present in highly developed zones of Mexico City. Even though its expansion has considered low to medium income zones as Iztapalapa, it never materialized. Moreover, to access the system it is necessary to have a credit card; but this service is limited in Mexico. Nationwide, by 2012 only 13.3 out of approx. 112 million inhabitants have access to this card (ANTAD, 2015).

In the same line, interviewees suggested that at this moment in time, it was suitable to increment mobility and the Federal District to think, on a later stage, about the State of Mexico. "At the present time [...] in a cost benefit analysis it would be better to encourage an integration of transportation systems in the Federal District, before thinking incorporating the State of Mexico", an interviewee with expertise in mobility interventions commented, and added "it would generate more chaos. The real short-term challenge is finding an integration policy in the DF". To some extent, this has been made in the megacity. At the present time, it is possible to acquire multi-modal transportation cards which can be used only in certain public transportation services (BRT, subway, and light rail), but are only valid in Federal District transportation, and cannot be used to pay buses fares.

Indeed, no integration between different modes of transportation has been established. Each mode of transportation has its own operation and subsidies schemes, which may hinder intermodality according to an interviewee. An interviewee who has collaborated in Mexico City transportation project commented: "Technically, it [the integration model] can be achieved in short term, but in political terms probably not". Moreover, another interviewee, with experience in urban geography consulting, commented that most policy interventions in transportation infrastructure are neglecting the concept of network: "We still do not put enough attention to the concept of network. [...] At the present time those who are building it [the infrastructure] are more worried about their public work rather than of a city project". Focusing on the public work rather than a city project, also reproduces the old paradigm of mobility as transportation. It becomes a sectorialized vision on mobility, which attempts to provide only infrastructure without taking care of other elements surrounding mobility, as changing mobility patterns and reducing travel distances.

Naturally, any type of intervention which is disruptive -referring to its novelty-, has a learning process for all actors participating in sustainable mobility: Users, producers, policy

makers, and so forth. On the policy side, details as implementing a interconnected approach to bicycle paths or knowing basic information as the technical requirements for constructing bicycle sheds to enhance inter-modality are small -but crucial elements- that are hindering this type of mobility. Moreover, a crucial characteristic in traditional transportation is that governmental institutions have already mapped all the actors for a public work, but when introducing a novel transportation method this is not present. An interviewee commented on this respect: "What is the biggest barrier in doing bicycle lanes? That they do not have any reference to start working [...] When you ask the Ministry of Public Works about which projects it want to make, they choose whatever they do best. You say to them 'do a overpass', and they say 'perfect'. They already have reference terms, times costs, they have everything. Even the contractors". However, when asking for a different project, such as bicycle schemes or pedestrian routes, they do not know what to do: "Ask them to do a work they had not done before, they can take years", a respondent from a transport organization mentioned.

Another example of this type of 'minimal' but vital characteristics that hinder mobility was mentioned by the same participant. When discussing about Madero street in downtown Mexico City. Before 2006, the Federal District had a strong revitalization strategy for the historical centre. Its rehabilitation included the maintenance of roads, including Madero. The participant recalled this event: "[Before the rehabilitation] Madero was of paving stone, but he [the major] put stamped concrete pavement. [...] As soon as the Madero got this pavement, it was replicated in all the surrounding streets, Bolivar, Isabel, Palma. The problem is doing the first one. [...] After the first intervention, you do not need any mass media announcement, it [the Ministry] started doing it automatically." The interviewee added that this also happens in other type of interventions, such as BRT or bicycle paths, "our organization was really involved in Ecobici [the first public bicycle scheme project] in Mexico, especially in the design. [...] But the last expansion phase of Ecobici we did not help at all. We did not help, we just observed. Everything was in automatic. [...] You have to construct something [the design and scheme of Ecobici], and on a later stage the government do it by itself'.

Another vital element for upscaling sustainability project is what an interviewee defined as *learning by experiencing*. Enhancing new modes to enable mobility requires users to know how to use novel transportation modes and interact with current mobility options. *Learning by experiencing*, as I understood it, is an outcome of constant interaction between novel and incumbent modes of transportation. For example, cyclists need to learn how to ride in a city which is dominated by the car, while current car users also need to adequate their driving behaviors as transportation modes such as BRT or bicycles emerge.

Car users should adapt to novel mobility practices. Mentioning about the program Ecobici, an interviewee noted: "And now they say that drivers, as soon as they take a car, they become potential killers[12] [of cyclists and pedestrians]". However, car users need to face an increasing reduction of urban space to promote BRT and bicycles against car lanes. "In

[12]This phrase should be understood not by its literal meaning, but as an idiomatic phrase.

the places you require mass transit and exclusive bicycle lanes, are spaces of high demand [for automobility]", an interviewee commented. And following the rationale of economic capacity and population densities, the places which require more public transportation are those in which car is more used. The city officials, according to an urban planner, 'have reduced the number of car lanes, but no other mass transportation has been established. [...] This is also an unfair competition for cyclists, which are in a weak situation [against car users]". This perception against car users was also shared by other participants. However, other underlying reasons were considered. Another interviewee commented that car use should be discouraged unless other mobility options are built: "I see that there is a movement, at least in my city, against car use [...] against the spatial use of cars. In the case of Mazaryk[13], they have reduced the number of car lanes, but no other mass transportation has been established".

Another type of interventions are organizational. According to interviewees, several pilot project have been made in this respect, from teleworking to stagger entrance hours in governmental offices. Considering teleworking, an interviewee commented that certain elements at home limit the effectiveness of teleworking, such as taking care of every day activities or children: "[in Mexico City] staying at home generates a lot of problems [...] people start taking care of their children and doing their shopping [instead of working]." The interviewee, who has worked in project related to organizational innovations for mobility, added a novel idea which has not been tested, but it is a promising form of teleworking: *Telespaces*, areas in which people attend to do telework near their houses, operated for different companies at the same place. "It is possible to create a network of *telespaces* reachable by walking or cycling distance. This allows to take people out of their house" and enjoying the benefits of smaller travels.

Also state of the art innovations such as Big Data Analytics were discussed in the interviews. It was observed that two major concerns arose: (1) the technologically pushed side of these innovations, and (2) the lack of human capital to deal with these solutions. Participants commented that it is necessary to *tropicalize* the IT oriented solutions for mobility. One interviewee described an insightful perspective on this type of innovation, "the companies working on this topic [smart cities and big data] are solving problems that are *not really* a problem". Most IT companies, as Siemens and IBM, are pushing in several megacities the adoption of data intensive solutions for mobility and transportation. In the opposite direction of this approach, participants commented that more clever and basic application are more suitable for a megalopolis like Mexico City. It is difficult to envision the application of predictive analytics in cities in which it is impossible to have reliable data of bus lines, nearest bus stations, and times and availability of modes of transportation. "Sometimes they [companies] do not perceive that the major obstacle for innovation is having decently operated computer in the ministries", a participant commented.

Tropicalization is related to the modification of a product of service to fit in a given context. Given a common problem with the same characteristics (e.g. traffic congestion

[13]The most expensive avenue in terms of land value in Mexico City.

due to excess of car supply), the solution can be dramatically different in two places according to context dependent elements as culture, knowledge, and financial capabilities, just to mention a few of them. An interviewee, who has worked closely with embassies funding projects on mobility, referred to it as follows: "Collaborating with them [embassies] does not only bring resources, but also expertise. Time ago they had similar problems, but in different scales. The number of inhabitants is completely different [between European cities and Mexico City". The respondent also commented: "Contextualizing [policy interventions] also includes understanding political timing, [...] institutional changes [...] to whom [public servant] the project should be aimed, what mechanisms are available, [...] and also developing our own methodology". Another interviewee, which has worked with international consultancy firms, stressed that some of the ongoing projects fail as methodologies, approach and know-how is not *translated* into Mexico City context.

