MANAGEMENT OF URBAN MOBILITY AND TRANSPORT IN THE METROPOLITAN AREA OF GUADALAJARA

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ABSTRACT

The management of the Metropolitan Area of Guadalajara, Jalisco, Mexico, during the last decades has had a negative impact on the territory, urban mobility, transport and the environment as a result of urban sprawl governed by speculation and high automobile dependency, and the lack of consistent and effective public policies with capacity to transform the metropolis to the quality of life.

The paper exposes the general consequences of an unsustainable metropolitan and alternatives for change also are discussed.

KEY WORDS: Metropolitan management, metropolitan sprawl, urban mobility, transport, environment, and sustainability.

INTRODUCTION

The urban growth of Latin American cities based on a dispersed territorial expansion represents enormous challenges for the public and private urban mobility and the transportation of people, goods and services, in order to produce severe social, economic and environmental externalities in an urban management context ruled by real estate speculation and the high dependence of the automobile as a mean of transportation and energy space dominant.[1]

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1 This city model is typical of capitalist cities: "zoned by their functions such as office areas in downtown, shopping malls and entertainment in the suburbs connected by highways" (Rogers, 1997:33). The opposite model is the "dense cities" or "compact cities" which pretend that their communities connect with their neighborhood, using fewer resources and producing less pollution.

Most Latin-American metropolis grows under this model, away from any sustainable territorial consideration and the exponential increase of their car ownership rates.

Paradoxically the cities that were created for the social, economic, cultural and environmental exchange (Engwicht, 1993), now a day suffer from remoteness, fragmentation and segregation, with major problems that nobody assumes and all suffer.

1. THE IMPERFECT TRINOMIAL

1.1 TERRITORY

The main metropolises in Mexico are growing scattered and disorderly manner with serious impacts on coexisting, prosperity and health on their habitants.

The urban surface of the 59 metropolitan areas and cities in Mexico bigger than 50 thousand habitants occupy an area of 1.14 million hectares, up 600% than 30 years ago; most part of this territory is occupied by 11 metropolitan areas over a million habitants and an average population density of 62 habitants per hectare. Meanwhile the urban space grew 5 times; population grew only 1.8 times (ONU-HABITAT, 2015).

This way of growth, with long distances and serious accessibility limitations, has made from the private automobile the main actor of urban mobility. In accordance with *Reporte Nacional de Movilidad Urbana en Mexico 2014-2015* published by ONU-HABITAT said that the Metropolitan Area of Guadalajara (AMG, for its acronym in Spanish), the Metropolitan Area of Mexico's Valley, and the Metropolitan Area of Monterrey, concentrate the 40% of the private automobile of the country (ONU-HABITAT, 2015). The current car ownership of Mexico presents an annual growth of 6.32%, higher than the demographic rate which represents 2.41%. It is expected that, continuing with this trend, by the year 2030 the country has car ownership fleet of 70 million vehicles, mainly composed by private vehicles (ITDP, 2012).

The high rate of car ownership it is closely related to the scattered city model; shown in **Table 1**, the density of population in the AMG case is relatively low related to its urban area. The scattering process has been attributed largely to the irresponsibility of some public and private actors who have given the public good to the real estate speculation and massive housing construction of suspicious quality, with unsatisfactory public services, insufficient urban equipment, and a limited urban accessibility and public transportation range service.

TABLE 1. POPULATION DENSITY AND CAR OWNERSHIP[2]

	Population	Urban Surface (hectares)	Population Density (hab/ha)	Total Vehicle Fleet	Private Automobile	Motorization Rate cars/1000 hab
AMG	4,865,122	65,943	74	2,034,942	1,341,901	275.82
Mexican Republic	119,530,753	1,960,615	61	38,023,535	25,543,130	213.70

Source: own calculations based on INEGI, 2014 and 2015.

The AMG, second largest metropolis in Mexico by its role as regional node and articulator of economic relations with the center and north part of the country, has a population of 4,865,122 habitants and it is integrated by 9 municipalities[3] in an urban extension of 65,943 hectares and a 74 density of habitants by hectares (INEGI, 2015).

In almost three decades the metropolis has grown more than its population with rates of car ownership that is found above national average and Latin America.[4] The AMG it has already over two million vehicles registered, which half of those are private vehicles (see **Table 1**).