It appears that one of the most relevant guides leading mobility interventions are putting order in a fragmented, chaotic city. "The Metrobús worked for putting order in the most transited avenues", an interviewee with expertise on transport interventions commented, and added "it makes them [the avenues] more or less civilized. [...] This trend is also happening in other regions, such as the Western Urban Highway". This is especially important in multi-modal zones, in which the space need to be shared or coordinated among different transportation modes. Ironically, the places that require better transportation services, are those which have a more intensive use. Space, as a scarce resource, is a place for competition and controversy among different providers and users of transportation modes.

In addition, and probably based on the strong push that novel transportation modes need to have to compete against other services, most interviewees were skeptical towards bottom-up approaches to mobility. An interviewee recalled that "in some Asian cities, people build handcrafted mobility accessories to provide transportation. But Mexico City is not the case. It does not happen here. Even the bicycle introduction was a top-down approach, in which the Ministry of Environment had a strong participation". All transportation modes, either formal or informal, tend to agglomerate into groups which are later used to represent their interests.

Moreover, policy interventions face an opposition due to uncertainty and inertia. Talking with an interviewee with experience in Transport-Oriented Development (TOD) about the participation of her organization in mixed land use strategies, commented: "At the beginning, we went against the flow [...] urban residents near metro stations did not like the idea, because more people, noise and other things would come [with intermodality]". According to the interviewees, this may occur due to the lack of effective communication from governments to urban citizens. This is not class-binding, as both upper and lower classes oppose this type of interventions. "They [citizens] see mobility interventions as an imposition", a urban sociologist stressed. In fact, the construction of the newest subway line (12) expanding the subway to rural areas and the overpass in a medium class neighborhood were highly contested since their announcement. Another interviewee commented: "governments have not been able to make attractive for citizens the mobility discourse".

However, it seems there is a mismatch between land and mobility policies. Commercial and sectorial interests are crucial in decision making, versus a more rational, mobility-oriented decision. "Were am I supposed to build a mall? In places were public transport exist. But this does not happen in reality", a sustainable urban development researcher commented. Additionally, certain interventions on non-motorized mobility, which are crucial for the rehabilitation of public spaces in Mexico City, face two limitations: On one hand, there is no allocated or fixed budget to non-motorized transport. The project which take place regarding non-motorized roadways comes from different schemes, such as patrimonial rehabilitation or social development programs. On the other, it is still mainly links non-motorized mobility with leisure activity. This limited view does not help to incorporate this type of mobility into the daily life of Mexico City inhabitants. And interviewee was concerned that the consultancy he has made to local institutions is not changing daily routines of Mexico City inhabitants: "At the moment, the focus reduces to pedestrian ways. Now, the concept is 'let's make it on historical centers to make tourists attend', but the concept should be creating pedestrian routes to make the citizens use them everyday: Their [own] neighborhood and *barrio*. [...] This shift would allow to people to use it daily, rather than just on the weekends".

However, evaluation and follow-up of mobility initiatives seem to be limited in the megacity, especially because of the lack of data. First, because the data available is focused on transportation services rather than mobility: "We understand how cars move, but not how people do it". Another interviewee commented that lack of data is not able to push the mobility agenda, because it is impossible to evaluate the outcomes of specific mobility interventions: "Everything [in mobility interventions evaluation] is just perception. Sometimes we believe things go right, sometimes, we may think it went wrong. But everything is a perception. It is really difficult to reach agreements if there is no data. [...] Everything becomes a communication war, in which we [as an organization] participate. But this [war] is really stupid."

4.5 Visions and expectations dimension

Surprisingly, most of the interviewees were optimistic in the future of mobility and the incorporation of sustainable solutions in the following years. Really small changes have been done in recent years, but which have established alternatives to mobility transportation. BRT has grown exponentially, and an increasing use of bicycles and friendlier and less pollutant modes of transportation. Certain practicalities and technologies are still on debate (i.e. the role of the car or the bicycle), but similar concerns and future strategies are present among relevant actors. Moreover, visions and expectations in mobility are spatially limited to the central city, meaning that it may not be possible to construct or imagine a sustainable mode of transportation in megalopolitan dimension in the following years.

A first finding was that the vision of mobility and of the megacity is still contested. No interviewee, or neither any urban development plan consider the expansion of the ur-

ban area. However, some interviewees suggested that the city can still grow vertically, and better densities may improve how people mobilize in the city. "We need to take advantage of areas, near public transportation, to develop them. [...] There are international standards to develop this strategy", an interviewee with experience in TOD commented. Other interviewee, working on the same topic, suggested: "The population density is terrible. Current population density points you to Dakar, to the Third World', to a lack of quality of life". Other interviewees are more skeptical about the growth capacity of Mexico City. An interviewee with experience in land use, suggested that the city has reach its limits, and this limits should reduce or eliminate future growth: "The city grows until it can, and not until you want. You cannot redensify land endlessly [...] Other cities as San Francisco and Los Angeles said 'stop' [...] they [the government] say '[let's follow a development which is] vertical, densified, and polycentric'. You can only laugh about it. Do you think in this city it is possible to live in the same area in which you work? You cannot think about this type of development because it is already developed. You can increase density, make vertical areas, but you cannot open more roads. You have, for a long time, destroyed all public areas, from parks to sidewalks".

To some extent, the second vision of limited growth is more in accordance with the spatial patterns of urban growth described in the literature about megacities. Cities should be developed in a vertical, densified, and polycentric fashion, but this approach may be difficult to implement for two reasons: On one hand, the built environment development is difficult to reverse. On the other, market mechanisms may not be aligned with the public interest in developing an inclusive city, which is an essential part of sustainability. Real state interventions for medium to high density areas may be located in areas with high value of land but reduced connectivity. Interventions in areas with high connectivity (as Benito Juárez borough) have not increased the number of residents in the area. According to the INEGI, in this borough the population has remained constant in the last 10 years even though it has the best HDI in Mexico, and the increasing pressure on land have made it one of the boroughs with highest irregular constructions and increasing informal activities in the public space (Suárez, 2014). Finally, an interviewee had reserves of this model, as it can generate a process of gentrification: "You can build high buildings, as in la Colonia Doctores, but you gentrify its inhabitants, and you send them to places far away".

This may indicate that policy interventions regarding housing (and consequently mobility) may have a negative incentive in reproducing the conditions of the megacity. Without an adequate legal framework guaranteeing the inclusiveness and rule of the law, higher densities may also result in higher informal activities, infrastructure stress and overload, detriment of public space, and gentrification and social fragmentation. Gentrification is specially important to be considered as throwing previous inhabitants out of the central city does not solve the mobility question in megacities, but only takes it to their periphery.

Another vital element in visions and expectations is that it allows the construction of mechanisms in which different actors collaborate and build a shared vision on mobility. The interviews suggested that the formal, established mechanisms for this purpose have limited influence in decision making in the megalopolis. However, it is interesting to point

out that all interviewees (except one) have in some period back in time collaborated in advisory boards with state or national governments. My interpretation is that due to the lack of long-term planning and effective governance, these boards are only useful to broaden the possibility space of mobility policy interventions. It is an area in which the state and national administrations can nourish from different views which may be useful to operationalize more sustainable mobility interventions. However, contestant organizations, do not participate in these mechanisms making the policy process non-consensual and with limited legitimacy. From these mechanisms, novel proposals on policy designs and interventions have emerged. These proposals may never seen a green light, but contribute to develop skills and new approaches, especially in organizations which push for specific mobility agendas. It is worth to mention that most of the organizations interviewees know from these mechanisms; however, no publication co-sponsored by two or more of these organizations were found.

It seems that the incentives for envisioning sustainable mobility are in clear contradiction of the ones suggested in the literature. In the case of Mexico City, different levels of government and territorial administration may intervene in transportation infrastructure to boost their public image. The *Plan Verde*, which was the starting point for this research, was just a media strategy to boost the political career of its proponent, the major Marcelo Ebrard. An interviewee who has been involved in transportation policy before 2007 commented: "The sustainability program in Mexico City was just *branding* for [the former major of the Federal District] Marcelo Ebrard". Another interviewee with more than ten years of involvement in mobility and land-use, added: "I completely sustain that the sustainability plan of Mexico City does not exist". In Mexican politics, far-reaching infrastructure projects have been used by politicians to attract attention to their office: From López Obrador and the second level of the urban highway periférico (Major DF, 2001-2006), to the urban north highway of Peña Nieto (Governor State of Mexico, 2001-2006) or the suburban rail from Calderón (President, 2007-2012). However, in recent years novel transportation interventions, which are more sustainable and broader than supply-demand sided, started being exploited by politicians, such as BRT, subway lines, bicycles schemes, or rehabilitation of public spaces to enable pedestrian mobility. One of the main drawbacks of this approach is that projects should be visible. As long as a major incentive of mobility interventions is to boost the public office image, smaller interventions with reduced notability are not encouraged.

A possible interpretation for the increasing interest in sustainable mobility is that it can boost politicians careers. Concerns about climate change, environment, health, and congestion can be targeted by novel interventions rather than the old fashioned 'supply and demand' approach for individualized motorized mobility. "The sustainability [discourse] is starting to be a dominant concern. Now politicians are worried about it", and interviewee with a vast career in public office suggested. Moreover, sustainability has shifted from a merely environmental issue towards "not just the environmental side of sustainability, but also others, such as social, socio-economic, and [...] governance". This approach apparently seems novel. For example, in 2014 the Federal District converted the Transport Ministry in a Mobility Ministry. Still the federal and the State of Mexico governments have a Transportation and Communication Ministry. Another key remark to mention is that the

novel non motorized or BRT transportation schemes came from the Environmental Ministry. It became the institution in which innovations came into the city surpassing the inertia of transportation institutions. Moreover, different paradigms in the city de-align the work of different departments. Therefore, it is possible to observe cases in which two departments are fighting against each other to obtain resources and support their own projects. A respondent commented that "between institutions they tend to fight every year to obtain as much financial support as possible".

Regarding the strategies shaping mobility interventions, results may indicate that interventions are leading a rationale of reduction of emissions and moving more people in a more efficient way. It was evident that a general concern was the development of mobility interventions in a disaggregated fashion, which can be complemented by mass transit interventions: "We need to know how people at the neighborhood level moves", an interviewee point out, and suggested that the new paradigm in mobility should be focused in local levels. Understanding local-level initiatives can be of great advantage for low range transportation alternatives, such as walking or cycling. It can make more efficient the use of space, while also contribute to trigger multimodality, "allowing to make the users use bikes or walk in the last mile of their journey".

Moreover, there has been a shift of priorities in the use of public space, prioritizing pedestrians and cyclists in recent years. This intervention is necessary to enhance friendlier urban environment to non-motorized transportation. However, it can have to main drawbacks. On one hand, as mentioned by a respondent "public transportation is not growing at the same pace as private needs. Therefore, you can have interventions in which four car lanes are converted into one, but there are no other means to travel". Moreover, changing people behavior from car to public and/or non-motorized transport takes time, and "cannot be changed by decree". On the other, the areas in which public space have been recovered have large number of car use.

Regarding the strategies, it seems that public transportation is consensually observed as the path to take in following years. "There is a minimum agreement between organizations" an interviewee commented, "but one of the things we [organizations] all agree is in a better public transport". Considering that most megacities which were successful in implementing mobility policies relied on a heavy public transportation scheme, this may seem a right path to be taken. A scholar expecialized in history of automobility commented: "I really do not see the future of mobility based on the car". Moreover, the reliance on public transportation is able to overcome the high impact on monetary, environmental, and space terms of the automobility regime. However, the use and extension of a car is still debated and widely contested. As an interviewee commented, car is still a preferred mode of transportation in the megacity because of the "versatility" and "the deficient state of public transport".

From the certain and uncertain elements shaping mobility (as explained in figure 3.8), it was found that not all of them are present. Recapitulating, the certain elements shaping future mobility are: changing demographics, car ownership, increase transportation, competition of space in inner city, and climate change. The uncertain elements are: lifestyle

and cultural values, technological innovations, energy use, social conditions, governance, land use policies and urban forms, business models, regulations, global economic growth, and IT architecture.

Relating the certain elements in future mobility it was observed that car ownership and competition of space in inner cities are strong concerns. Car ownership is increasing in Mexico City, according to a urban planner interviewed. She mentioned: "The public transport is deficient, generating incentives for people to buy a car as soon as the can". As demonstrated above, certain concerns regarding the use of space for multiple transportation modes is still a concern. Changing demographics and increasing transportation do not seem major affairs in future mobility. My interpretation is that, Mexico City urban inhabitants still fulfill their transportation requirements, even considering the negative conditions in which they do it. Increased transportation demand is present in the case study long ago before 2007, and transportation is still running, to some extent, adequately. Climate change is the overlapping discourse to promote sustainability which will be present as long as unsustainable forms are present.

On the other hand, some uncertain elements are more present than others. As it can be drawn from this chapter, social and spatial segregation, including a national context of large income inequality, are key factors which are representative and need to be taken into account when considering mobility policies. Governance is also a present concern in any aspect of megalopolitan dimension. However, other elements, as business models, regulations, and technological innovations are present. Apparently, the novel participation of actors and the increasing need of sustainable mobility are guiding the emergence of novelties in these areas. However, it is still too soon to find clear directions in how is going to be addressed in the future. A final element, as energy use, was never present. This may the case as Mexico is one of the major producers of fossil fuels in the world, and it is not constrained by its use. In the same line, the uncertain global economic growth may not be a concern in Mexico City, as the country has lived almost thirty years with reduced growth. I would suggest that, in complex dynamics such as the ones found in a megacity, the priorities and concerns of mobility interventions rely more in context dependent areas, rather than global concern pushed by mobility and transport organizations. Moreover, this is also indicating a mismatch between visions/expectations of companies in the mobility business and what is happening really in the increasing number of megacities.

Chapter 5

Conclusions

This report aimed to answer an academic concern about how mobility is constructed and envisioned in a megacity, using Mexico City as a case study. Answering the question of *Which are the factors shaping the construction and visions of mobility in Mexico City during the period 2007-2027?*, it was found that context-dependent factors largely shape the way in which the future of mobility is being constructed and envisioned. These factors are of diverse nature, such as socio-economic conditions, urban planning, and mobility cultures. Moreover, it was noted a large gap between the literature available and what is really happening in the case study. In the case study, it was possible to observe that the institutional condition of weakness and the abysmal socio-spatial fragmentation among regions composing the megacity, constrain the development of sustainable mobility.

The first step to answer the research question was to develop a framework based on the characteristics of megacities and their mobility systems, which is comprised in sub-question 1.1. (*What characterizes mobility systems of megacities and what opportunities and challenges can be detected in the literature?*). It was suggested that megacities can be understood better by analyzing their qualitative characteristics. The complex institutional dynamics, and the diverse economic and social realities are difficult to evaluate using a quantitative approach. More qualitative research should be made to grasp this complex reality.

This concern encouraged me to develop a framework. The framework is one of the key contributions of this research. It is expected to be a basic tool for future research in megacities, especially those located in developing countries. As an academic product built from scratch, the framework has a considerable room for improvement. I consider two especially important future directions: In-depth understanding of the interrelations between the dimensions proposed, and testing if the conditions proposed hold in different megacities (i.e. by a comparative study). However, the reviewed literature suggested that each megacity mobility regime is largely dependent on contextual factors. The following studies should bear in mind this limitation, and should avoid providing an overarching and

universal approach for megacities mobility.

Chapter 3 analyzed in detail the five dimensions observed and which are integrated in the framework. Each dimension encompasses a set of factors which are shaping mobility construction and visions in megacities. The framework consisted of three dimensions related to megacities (theory and methodology, socio-spatial dynamics, and institutions and governance); one, to the mobility regime (mobility practices and interventions); an a final one, to visions and expectations. The benefits of agglomerating factors into dimensions is its modularity. New dimensions can be added, and new relations between and factors inside dimensions can be suggested. One of the advantages of using a framework with dimensions is that it can be later replicated to analyze other regimes in megacities. In the case our research is future health, factors can be added to each dimension and other dimensions changed completely (especially the fourth dimension, related to the regime).