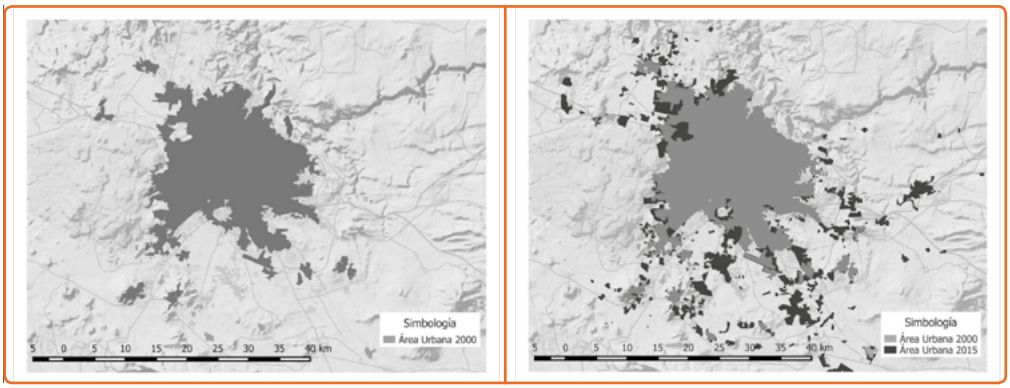
2 The population date correspond to the year 2015, in the case of the registration of vehicles of the last available update is from 2014.

3 Until the first half of year 2014, the 8 municipalities integrated in the metropolis were Guadalajara, Zapopan, Tonala, Tlaquepaque, El Salto, Juanacatlan, Tlajomulco de Zuñiga and Ixtlahuacan de los Membrillos. On July 8 2015, by decree 25400 the Congress of the State it was incorporated the ninth municipality called Zapotlanejo, an arguable decision because its incorporation to Metropolis Area level and Metropolitan region not conducive extensive urban growth.

4 In 15 Latin American comparisons, the AMG finds itself among the cities with major car ownership rates along Mexico City, Buenos Aires and Curitiba (CAF & Latin America Development Bank, 2011).

According to the report Área Metropolitana de Guadalajara. Expansión urbana. *Análisis y prospectiva: 1970-2045* published by the Metropolitan Planning Institute of Guadalajara Metropolitan Area (IMEPLAN, for its acronym in Spanish) the building surface of the city grew double its size in the past 25 years (1990-2015) and grew with a 2.9% annual average rate, meanwhile the population annual average rate was 1.9%. (IMEPLAN, 2015: 59).[5] This way the city grew much faster than its population (see **Figure 1**).

Figure 1. – Urban area sprawl 2000 y 2015.



Surface 2000: 47,603 ha Surface 2015: 65,943 ha

Source: self-elaboration based on the Geostatic Municipality Frame INEGI, 2000 y 2015.

The municipalities of Guadalajara, Tlaquepaque and Tonala register the most density population above average of the AMG which 74 habitants per hectare, however, except Guadalajara's municipality, differences are around 18% rate. The rest of the municipalities are below this rate, registering the least density the municipalities of Ixtlahuacan de los Membrillos and El Salto (see **Table 2**).

5 The analysis of IMEPLAN just includes the municipalities of Guadalajara, Zapopan, Tonala, Tlaquepaque, Tlajomulco de Zuñiga, Ixtlahuacan de los Membrillos, El Salto y Junacatlan.

TABLE 2. POPULATION DENSITY AND URBAN AREA PERCENTAGE BY MUNICIPALITY

Municipality's Name	Population	Urban Surface	Population Density (hab/ha)	Urban Surface Percentage Occupied by Municipality
Guadalajara	1,460,148	14,277	102	21.7%
Ixtlahuacan de los Membrillos	53,045	1,270	42	1.9%
Juanacatlan	17,955	296	61	0.4%
El Salto	183,437	3,741	49	5.7%
Tlajomulco de Zuñiga	549,442	9,280	59	14.1%
Tlaquepaque	664,193	8,573	77	13.0%
Tonala	536,111	6,534	82	9.9%
Zapopan	1,332,272	20,803	64	31.5%
Zapotlanejo	68,519	1,170	59	1.8%
AMG	4,865,122	65,943	74	100%

Source: self-elaboration based on INEGI, 2015.

While in peripheral municipalities continues promoting urban sprawl growth with a housing supply oriented mainly to poor population and large service problems, mobility, accessibility, and both internal and external connectivity, the central municipalities are oriented to vertical growth aimed to middle and high economic status population, with exclusivity and gentrification intentions, but at the same time without enough infrastructure and equipment, producing a high specific demand and shortages of basic services, obviously including concerning towards road infrastructure and public transportation.

The trend of urban growth is given predominantly to the south, north and northwest supporting irrationally by general and unsustainable urban planning that in practice keeps giving discretionary action to the authorities in turn.

One of the most relevant breakthroughs in planning and management in inter municipal level is the creation of the IMEPLAN. After a process of reforms and additions to the law in order of having a better metropolitan coordination, the IMEPLAN began its functions in 2014, among the first consultation documents published online by this agency *Plan de Ordenamiento Territorial Metropolitano* (POTMet) and the *Programa de Desarrollo Urbano* (PDU) are found. In these documents, the current conditions of the city are presented and proposed, in general, some conditions to consolidate a strategy of land management.