It is possible to draw from this chapter that a multi-dimensional and multi-disciplinary approach should be considered for analyzing megacities' mobility. As scholars become more concerned about mobility and less about transport, this tendency of multiple disciplines and dimensions is expected to continue. However, one of the main drawbacks of mobility is that it tries to incorporate as many disciplines as possible: Urban planning, sociology, economics, and transport, just to mention a few of them. A multi-disciplinary approach comes along with reduced precision and a broader scope.

It was observed that one of the first challenges in understanding mobility in a megacity was the lack of an integrated, megalopolitan vision. Major policy interventions in mobility are concerning the central city and, moreover, reflect the dominance of the central urban part in comparison to the periphery. In addition, it was observed that the conditions among the different states in the megacity differ dramatically. The differences among regions is reinforced by different types of urban expansion and management, which are difficult to reverse. The expansion and management can occur outside the legal boundaries of formal institutions.

Even considering these megacity challenges, mobility interventions are being taken and shaped constantly by policy actors. In the case study, it was found that politicians, scholars, and transportation organizations are the most prominent actors. A second category of actors are those supporting policy interventions but without a direct influence on it. From this category, foreign representations (embassies and funds) and civil society organizations have specific roles in mobility interventions (transfer of know-how and generating social costs and benefits for the mobility interventions, respectively). IT companies have not been able to contextualize their mobility solutions to fit Mexico City mobility needs, limiting their capacity to influence policy. Para-legal institutions are strong actors limiting novelties and reproducing old vices of a para-transit style of city.

The megacity is able to operate in a sub-optimal way and without measures of megalopolitan scope. As lack of incentives for cooperation are present, thinking about coordinated policies seems improbable in the short-term. However, the incentives may operate

in a different way: Governors may compete for capitalizing projects in their jurisdiction to attract attention of their actions towards sustainability and inclusive mobility. It is not a competition just between neighboring states, but it also can be observed as a major, global concern to make cities more competitive in the context of globalization.

The first sustainable mobility interventions since 2007 were observed with skepticism, but they have been supported and have received wide coverage in recent years. Ten years ago, it was impossible to think about a vision of mobility competing *vis a vis* a vision of transport. However, today the first mobility ministry has been established in the Federal District, and according to an interviewee, the State of Mexico will follow the same route in the following months. A shift towards mobility encompasses a redefinition of car use, the re-emergence of non-motorized transport, and an approach wider than just 'supply and demand', which was put into practice in recent decades but never solved the mobility concerns in Mexico City.

Probably, due to the complex environment of decision making and interventions in the city, it was nearly impossible to observe long-term, defined policies in the megacity, especially until 2027 (the final year of the time frame selected). There are some master plans for infrastructure investments but, as history shows, these are rarely taken into account. My interpretation of this aspect is that there are no common visions among urban stakeholders. Sustainability is still a contested process in the case study: Apparently there is a limited, minimum, and weak consensus. For example, a better public transport seems to be agreed by most policy actors, but the role of each public transportation mode is still debated.

Apart from this lack of minimum consensus, the city is trapped between large forces which reproduce the same inertia of old fashioned interventions, such as para-formal institutions or embedded interests. Some of the actors hindering change are leaders of public transportation services and the ministry of Infrastructure. For this reason, I argue that the policy interventions which have taken place are widely contested and the time for its upscale may take a long time. Services as BRT or Uber, which are novel to the city, are still contested by traditional transportation providers, and the adoption process is slow. Efficient alternatives such as Uber, which was introduced few months ago, has had a direct impact in the public debate of how the service of taxis should be provided in the city. The service became so popular that in a couple of months it was legalized (Corona, 2015).

In the majority of the successful mobility interventions, it is possible to observe a combination of two factors: (1) an increasing participation of civil society pushing forward a sustainability agenda, and (2) an interest of the government to take the political costs of these interventions. The lack of civil society participation de-legitimize policy interventions. The participation of governmental institutions may seem necessary to coordinate mobility options which concerns the reconfiguration of the public and shared space of Mexico City. Moreover, there are certain public works which can only be taken by sponsorship of public offices and are not suitable for private investment. Another type of suitable funding for these interventions are international financiers. However, as it was observed in the fourth chapter, the room for maneuver in implementing alternative and novel solutions to mobility

is low. Financiers replicate interventions with minimal risks and proven success. Financiers innovation policy is to 'pick winners', which can lead to sub-optimal mobility in the long term.

We see that the radical innovation taken place in recent years did not come from Transportation or Communication ministries in the city of Mexico, but originated in the Environmental Ministry. In the Federal District, Martha Delgado -former ministry of the environment- is recognized as a key figure in pushing the sustainable mobility agenda. In the context of contested visions about mobility, ministries which are not in principle responsible for mobility may offer novel alternatives to the current regime. It can be observed as a different *problem framing*, in which different departments can break the current inertia. Moreover, this also shows that bottom-up may no be suitable for offering radical innovations in the terms of transport, as the dimension of the megalopolis may limit the capacity of these interventions. Large scale population dynamics require support of agencies which enable the adaptation and reconfiguration of the built environment.

Bottom-up approaches, as para-legal transportation systems or Uber, just take advantage of lack of service provisioning in the city, but offer no paradigmatic solutions which can be later upscaled. A bottom-up approach which I consider beneficial for urban mobility construction is the role of civil society. It is clear that CSOs participate actively in transferring know-how and minimizing political and social costs of novel interventions. However, it should be discussed if these organizations are really supporting bottom-up strategies, as many of them are established international transportation organizations and do not come from the megacity 'civil society'.

Another key element was the intrinsic relation between land and mobility. The scarcity of land in a megacity is always a concern for mobility interventions. This relation between space and mobility should be of concern for urban transportation interventions. This relation may indicate that novel individualized solutions as smart cars may not be suitable for these type of urban settlements, as the supply of roads may not enough to move the millions of inhabitants which cross this city every day. If we prioritize the optimal use of land, policies encouraging mass transit systems, and reduced roadway congestion should be a guiding vision. The new (2014) Mobility Law in Mexico City has adequately changed the priorities of public space, making cycling and walking the priority modes of transportation in policy interventions and funding. However, the law still has a flaw point, which is that no annual budget has been defined for these types of transportation, in comparison to automobility or mass transit.

When thinking about future mobility, sometimes we pay too much attention in state of the art innovations and neglect which technologies are really using the commuters. This is also present in the case study: The gap between IT companies offering 'smart' solutions and every day practice of commuters and providers of public transport is abysmal. This research provides a general overlook of how basic technological barriers are the ones limiting adoption of new technologies. It may be necessary to align the interests of large smart mobility enterprises, and the current needs and lack of knowledge and infrastructure in

megacities such as the case study.

Several theoretical implications can be drawn from this research. First, is that agency-based models may have severe limitations to understand megacities' dynamics. Certain approaches advocate to a higher role of individuals and niches in bringing societal innovations. However, as it was observed in the case study, most of the successful policy interventions were in a top-down fashion. Agency is limited and probably not suitable for such large agglomerations. It may be adequate to incorporate a more functionalist, structural perspective when analyzing mobility in megacities. The dimensions of the megacity make individual interventions only suitable for short-term distances. In our case study, it was observed that most of the journeys occurred between several districts and with long distances.

It was found that the mobility system in Mexico City is far from optimal, but it is still functioning and have a strong inertia. Using Multi-level perspective based theories, we can infer that the components of the regime are'de-alligned'. Therefore, why is the regime so stable? A concept that could be suitable for understanding this phenomenon is resilience: Adaptive systems which change over time, and face constant stress and challenges. This resilient condition, allows regimes to evolve as new context emerge, without radical changes. The mobility regime is built to function in a complicated environments, adapting itself easily to new realities.

Moreover, findings of the case study suggests the contested nature of sustainability mobility. In complex scenarios, such as megacities, sustainability interventions are largely related to space. Sustainable mobility interventions affect current urban forms which may have negative impact on people who cannot afford it. Therefore, it may be appropriate to evaluate until what extent sustainability is inclusive and 'people-centered'. New models to limit the negative impact of sustainable interventions should be encouraged, and future studies should focus on the social impact of sustainability.