Despite what the POTMet in terms of metropolitan organization and within a historical legal framework to the AMG related to territorial planning this contains serious inconsistencies. The plan considers excessive urban reserves. Such consideration, alone, promotes the spread and expansion of the city complicating the consolidation of the central core. Currently, urban surface is just over of 65 thousand hectares and the population density of 74 habitants per hectare, however, the document mentions that still exists 44,416 hectares as reserve, of which 23,870 argue that are feasible urbanization (in addition to the current urbanization); 17,377 are conditioned, meaning that they can be urbanized if the territorial and environmental suitability report is fulfilled; 3,170 are restricted, meaning that they have a very low territorial competence for urban development but can be developed whenever feasible and restricted reserves are exhausted develop (IMEPLAN, 2016).

The total urban area considered in 2015 by POTMet is 72,463 hectares, if these are added 44,416 hectares of urban reserves the total is 116,879 hectares. If the projection on the rise of the 2045 year of World Urban Prospects (WUP) of 6,621,876 habitants (quoted by the document itself) is used, and if the totals of urban reserves are used, the density will decrease to 57 habitants per hectare, a significant drop compare to the current density.

The excessive promotion of urban reserves would only exacerbate the dispersion problem. The city would become in an even less manageable and with greater space mobility problems. This is a severe contradiction towards compact city policies from public institutions begin to promote and would allow housing supply away from the city center continues to spread using urban reserves.

Is not a minor manner that, despite the problems mentioned above that has led dispersion, promotes contradictory policies. Keep thinking that metropolises endless extensions zoned abstractly and ambiguously, just contribute to a bigger disorder and to discretion, than to the order of a livable quality of our cities. Progress in legislation and policy matters begins to veer towards a sustainable city, so the space gained in the matter cannot and should miss. Land use planning is the first step to substantively improve urban mobility.

If the purpose of POTMet (2016) is to convert the metropolis of Guadalajara in a more cohesive and functionally polycentric city, but not noticed how it will happen this transformation without the conceptual and instrumental coherence to achieve, and especially without the provision of municipal presidents in turn to transfer part of the expected growth of the municipality in favor of balanced metropolitan development.

Clearly, institutional planning of the territory was abandoned

in the late eighties and the city was placed in the hands of property developers as well exposes Garcia (2004) in his book *La Ciudad Hojaldre*. In thirty years it has come to a true urban crisis where levels of state and local government seem to have given up their constitutional rights of the territory, losing the social and environmental sense of urban future, applying the same methods that produced the city divided and fragmented, as new initiatives coordination, governance and metropolitan governance should precepts and from different methodological instruments that have led to inequality and urban disorder. Keeping the same methods and precepts of the laws and regulations of the last century urban perpetuate the same practices and the negative consequences of the current crisis.

1.2. MOBILITY AND TRANSPORT

The daily urban stage expresses itself in a greater intensity on a daily commute and high motorization, with a transportation flow generator of large fragmentations and large road crashes, accidents and environmental pollution. Both the scope of the Metropolitan Region and the Metropolitan Area, getting in and out the city it is every time harder and harder, especially with the messy mixture and very little unregulated of goods and services transportation; the articulation and external and internal flow are producing an incremental slowdown in which overcrowding is the main actor.

Even when the vehicular growth is multifactorial, the preeminence of private automobile is connected to the insufficient coverage and the offer of good quality public transportation, capable of attract the trips produced by private transportation.

In the case of AMG the public transportation has grown a little since 20 years ago by political controversies rather than serious technical debates. Beyond the political situations, a large section of the so-called political class does not yet comprehend the basics of Thomson's classic transportation economy from last century still in force: complementarity, transferability, competitiveness (Thompson, 1976). In other words, non-mean of transportation is capable by itself to meet of all the public transportation need, they all complementary, and their development depends on current economic and politics circumstances; what cannot be lost sight is that only this complementarity can be achieved in an integrated conception of the whole urban transport conception either public or private. This implies inter-modality and the physical, operational and competiveness facilities to accomplish transferability and maintain good quality standard service.

Despite the significant growth that will be achieved in the massive transport network with the new line of the urban electric train, the 85% of the millions of daily trips will continue in collective public transport, that is to say, by busses, if things continue the same way the general perception of users will continue being negative.

The collective public transport system, as in many parts of the country and Latin America, will continue operating primarily under the *man-bus* model with a daily struggle among them for the passenger with no integration, so far from being in a real alternative has contributed to the modal shift from private car users.

Currently, it is estimated that in the AMG about 12.7 million person-trips are daily produced throughout many means of transportation (see **Table 3**). However, notwithstanding the total public transport trips are higher than private transport, if we do not consider the transshipment factor of 1.4, the origin-destination final travel between public and private transport approach, which means that the public transport travel have been declining and the already private transport travels have increased alarmingly.