Three final theoretical implications can be drawn from this the findings. First, more relevance should be given to the concept of 'ecosystem'. Policy interventions are determined by factors such as availability of contractors and financiers, institutional capacity, or rule of the law. More attention should be given to the ecosystem, as its elements were completely relevant to understand mobility policy in the case study. Another implication is that studies in socio-technical regimes should contextualize the different factors to fit into the case study. As it was observed, grocery shopping, car use, or teleworking are context-dependent. Finally, more academic relevance should be given to the concept of 'space'. If the urban population continue growing, space will become a more scarce and valuable resource. It should be given a proper dimension in public policy and innovation, because most of the social issues, and technical and economic rationales, are related to the use of space by the city inhabitants.

Policy recommendations

Several policy recommendations can be drawn from this research. First, it is necessary to harmonize and provide reliable data for measuring the impact of existing interventions and propose new ones. Without the access to this type of data, interventions are still reproducing an inadequate and sub-optimal vision of how the city inhabitants should mobilize. There is no clear information about indexes, and those present, just cover a subset of the complete dimension of mobility. The information about daily short distance journeys and preferences in every day life city inhabitants is almost inexistent. A first step may be integrate and open current data, and generate new indexes which can be used for a real evaluation of policy interventions.

Moreover, it was observed that the central part of the city plays a big role in the construction of mobility in Mexico City. Therefore, it may be necessary to integrate the services in this area of the city to expand it to the surroundings on a later stage. However, the outskirts of the city are underprovisioned in mobility services, having a strong presence the para-formal institutions which were described in chapter 4. In these areas, it may be necessary to coordinate a better social communication strategy to make their citizens participants of the policy process rather than merely 'users'. With this strategy, the construction of sustainability may be less contested in comparison to the present time, and enable a consensual approach.

Another policy consideration is the inclusiveness of sustainable mobility. As described before, most interventions have an income per capita rationale which favors just a small percentage of the population in Mexico, considering the large amount of commuters in the city. If this continues, we may never see an inclusive model of mobility for low-income population. Urban policies should encourage an expansion of mobility services to this population, especially as the findings of the social dimension of the framework were quite important. Without interventions of this type, a self-reinforcing cycle of spatial and social segregation may continue and deepen. It is evident that low-cost solutions should be encouraged, as investment returns in these areas may be limited in the long-term.

Additionally, infrastructure and services should be complementary to allow people use greener mobility alternatives. In the current scheme of payment, only credit card user can access public bicycles schemes; and it is impossible to guarantee the safety for cyclists when using roadways in the city or parking their bicycles outside multi-modal transportation centers. Without proper strategies supporting multi-modality, it would be impossible to consider a shift in modern paradigm. It will reinforce the current trend of car use and avoidance of public transport.

The interventions in infrastructure should have two design principles in mind: The development of a network approach, and the use of disaggregated journey patterns to maximize short-distance journeys of Mexico City inhabitants. The network approach can compliment different modes of transportation in Mexico City, while the use of disaggregated journeys

can maximize the effect of mobility interventions in the case study. Micro- and macro interventions should be complemented to allow a megalopolitan vision on mobility, but at the same time target individual journey patterns.

In relation to governance and institutions, strong incentives for a megalopolitan vision should be encouraged. At the moment, they exist, but their reach is almost negligible. The mechanisms are not working properly, and there is no expected change in the following years. Setting an agenda for common visions in Mexico City, may contribute to shape a more coordinated urban development and management, as long as all the relevant key actors participate in it. It is necessary to avoid the creation of mechanisms which are *apparently* working, but without any real legitimization in society.

A recommendation which is not taken into account by advocates of smart solutions in mobility is the transfer of know-how to public office. These advocates should be aware of the clear limitations of advanced technological solutions in megacities. They should push for a step-by-step strategy considering the current knowledge and infrastructure in these settlements. Technologically pushed innovations, as a smart solution, may fail as no clear analysis is made about the tacit and tangible constrains in the adoption of novel technologies.

Finally, considering the fact that Mexico City can be also observed as a set of multiple cities, metropolitan coordination should also take this into account. Multiplicity of cities offering different services, generate different journey patterns. This structure is already existing, and the idea of 'polycentric' cities may never reach its full potential, as built environment is difficult to reverse. Mass-transit strategies should be encouraged to connect these cities and enable better transportation schemes in the city. During the last century, Mexico City has shifted from different paradigms in urban development and transportation: From large, extensive Parisian boulevards and subway stations, to North American urban sprawl development. Probably, it is time again to reconsider which form and type of city the Mexico City inhabitants prefer, and nourish from already existing solutions of mobility already available in the developed world.

List of Acronyms

BRT Bus Rapid Transit

CAM Metropolitan Area Commission, *Comisión del Area Metropolitana*

CETRAM Modal Transfer Center, *Centro de Transferencia Modal*

CMA Metropolitan Environmental Commission, *Comisión Ambiental Metropolitana*

COMETAH Metropolitan Commission on Human Settlements, *Comisión Metropolitana de Asentamientos Humanos*

COMETRAVI Metropolitan Transport Commission, *Comisión Metropolitana de Transporte y Vialidad*

CONAPO National Population Commission, *Consejo Nacional de Población*

EOD Origin-Destination Survey, *Encuesta Origen Destino*

DF Federal District, *Distrito Federal*

FM Metropolitan Fund, *Fondo Metropolitano*

FONADIN National Infrastructure Fund, *Fondo Nacional de Infraestructura*

HDI Human Development Index

IFMO Institute for Mobility Research

IMF International Monetary Fund

INEGI National Institute of Geography and Statistics, *Instituto Nacional de Geografia y Estadística*

MAMSL Meters above sea level

MLP Multiple Level Perspective

OECD Organization for Economic Co-operation and Development

PAN Partido Acción Nacional

PITV Integral Program of Transport and Roadways, *Programa Integral de Transporte y Vialidad*

PRD Partido de la Revolución Democrática

PRI Partido Revolucionario Institucional

PROTRAM Mass Transit Federal Support Program, *Programa de Apoyo Federal al Transporte Masivo*

RTP Passenger Transportation Network, *Red de Transporte de Pasajeros*

UN United Nations

UN-Habitat United Nations Human Settlements Programme

UNDP United Nations Development Programme

WB World Bank

ZMCM Mexico City Metropolitan Zone, *Zona Metropolitana de la Ciudad de México*

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Appendix A

Mexico City Mobility Data

Table A.1: Municipalities composing Mexico City megacity

State	Municipality	State	Municipality
DF	Azcapotzalco	México	Huixquilucan
DF	Coyoacán	México	Isidro Fabela
DF	Cuajimalpa de Morelos	México	Ixtapaluca
DF	Gustavo A. Madero	México	Jaltenco
DF	Iztacalco	México	Jilotzingo
DF	Iztapalapa	México	Juchitepec
DF	La Magdalena Contreras	México	Melchor Ocampo
DF	Milpa Alta	México	Naucalpan de Juárez
DF	Álvaro Obregón	México	Nezahualcóyotl
DF	Tláhuac	México	Nextlalpan
DF	Tlalpan	México	Nicolás Romero
DF	Xochimilco	México	Nopaltepec
DF	Benito Juárez	México	Otumba
DF	Cuauhtémoc	México	Ozumba
DF	Miguel Hidalgo	México	Papalotla
DF	Venustiano Carranza	México	La Paz
Hidalgo	Tizayuca	México	San Martín de las Pirámides
México	Acolman	México	Tecámac
México	Amecameca	México	Temamatla
México	Apaxco	México	Temascalapa
México	Atenco	México	Tenango del Aire
México	Atizapán de Zaragoza	México	Teoloyucan
México	Atlautla	México	Teotihuacán
México	Axapusco	México	Tepetlaoxtoc
México	Ayapango	México	Tepetlixpa
México	Coacalco de Berriozábal	México	Tepotzotlán
México	Cocotitlán	México	Tequixquiac
México	Coyotepec	México	Texcoco
México	Cuautitlán	México	Tezoyuca
México	Chalco	México	Tlalmanalco
México	Chiautla	México	Tlalnepantla de Baz
México	Chicoloapan	México	Tultepec
México	Chiconcuac	México	Tultitlán
México	Chimalhuacán	México	Villa del Carbón
México	Ecatepec de Morelos	México	Zumpango
México	Ecatzingo	México	Cuautitlán Izcalli
México	Huehuetoca	México	Valle de Chalco Solidaridad
México	Hueypoxtla	México	Tonanitla

Table A.2: Municipalities/boroughs considered for the Origin-Destination Survey

State	Municipality	State	Municipality
DF	Azcapotzalco	Mexico	Ecatepec de Morelos
DF	Coyoacán	Mexico	Huehuetoca
DF	Cuajimalpa de Morelos	Mexico	Huixquilucan
DF	Gustavo A. Madero	Mexico	Ixtapaluca
DF	Iztacalco	Mexico	Jaltenco
DF	Iztapalapa	Mexico	Melchor Ocampo
DF	Magdalena Contreras	Mexico	Naucalpan de Juárez
DF	Milpa alta	Mexico	Nezahualcoyotl
DF	Álvaro Obregón	Mexico	Nextlalpan
DF	Tláhuac	Mexico	Nicolás Romero
DF	Tlalpan	Mexico	Papalotla
DF	Xochimilco	Mexico	La Paz
DF	Benito Juárez	Mexico	San Martín de las P.
DF	Cuauhtémoc	Mexico	Tecámac
DF	Miguel Hidalgo	Mexico	Teoloyucan
Mexico	Venustiano Carranza	Mexico	Teotihuacán
Mexico	Acolman	Mexico	Tepetlaoxtoc
Mexico	Amecameca	Mexico	Tepotzotlán
Mexico	Atenco	Mexico	Texcoco
Mexico	Atizapán de Z.	Mexico	Tezoyuca
Mexico	Coacalco de B.	Mexico	Tlalmanalco
Mexico	Coyotepec	Mexico	Tlanepantla de Baz
Mexico	Cuautitlán	Mexico	Tultepec
Mexico	Chalco	Mexico	Tultitlán
Mexico	Chiautla	Mexico	Zumpango
Mexico	Chicoloapan de J.	Mexico	Cuautitlán Izcalli
Mexico	Chiconcuac de J.	Mexico	Valle de Chalco S.
Mexico	Chimalhuacán	State of Mexico	Tonanitla

Table A.3: Journeys from municipality to destination (2007)

Origin	To Federal District	To State of Mexico	Ratio
Federal District	**10,709,884**	**356,431**	**30:1**
Álvaro Obregón	953,410	15,905	60:1
Azcapotzalco	503,711	36,114	14:1
Benito Juárez	626,363	12,775	49:1
Coyoacán	878,009	11,397	77:1
Cuajimalpa de Morelos	208,360	11,564	18:1
Cuauhtémoc	652,269	20,597	32:1
Gustavo A. Madero	1,343,577	90,706	15:1
Iztacalco	458,009	13,196	35:1
Iztapalapa	2,034,447	77,209	26:1
La Magdalena Contreras	290,971	2,992	97:1
Miguel Hidalgo	477,367	22,855	21:1
Milpa alta	92,975	1,862	50:1
Tláhuac	361,028	9,324	39:1
Tlalpan	876,606	7,307	120:1
Venustiano Carranza	489,932	17,561	28:1
Xochimilco	462,850	5,067	91:1
State of Mexico	**2,123,731**	**8,708,055**	**1:4**
Acolman	9,787	84,312	1:9
Amecameca	2,874	28,792	1:10
Atenco	3,232	51,285	1:16
Atizapán de Zaragoza	65,918	540,670	1:8
Chalco	41,863	172,894	1:4
Chiautla	1,225	19,283	1:16
Chicoloapan de Juárez	58,368	171,378	1:3
Chiconcuac de Juárez	-	13,709	N/A
Chimalhuacán	113,217	345,328	1:3
Coacalco de Berriozábal	60,923	339,085	1:6
Coyotepec	1,085	20,109	1:19
Cuautitlán	9,207	122,093	1:13
Cuautitlán Izcalli	66,794	521,207	1:8
Ecatepec de Morelos	403,693	1,355,572	1:3
Huehuetoca	4,905	54,364	1:11
Huixquilucan	73,594	185,911	1:3
Ixtapaluca	120,179	343,472	1:3
Jaltenco	7,442	22,984	1:3
La Paz	65,044	155,159	1:2
Melchor Ocampo	1,481	36,779	1:25
Naucalpan de Juárez	163,100	733,678	1:4
Nextlalpan	1,220	33,076	1:27
Nezahualcoyotl	359,306	773,749	1:2
Nicolás Romero	24,359	270,410	1:11
Papalotla	441	7,196	1:16
San Martín de las Pirámides	1,630	30,849	1:19
Tecámac	62,749	313,607	1:5
Teoloyucan	3,514	63,488	1:18

Teotihuacán	3,267	51,145	1:16
Tepetlaoxtoc	2,136	23,548	1:11
Tepotzotlán	2,754	52,082	1:19
Texcoco	17,302	227,893	1:13
Tezoyuca	2,143	26,465	1:12
Tlalmanalco	2,166	25,566	1:12
Tlanepantla de Baz	203,995	630,430	1:3
Tonanitla	1,244	9,702	1:8
Tultepec	11,888	114,178	1:10
Tultitlán	74,000	412,539	1:6
Valle de Chalco Solidaridad	69,537	156,034	1:2
Zumpango	6,149	168,034	1:27
Tultitlán	74,000	412,539	1:6
Valle de Chalco Solidaridad	69,537	156,034	1:2
Zumpango	6,149	168,034	1:27
TOTAL	**12,833,615**	**9,064,486**	1.42:1

Table A.4: Municipalities considered for the *Encuesta Origen Destino*

Type of integration	Federal District	State of Mexico	**Total**
Physical	16	33	**49**
Urban policy	0	4	**4**
Functional	0	3	**3**
Total	**16**	**40**	**56**

Table A.5: Demographic characteristics of municipalities/boroughs in Mexico City

Municipality type	Type of integration	State	Municipalities	Population	Extension	Density (hab/ha)
		Subtotal	**52**	**17,844,829**	**5,079**	**117.98**
Central	Physical	DF	16	8,605,239	1,495	163.76
		México	36	9,239,590	3,584	97.63
	Urban policy	**Subtotal**	**17**	**370714**	**2200.363**	**30.43**
		México	17	370,714	2,200	30.43
External		**Subtotal**	**7**	**181,134**	**587**	**48.72**
	Functional	México	6	134,790	510	47.26
		Hidalgo	1	46,344	77	57.47
Total			**76**	**18396677**	**7866.086**	**92.02**