TABLE 3. MODAL DISTRIBUTION OF TRIPS PERSON DAY

Mean of Transportation	Total Trips Per Day	%
Public transport	4,114,042	32.4
Private transport	2,760,227	21.7
Pedestrian	4,860,346	38.2
Cyclist	266,636	2.1
Others	695,729	5.6
Total	**12,696,980**	**100**

Source: IMTJ, 2015.[6]

6 Updated data from the IMTJ based on studies and Origin and Destination Demand Study Multimodal Displacements of AMG survey elaborated in 2007 (Gobierno del Estado de Jalisco, 2007). The person day trips on public transport in year 2002 were approximately 20% higher.

The slow pace of the organizational model change and public transport operating in many cities of the country, including AMG, is due to both the carrier sector that persists in obsolete individual practices, as well as the progressive loss of the rectory and operational State control in the operation, coupled of the absence of public and private mechanisms to promote the transformation to a more efficient and effective business operating model. Changing a sector that has been operating in the same way for over 70 years is not an easy task, even less if a change of direction in public policies is not given, expecting to change by itself or simply by authority, is an illusion.

The carrier can only obtain resources by the incomes coming from the fare, and if it is contained by justified reasons or not, it only remains the application of public budged to encourage and promote the change until the conditions are given in order to obtain a quality service. When all of this happens, the State Government must stablish with clarity the technical rate (usually higher than the social rate), and clearly assume the subsides that persecute the users —not carriers— who do not have the economic possibilities to cover the real cost of public transport, through green funds[7] budgetary take at federal and state level to strengthen an environmental public policy and mobility capable to guide our cities to sustainability.[8]

The best examples of Integrated Public Transport Systems in the world are not those who are self-sufficient financially and managerial public and private vision would have us believe, as public transport as well as being constitutional right and obligation of the State, is a necessity essential for social welfare, economic prosperity and environmental improvement.

In the public transportation systems that dazzles for its efficiency and quality, but also for its cost, a significant budget of federal, state and municipal origin intended for mass and collective public movement with companies providing both public service and private, and a government fortress strong politically, technically and administratively, with laws, rules and clear rules of operation where the service center is the user.

7 The Green funds "[...] are resources destined to contribute to the conservation and sustainable management of natural resources and environment from justice and solidarity, anticipating in the execution and administration of strategic environmental development projects in the local, national and international scope". Obtained from http://www.fondoverde.org.

8 The government chief of Mexico City recently mentioned that he will look for finance scheme called "green funds" with the secretary of treasury to modernize public transport (El Financiero, Abril 05 de 2016).

In the best urban practices, mobility appears to be as the core of public publicity, which implies achieving a walkable, accessible, and safe city, which intensifies its social, economic, and environmental interactions throughout circulation and preferential accessibility of non-motorized media and public transport. This implies making a more livable city with all that this means: moving easily; using transport systems based on bicycle; having shared road space for transit of cyclist and public transport; developing an integrated public transport with physical, operational and integration tariff system; deter and reassure the motorized traffic on streets and high attraction areas and trips generation; and above all have roads and vital areas with smart urban actions of urban diversification to avoid specialization of uses, densification avoiding gentrification, design to improve the urban and architectural quality of the city, next to housing public spaces, the schools, universities, businesses and workplaces.

No single action mentioned above is effective by itself, and even less if an ambiguous posture towards motorized transport or the urban interventions oriented to private transport. The so-called Transit Oriented Development (TOD) can only be real and effective if it is congruent and consequent with all that implies. Territorial intelligence related to sustainable transport lies in reconciling balanced between public and private interests, prevail the former over the later, mainly related with uses and ground destinations, otherwise it would be an alibi to keep on doing "good real estate business", to keep building apartment towers paradoxically based on individual motorization despite its closeness to massive transport.

All of this implies, without a question, to check and modify the policies and parking regulations for private transport, as parking lot for the automobile is like the station or terminal for public transport. And while we must promote intermodality, is under debate the concept of "park and ride", very arguable in massive transportation stations, which it would be better to promote spaces to build housings without parking

drawers in order to generate shorter trips in public transport linking distant car trips.[9] The strategies *push and pull* to attract private users to public transport and non-motorized are necessary, restricting the preferences in circulation and motorized accessibility in central areas, but this makes no sense if at the same time the use of private transport keeps being pushed through more private parking spaces are however distant, because the bottom line is to offer integrated transportation alternatives for its comfort, safety, speed and cost are able to compete with the car.

The use of private capital gains should pay off the surplus in social and environmental with social interventions that reduce side-car use, as the great virtue of a line or mass transit line pretroncal-as a metropolitan corridor transport- it is to develop what some have been called "urban footprint", which is nothing to consider more social and private surplus value of territory more in the sense of nodal network than zonal, developing a concentric environment uses and destinations around stations transport criteria of proximity, and a linear strategy between stations based on various gradients of densification and urban diversification. All this can only occur with the conjunction of political, social and business leadership, able to reconcile public interest with private because the invisible hand of the market is neither as invisible nor fair.