Table A.6: Transmunicipal and internal journeys

Location	Transmunicipal journeys Origin	Transmunicipal journeys Destination	Internal travel
Mexico City Megacity	**21,947,157**	**21,815,759**	**8,865,930**
Distrito Federal	***12,805,174***	***12,832,615***	***4,596,471***
Azcapotzalco	645,293	649,253	217,618
Coyoacan	1,100,687	1,103,951	377,247
Cuajimalpa de Morelos	245,262	245,984	119,184
Gustavo A. Madero	1,449,508	1,453,531	661,145
lztacalco	490,265	491,666	116,800
lztapalapa	1,821,880	1,812,574	878,538
La Magdalena Contreras	234,456	234,041	94,440
Milpa Alta	79,718	79,677	40,398
Alvaro Obreg6n	954,818	954,641	405,635
Tláhuac	278,465	277,306	106,674
Tlalpan	854,410	853,662	380,939
Xochimilco	394,415	394,941	191,054
Benilo Juarez	982,823	986,277	258,559
Cuauhtemoc	1,685,565	1,695,206	358,903
Miguel Hidalgo	941,989	941,402	229,369
Venustiano Carranza	645,620	658,503	159,968
State of Mexico	***9,064,036***	***8,891,423***	***4,268,778***
Alizapan de Zaragoza	476,829	474,526	213,137
Coacalco de BerTiozabal	339,034	338,947	163,200
Cuaulitlan	124,140	123,204	41,867
Chalco	202,271	202,770	100,906
Chicoloapan de Juarez	155,677	15,266	59,430
Chimalhuacan	300,783	298,287	110,511
Ecatepec de Morelos	1,442,070	1,439,745	808,521
Huixquilucan	204,456	204,118	84,120
lxlapaluca	320,774	315,747	152,666
Naucalpan de Juarez	938,254	937,117	495,795
Nezahualcóyotl	901,547	897,062	351,756
Nicolas Romero	202,503	201,364	100,680
La Paz	185,052	184,602	61,849
Tecamac	285,837	283,872	149,227
Texcoco	267,934	266,150	180,931
Tlalnepantla de Baz	842,161	842,457	303,857
Tultitlán	349,050	344,700	123,280
Cuautitlan lzcalli	558,679	557,062	316,184
Valle de Chalco Solidaridad	151,922	149,909	41,276
Others	815,063	814,518	409,585
Outside Mexico City	***61,125***	***72,254***	-
Missing	***16,822***	***19,467***	***681***

Table A.7: Add caption

Destination place	DF	State of Mexico				**Total**
		Physical	Urban policy	Functional	Total	
Home	4,954,032	4,695,748	227,238	56,302	4,979,288	*9,933,320*
School	1,701,429	1,470,320	64,468	16,835	1,551,623	*3,253,052*
Office	1,328,295	866,220	29,397	6,984	902,601	*2,230,896*
Commercial facilities	972,017	970,063	47,273	11,482	1,028,818	*2,000,835*
Industry	165,371	215,226	9,980	4,331	229,537	*394,908*
Second house	448,563	472,167	25,019	5,572	502,758	*951,321*
Health facilities	400,656	338,381	18,259	3,662	360,302	*760,958*
Restaurants and bars	105,078	44,003	1,751	54	45,808	*150,886*
Laboratories	77,764	37,775	25,360	3,548	66,683	*144,447*
Sports complex	66,343	36,292	820	277	37,389	*103,732*
Parks and recreation	35,486	20,360	948	216	21,524	*57,010*
Other	660,015	685,636	42,877	9,205	737,718	*1,397,733*
Total	**10,915,049**	*9,852,191*	*493,390*	*118,468*	**10,464,049**	**21,379,098**

Table A.8: Multimodal journeys in Mexico City

First Mode	Type of transport						
	Subway	Light rail	BRT	Trolley	RTP	Suburban bus	Minibus
Subway	-	13,656	9,299	12,212	35,343	187,445	960,681
Light rail	12,801	-	302	137	684	369	12,725
BRT	21,815	299	-	1,616	2,167	7,084	43,627
Trolley	23,516	231	1,399	1,148	3,998	3,739	27,528
RTP	62,798	2,646	2,595	4,109	8,143	11,395	95,736
Suburban bus	322,035	2,624	9,348	3,114	11,052	58,639	308,258
Minibus	1,558,000	44,307	49,889	28,549	105,099	347,147	1,969,067
Taxi	58,670	831	1,879	443	3,545	26,802	67,296
Car	17,203	691	1,406	100	471	3,470	13,647
Motorcycle	-	-	57	-	-	55	96
Bicycle	321	-	-	85	-	69	681
Other	9,996	58	510	42	458	1,995	12,602
Total	***2,087,155***	***65,343***	***76,684***	***51,555***	***170,960***	***648,209***	***3,511,944***

First Mode	Type of transport					**Total**
	Taxi	Car	Motorcycle	Bicycle	Other	
Subway	36,722	5,367	69	138	4,943	**1,265,875**
Light rail	367	-	-	-	127	**27,512**
BRT	2,035	415	-	-	547	**79,605**
Trolley	908	-	-	85	-	**62,552**
RTP	1,862	99	-	-	242	**189,625**
Suburban bus	19,274	485	-	69	1,774	**736,672**
Minibus	95,687	5,020	103	168	14,664	**4,217,700**
Taxi	2,804	820	-	-	1,632	**164,722**
Car	2,335	753	108	678	1,286	**42,148**
Motorcycle	113	-	-	-	-	**321**
Bicycle	130	429	-	-	-	**1,715**
Other	1,511	1,136	-	-	249	**28,557**
Total	***163,748***	***14,524***	***280***	***1,138***	***25,464***	**6,817,004**

Table A.9: Journeys by activity and origin/destination location

Location	Work		Home		Study	
	From	To	From	To	From	To
Mexico City	**5,588,292**	**5,588,292**	**9,849,659**	**9,849,659**	**1,941,692**	**1,941,692**
Federal District	***2,892,669***	***3,848,205***	***6,352,649***	***4,905,069***	***986,238***	***1,171,813***
Azcapotzalco	136,712	202,363	333,523	241,626	46,541	71,645
Coyoacan	231,076	271,863	563,821	392,321	76,975	198,240
Cuajimalpa de Morelos	53,115	72,149	124,928	100,106	21,681	24,825
Gustavo A. Madero	368,379	319,620	666,232	653,499	122,668	166,586
lztacalco	125,022	137,536	224,807	213,543	39,680	48,898
lztapalapa	537,601	405,844	709,047	928,866	171,262	130,004
La Magdalena Contreras	71,988	45,153	81,201	128,909	24,677	16,075
Milpa Alta	25,963	15,278	30,491	44,637	9,846	8,545
Alvaro Obregon	239,247	256,968	409,090	429,846	93,705	74,107
Tlahuac	91,564	50,887	91,449	169,192	35,659	22,017
Tlalpan	201,442	194,254	378,919	386,917	86,429	82,926
Xochimilco	113,684	74,183	151,651	216,376	46,562	36,670
Benito Juarez	173,166	377,619	549,902	264,148	52,363	67,847
Cuauhtemoc	231,523	771,769	1,111,156	295,408	70,784	103,254
Miguel Hidalgo	149,875	432,512	579,521	214,373	45,192	82,503
Venustiano Carranza	142,312	220,207	346,911	225,302	42,214	37,671
Estado de México	***2,692,194***	***1,694,424***	***3,428,677***	***4,944,537***	***955,081***	***764,903***
Atizapán de Zaragoza	143,193	74,732	167,132	272,934	57,991	45,448
Coacalco de Berriozabal	91,836	42,610	127,557	176,544	35,442	41,548
Cuautitlan	30,455	22,959	55,000	58,765	14,201	12,983
Chalco	62,179	45,727	86,169	102,040	18,992	16,454
Chicoloapan de Juarez	56,919	18,887	42,216	101,123	16,056	9,969
Chimalhuacan	124,313	31,489	72,202	210,797	34,216	15,684
Ecatepec de Morelos	462,754	257,036	530,198	816,460	156,758	113,018
Huixquilucan	58,281	40,221	72,184	120,931	26,583	12,155
lxtapaluca	102,953	41,045	96,934	202,985	35,937	21,524
Naucalpan de Juárez	227,577	236,872	433,945	409,197	79,673	94,297
						(continued)
Estado de México	***2,692,194***	***1,694,424***	***3,428,677***	***4,944,537***	***955,081***	***764,903***
Nezahualcóyotl	298,847	148,206	314,564	520,552	95,423	80,450
Nicolás Romero	71,400	18,036	56,360	136,362	29,654	18,076
La Paz	52,951	35,850	71,994	100,122	17,777	11,890
Tecamac	81,063	42,346	95,318	165,574	32,080	24,561
Texcoco	54,194	55,887	131,134	111,411	27,692	31,317
Tlalnepantla de Baz	206,744	233,702	393,071	375,503	69,862	66,714

Tultitlan	117,634	61,492	108,008	220,474	42,661	16,287
Cuautitlan Izcalli	144,006	135,827	245,662	266,431	49,195	54,132
Valle de Chalco S.	84,512	21,603	37,644	109,843	15,827	9,568
Others	220,383	129,897	291,385	466,489	99,061	68,828
Outside Mexico City	*2,241*	*35,955*	*53,922*	-	*364*	*3,821*
Missing	*1,188*	*9,708*	*14,411*	*53*	*9*	*1,155*