Although pedestrian travel and daily cyclists in the AMG represent almost 40% of the total metropolitan, they do not have the infrastructure and acceptable conditions of safety and design. Every action undertaken in non- motorized mobility faces great resistance, especially of those car users who do not respect the pedestrian or cyclist, arguing recklessness of passersby or the minority of cyclists, which they say do not justify the infrastructure construction, or the measures that have been taken partly pedestrian priority or tranquilization and moderation of motorized traffic. Even some businessmen come to mistakenly believe that the success of its shops, restaurants or recreation centers, depends on the priority and ac-

9 In the triennial works of metropolitan bottom of AMG, they have just announced two Park & Ride linked to two stations on the new line 3 Urban Electric Train, which should be analyzed from this point of view (Gobierno del Estado de Jalisco, 2016).

cessibility of the car, when there is evidence to prove otherwise.[10]

40% of trips that people do not power driven, 37% occur walking despite the distances between housing and neighborhood facilities and public transport stops have increased, particularly in the peripheral municipalities and in the middle of the AMG. According to the survey of the origin and destination of 2007 two quarters of the trips lasted between 10 and 20 minutes, a trend that certainly has been sustained, as the dosage of urban infrastructure has been inadequate and the location has been spatially unbalanced. Network sidewalks are impaired in the central metropolitan areas, and are very scarce and frequently interrupted in urban settlements scattered in the peripheral municipalities. Several municipalities in various government administrations have tried to lessen the problem or make superficial urban renewal with partial success, since the invasion of the car and irregularity in the use of curb persist.[11]

At the end of 2014 were implemented in the AMG the first so-called 30 zones, which are areas of preference for non- motorized mobility (walking and cycling) and public transport. Currently they are operating in three centers of the metropolis: in the historic center of Guadalajara (an area of 9 planned), in the historic center of Zapopan, in the historic center of Tlaquepaque.

The cycling network is insufficient, barely 48.30 kilometers of segments disconnected to each other, with diverse typology and in some cases very bad designed; in a greater amount of segments to the northwest and south, and none to the southeast side of the metropolis. The Government of the State has a 200.8kilometers cycling line program called "Provici", however, up to today just the first 36 kilometers have been completed. There is a central topic in political terms that has not been at all clear and it is fundamental: it is proven to an international level that the amount of urban cyclists it is directly related to the existing kilometers cycling lines and their security level, this is why very little can be expected from a segmented and insecure cycling network of barely 48.30 kilometers across the city.

10 In 1993, the Chamber of Commerce of Metropolitan Center of Guadalajara in connection with the construction of line 2 completely underground by one of the main avenues of the city electric train, demanded that the government paves the side rails on the pretext to reduce vehicle speed so they could see their dressers.

11 Recenlty the Municipial Goverment of Jalisco and Zapopan just implemented a program called "free sidewalk" with substantive fines to the car drivers who invade pedestrian space or park improperly (Notisistema, May 16, 2016).

A program that has substantially moved forward is the Public Bicycle System so-called "MiBici", this system is aligned with international standards it currently offers 116 stations with 1,160 bicycles, ant this year will grow up to 236 stations with 2,000 bicycles, with a territorial coverage of 2,300 hectares and an installed capacity of 30,000 daily trips. Although the use of the system is incipient, mostly the massive transport works affectations in process, the reestablish of regular conditions, the expansion of the system this year and the final intermodality with the massive public and collective transport will make its use grow rapidly.

The territory, mobility and transport, in analogy, set an imperfect trinomial. Its results cannot be explained through the sum and interaction of its variables, even less, before the emergence of complex phenomena determined by the uncertain behavior and oscillatory social factors, educational political and environmental. Meanwhile comprehensive mobility policies are designed, the real state promoters abandon to make the city a vast and unwieldy space, carriers remain reluctant to the public transport transformation in an integrated and organized model, and ambiguously the different government levels keep betting to solve something that has no solution: an automobile city.

Disengagement between land management, urban mobility and transport generate trinomial imperfect ideal for uncertainty and expansion.

Some of the most significant social, economic and environmental consequences of this imperfect trinomial in the case of AMG are outlined below.

2. SOCIAL, ECONOMIC AND ENVIRONMENTAL CONSECUENCES

Urban mobility based mainly on the car use generates social, economic and environmental negative externalities. Considering the analysis of Newman and Kenworthy (1999) about cities and sustainability, high automobile dependency cities establish their priorities on building infrastructure and promoting urban disperse and vertical growth, leading to special-

ization, fragmentation and urban gentrification. The vehicle flow and its priority becomes on the public acting vectors, privatizing social gains and socializing losses.

Number studies have shown consequences of social dissociation, the loss of economic prosperity and environmental deterioration reflected °n public health and reduction of environmental benefits produced by a natural heritage and city interaction.[12]

2.1. SOCIAL CONSEQUENCES

Automobile dependent cities carry serious social issues, such as, isolation, fragmentation and lack of community life, conditioning commute of those who do not have a car; people because of their age, disability and economic status are unable to have it (Kenworthy & Lube, 1996).

Urban dispersion and not use of central spaces have brought with it the loss of closeness, because less income residents have to travel long distances or use emergent means of transportation to go on with their daily activities, which has affected social interaction and community life in a very sensitive way, constituting a new way of fragmentation and social exclusion.

Based on the Multimodal Demand Study Offsets Guadalajara Metropolitan Area data (SEDEUR, 2007) and recent monitoring for update the loss of social value hours and productive by the increased of commuting has been very significant. The distance between residential and working areas and education, and the loss of proximity to the neighborhood and district basic equipment increased commuting in a motorized and non-motorized way, especially in disperse growth areas. In just 10 years the average commerce speed of public transport decreased a 40% from 30 to 18 kilometers per hour, the same happened with private transport from 40 to kilometers per hour.[13] Commuting variable became the trip's rector, given the conditions of high traffic congestion, the

12 Kenworthy, J, Laube, F. (1996). Automobile dependence in cities: an international comparison of urban transport and land use patterns with implications for sustainability. *Elsevier;* and study Hooward Kunstler, J. (1993). *The Geography of Nowhere: the rise and decline of America's man-made landscape.* New York: Touchstone.

13 Data obtained from research conducted by IMTJ.

superimposition of public transport services and the lack of regulation time transport of goods and services.

The combination of traffic and access problems generates risks for both motorized and non-motorized traffic becoming some corridor and node in high accidental rate places. In 2015 were registered 31,527 traffic accidents in the AMG, 93.4% of accidents throughout the state of Jalisco.[14] In an annual comparative analysis 2012-2015, in 2015 there was a reduction of accidents in general with less injured and wounded than in 2012, particularity in alcohol deaths related; this can be attributed to the benefits of the state road safety program "Saving Lives" implemented by the Mobility Secretary of the state of Jalisco,[15] however it is convenient to point out that people who have died in the accidents have increased, which means that road accidents are becoming more serious (see **Table 4**).

14 Source: Directorate of Traffic Research Directorate General of Traffic Safety, based on files Proceedings of accidents, General Parts of the cabin Communications and the Commissioner General of Roads of the AMG and Delegations Fairground, complaints administrative shock and accident reports public transport Legal Office.

15 The Mobility Secretary of the state of Jalisco received in 2014 the "Golden Belt" awarded by the International Automobile Federation for its policies on road safety, mainly because of the "Salvando vidas" program (Gobierno del Estado de Jalisco, 2014).

TABLE 4. ROAD ACCIDENTS REGISTERED IN GUADALAJARA, ZAPOPAN, TONALA, TLAQUEPAQUE, TLAJOMULCO AND EL SALTO 2012-2015

Concept	2012	2013	2014	2015	Variation 2012-2015
Accidents in general	47,220	43,553	38,609	31,527	-33.23%
Accidents with injured	3,695	3,166	3,224	2,778	-24.82%
Wounded	5,688	4,717	4,755	4,243	-25.40%
Killed in the crash	228	224	223	243	6.58%
Dead	716	684	577	533	-25.56%
Alcohol dead	175	130	109	163	-6.86%

Source: Directorate of Traffic Research Directorate General of Traffic Safety, based on files Proceedings of accidents, General Parts of the cabin Communications and the Commissioner General of Roads of the AMG and Delegations Fairground, Complaints administrative shock and accident reports public transport Legal Office.

2.2. ECONOMIC CONSEQUENCES

Energy use in highly automobile dependent cities represents also a serious economic problem. In Mexico substantial public resources are designated to subsidize fue[16] stimulating private car market, instead of subsidizing public transport in a different way.

According to the Organization for Economic Cooperation and Development (OCDE, for its acronym in Spanish) recommendations, Mexico should eliminate fuel subsidize in order to completely released the prices of fuel in 2018, this as a measure to drive economic development (OCDE, 2015) since in this area it is a potential source of public resources. This subsidized turns to be aggressive for population to favor middle and upper class despite being financed with all population taxes, including lower class (ITDP, 2012).

As in many different Mexican cities, in the case of AMG the public investment for infrastructure designated to automobile, such as streets and avenues extensions, construction or roads and overpasses nodes, it is predominant, with little investment and huge benefit for public transport or infrastructure for non-motorized mobility. This drift to what is known as induced traffic, defined as the traffic vehicles increasing due to the increasing of vial offer, generating a vicious circle of more infrastructure, more demand and more infrastructure.