Location	Shoping		Leisure		Other	
	From	To	From	To	From	To
Mexico City	**1,075,114**	**1,075,114**	**612,856**	**612,856**	**2,886,544**	**2,886,544**
Federal District	***561,100***	***660,260***	***330,285***	***363,500***	***1,689,233***	***1,884,768***
Azcapotzalco	29,156	24,506	13,356	16,514	87,005	92,599
Coyoacan	45,642	42,823	37,075	38,224	146,098	160,480
Cuajimalpa de Morelos	14,859	14,852	3,508	6,791	30,171	30,261
Gustavo A. Madero	66,032	49,568	39,387	46,743	186,810	217,515
lztacalco	24,464	12,339	11,584	11,549	64,708	67,801
lztapalapa	88,590	90,887	47,642	41,690	267,738	215,283
La Magdalena Contreras	9,927	4,986	8,556	6,083	38,107	32,835
Milpa Alta	5,061	3,716	1,203	1,359	7,154	6,142
Alvaro Obregon	48,414	32,923	27,451	24,959	136,911	135,838
Tlahuac	17,528	6,682	6,347	4,581	35,918	23,947
Tlalpan	34,835	29,483	25,135	24,742	127,650	135,340
Xochimilco	21,795	17,249	8,821	10,616	51,902	39,847
Benito Juarez	38,937	45,253	28,033	35,672	140,422	195,738
Cuauhtemoc	57,356	191,094	38,909	46,115	175,837	287,566
Miguel Hidalgo	32,811	30,701	21,864	31,060	112,726	150,253
Venustiano Carranza	25,693	63,198	11,414	16,802	80,076	93,323
						(continued)
Estado de México	***512,131***	***411,267***	***282,136***	***231,101***	***1,193,817***	***982,589***
Atizapán de Zaragoza	31,938	22,373	13,177	10,567	63,398	48,472
Coacalco de Berriozabal	17,376	18,872	9,791	10,851	57,032	48,522
Cuautitlan	5,581	7,862	4,624	4,999	14,279	15,636
Chalco	12,270	13,011	3,102	3,717	19,559	21,821
Chicoloapan de Juarez	9,037	4,654	3,953	2,759	27,496	15,269
Chimalhuacan	16,294	8,805	13,971	8,367	39,787	23,145
Ecatepec de Morelos	72,575	60,293	41,937	38,969	177,848	153,972
Huixquilucan	14,521	9,532	7,992	5,612	24,895	15,667
lxtapaluca	23,084	14,202	12,960	7,401	48,906	28,590
Naucalpan de Juárez	47,991	47,958	24,668	23,973	124,400	124,820
Nezahualcóyotl	43,672	24,622	37,713	29,980	111,328	93,252
Nicolás Romero	12,363	7,928	5,980	4,091	26,746	16,871
La Paz	14,919	13,116	2,881	3,801	24,530	19,823

Tecamac	19,064	14,056	17,461	10,044	40,851	27,291
Texcoco	13,772	20,286	7,313	9,202	33,829	38,047
Tlalnepantla de Baz	44,642	42,919	22,029	18,359	105,813	105,260
Tultitlan	20,130	14,810	10,472	5,951	50,145	25,686
Cuautitlan Izcalli	30,336	27,743	15,031	11,702	74,449	61,227
Valle de Chalco S.	3,326	1,357	1,126	990	9,487	6,548
Others	59,240	36,868	25,955	19,766	119,039	92,670
Outside Mexico City	*1,837*	*3,073*	*297*	*15,011*	*2,464*	*14,394*
Missing	*46*	*514*	*138*	*3,244*	*1,030*	*4,793*

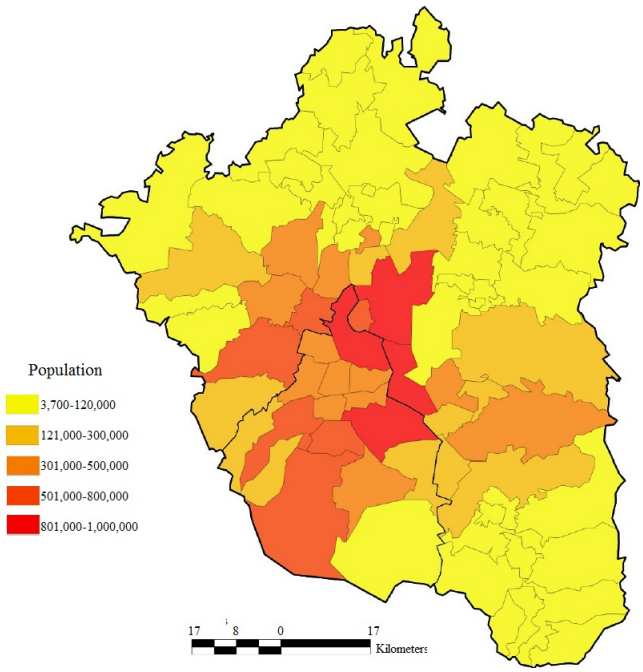

Figure A.1: Total population by municipality, 2007 (source: edited from Gobierno del Distrito Federal (2010)).

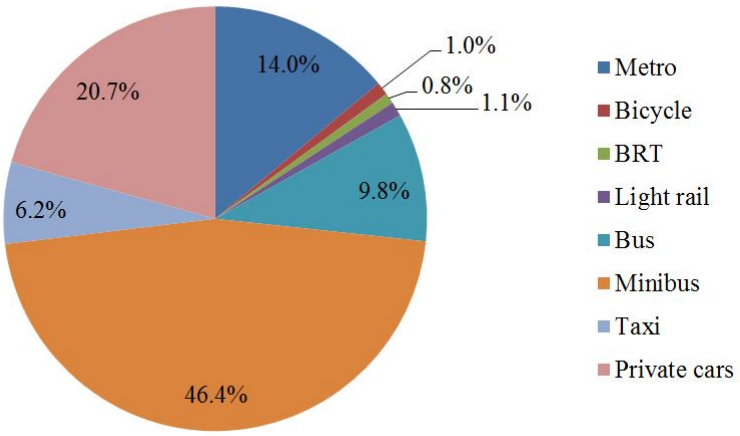

Figure A.2: Total journeys by mode of transportation, 2007 (source: edited from Gobierno del Distrito Federal (2010)).

Table A.10: Journeys related to reasons of traveling

Reason	DF	State of Mexico			Total
	Physical	Physical	Urban policy	Functional	
Work	2,795,716	2,634,218	130,750	27,608	5,588,292
Related to work	174,727	90,246	3,651	810	269,434
Home	4,902,186	4,666,598	225,212	55,663	9,849,659
Study	966,120	921,900	41,218	12,454	1,941,692
Shopping	528,855	511,319	26,079	8,861	1,075,114
Take someone	676,584	496,749	21,308	4,226	1,198,867
Social activities	300,801	300,270	9,230	2,555	612,856
Eating	84,591	44,308	2,579	480	131,958
Formalities	187,193	188,166	7,593	2,052	385,004
Other	469,123	401,947	24,137	6,074	901,281

Appendix B

Data sources

Table B.1: Interviewees

Organization	**Expertise**
International transport organization	Compact cities management, (non) motorized mobility design and implementation
Higher education institution	Social geography, population and environment, metropolitan transport, sustainability
International transport organization	Transport oriented development (TOD), geographical information systems
Civil Society organization	Land use, illegal urban settlements, sustainable city development
Environmental Research Institute	Urban development and environment economics, sustainability
Public policy consultancy	Urban sociology and urbanism, social programs evaluation
Environmental Research Institute	Urban development, land planning, consultancy
Higher education institution	Transport geography, regional planning, geographical information systems
Urban planners association	Urban public works, politics and infrastructure
Research University	History of mobility technology and infrastructure, Latin America
Research University	Developing world megacities

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