In the Metropolitan fund the AMG[17] recurred resource allocation for car road infrastructure. Until 2010 the Government of the State and Metropolitan Municipalities decided, by the first time, designate non-motorized mobility resource actions. That year economic resources coming from federal budget, they were distributed as follows: 547 million pesos for road infrastructure and 418 million for non-motorized and to improve public spaces such as parks and bicycle roads (Gobierno del Estado de Jalisco, 2014). In 2015 the designated investment amount for roadworks were 628 million, and for non-motorized mobility works, public transport and spaces was 424 million (Gobierno del Estado de Jalisco, 2015). It is an historical budget assignation for the Metropolitan Fund, last April it was approved that for 2016 over 70% of

16 According to the Competitive Mexican Institute (IMCO, for its acronym in Spanish) in 2012 subsidize for the gasoline represented 220 million of pesos (1.4% of PIB) and in 2013, 82 million pesos were designated. According to IMCO calculations the subsidize amount in 2012 it would have been enough to increase three time more the Opportunity program or the Social Security (IMCO, 2014). In 2014 the provided subsidize for gasoline ran out the first two-month period of that year ascending to over 7 thousand million pesos, despite that only 4 thousand million pesos were approved for the whole year (El Economista, March 30 2014).

17 The metropolitan fund is part of the federal assignations to Development of Metropolitan Areas and Border, it is objective is to promote the proper planning of regional , urban and regional planning to boost economic competitiveness development, sustainability and productive capacities of metropolitan areas (SHCP, 2012).

resources were designated for non-motorized mobility works, urban landscape, and trunk public transport corridors and modules deterrent transfers.[18]

As it was mentioned above, the daily commutes in AMG are more extensive in spatial and temporarily, however giving the motorization rate, the travel time has been the determinant variable. The increasing commuting represents significant losses in economic and social terms. If one considers that in the metropolis 2 million 900 thousand trips daily source destination by public transport are made (excluding transshipments), and that in the last years this trips have extended at least fifteen minutes more, it is possible to estimate that everyday 5 million 271 thousand 300 pesos are lost in time paid job (considering current minimum wage)[19] and 1,450 annual pesos. Losses are less alarming for private transport, because estimates amounts ascend to 3.5 rather than public transport.

Additionally, annual gasoline expenses in AMG, based in average kilometers traveled (KVR),[20] it is about 39 billion pesos for the private transport total fleet and approximately 2 billion[21] for the total fleet of public transport.[22]

The economic consequences to a family level are the most sensitive part of the prevailing transportation model; its income is substantially affected by the gradual increasing in transport costs, both public and private. According to the National Survey of Income and Expenditure Survey (ENIGH, for its acronym in Spanish).

2.3. ENVIRONMENTAL CONSEQUENCES

With regards to the effects to the environment, the high motorization level has directly impacted air quality. According to the National Institute of Ecology and Climate Change (INECC, for its acronym in Spanish), driving a car in perhaps the most polluting daily activity that the average citizen makes (INECC, 2009).

Carbon Footprint (CF) is the internationally recognized indicator to measure the impact of Climate Change[23] of a product, service or organization. There are different that regulate ISO. The CF points out both

18 Information from the live broadcast of the fourth ordinary session of the Council for the Metropolitan Development for approval of the works of Metropolitan Fund held on April 29, 2016.

19 Minimum salary wage established by the National Wage Commission by means of resolution published by resolution published in the Official Gazette of September 30, 2015 is 70.10 pesos.

20 KVR is an indicator that is defined as the number of kilometers traveled in a given period of time (eg , day, year, etc.) for a specific vehicle or fleet of vehicles or population (ITDP, 2012).

21 This is a general figure from a global calculation using the model of the International Energy Agency (2014).

22 A price per liter of petrol 13.97 pesos and 14.20 pesos per liter of diesel (current prices since February, 2015) was considered.

23 The climate change refers to the temperature increasing due to the presence of greenhouse effect such as CO2 in the atmosphere. In the words of Ruiz Rivera (2007) "CO2 action is similar to a woolen blanket, retains for a period of time the heat emitted by the Earth between surface and stratosphere". A variation in climate, however small, modifies ecosystem.

the Greenhouse Gas direct and indirect emissions expressed in tones of CO2 equivalent, its calculation, on transport, is based on CO2 and N2O emissions (Greenhouse Gas) produced by combustion engines of vehicles in use, if mediate motor vehicles, and functionality of these vehicles using as an indicator the occupancy rate. Thus, by calculating the Carbon Footprint can be compared the effect on Climate Change of different means of transportation.

To perform the AMG calculation, it is taken into consideration the National Institute of Statistic and Geography (INEGI, for its acronym in Spanish), data related to cars of private use and public busses. The emissions from tucks and cargo vans were not taken into consideration due to, with the available data cannot be discriminated between commercial and private use. See **Tables 5** and **6.**

TABLE 5. VEHICULAR FLEET AMG[24]

	Oficial	Public	Private	Total
Automobiles	5,127	12,765	1,311,118	1,329,010
Busses	77	5,530	1,930	7,537
Busses and cargo vans	7,641	622	489,986	498,249
Motorcycles	851		160,941	161,792
Source: INEGI, 2015			**Total vehicles**	**1,996,588**

TABLE 6. CHARACTERISTICS OF PASSENGER TRANSPORT IN THE MAG TO CALCULATE THE CARBON FOOTPRINT

	N° of Vehicles	Total Annual Travel (million km/year)	Load Factor
Private automobile	1,311,118	23,318	1.4
Public use busses	5,530	581	29.34

Source: self-elaboration based on INEGI, 2015; INE 2010, SEMARNAT, 2012 and CEJ 2012.

In AMG the carbon footprint that a person generates to move in a private vehicle a specific distance is 6.9 superior to the carbon footprint involved in carrying out the same displacement in public transport.[25] This is due to the low capacity and use of private cars in comparison to public busses whose emissions are divided among all users.

24 To calculate the carbon footprint of vehicles in the municipality of Zapotlanejo is not contemplated so that they can make comparable with the survey of origin and destination of 2007, since then this town was not part of AMG, so above these figures differ with the data **Table 1**.
25 Source: preliminary data from a study by IMTJ in the process.

TABLE 7. NUMBERS OF TRIPS BY MEAN OF TRANSPORTATION IN 2014

Mean of Transportation	N° of trips	Total Annual Travel (million km/year)
Automobile and motorcycle	2,698,904	23,318
Bus, trolley bus, light train, commuter bus and taxi services	3,018,876	581

Source: self-evaluation based on SEDEUR, 2007 and projections to 2014.

In this way, although the total number of displacements in the AMG in both public and private are similar (**Table 7**), this difference in transport capacity make the annual total kilometers traveled by private transport be 40.3 time higher than the total kilometers traveled by public transport, which, in one service meets the displacements average of 29, 34 people, against 1.2 from private transport. In this way, the total CF private transport is superior to public transport, although not as much as expected, because of the efficiency in fossil fuel use is significantly inferior to the private use transport. Even so, the CF total from private transport in the AMG is 11.3 times higher than the public transport network, which highlights the inequality contribution of both kinds of transport to Climate Change.[26]

Air emissions from transport are not just responsible of Climate Change but the high level of motorization impact directly to air quality (see **Table 8**), therefore, in citizen's health.

Car engines emit several kinds of contaminants which have side effects for health, ranging from relatively simple conditions as crying eyes and sporadic cough, to more serious diseases like lung cancer.

26 Preliminary results of a study in from IMTJ in process.

TABLE 8. AIR POLLUTION BY TRANSPORT TYPE IN THE MAG IN 2012

Means of transportation	Atmospheric Pollution (tons/year)					
	CF	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$
Cars, trucks and motorcycles	17,017.30	296,439.90	33,933.70	159.1	140.8	80.5
Busses	5,052.00	24,412.70	25,657.20	6.9	166.9	152.5
TOTAL						
(including other emissions from mobile sources)	26,589.50	348,752.80	82,765.00	172.9	521.5	423.5

Source: self-evaluation based on CEJ, 2012.

Except of asthma cases that has increased up to 60.6% in the municipality of Zapopan, in the AMG affectations like lung cancer, ischemic heart disease and respiratory infections reduced, meanwhile mortality of these conditions has increased. So, if pollution does not provoke the disease, it does make it worse for those who have it (CEJ, 2010).

Whereas cars, trucks and motorcycles AMG vehicles fleet, their carbon monoxide emissions almost reach 297,000 tons a year, in comparison to almost 24,500 tons a year produced by public transport. However, despite the more intensive use of private vehicles in the AMG busses from public transport network emit more particles less than 10 microns (PM10) given the age of the vehicle fleet, this contaminant is one of the most dangerous to health.

In the 2009-2012 period has been a growing tendency to the emissions (see Table 9) due to the increasing of the city's vehicular fleet and age. Vehicles over 10 years old emit about 60% of generated contaminants by the whole vehicular fleet (CEJ, 2012).

TABLE 9. PERCEPTUAL INCREASED EMISSIONS FROM MOBILE SOURCES IN THE AMG, 2009 TO 2012

	Type of Air Pollutant					
	CF	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*
Increase in emissions between 2009 and 2012	*20%*	*20%*	*15%*	*10%*	*20%*	*20%*

Source: self-evaluation based on CEJ, 2012.

3. TOWARDS A MANAGEMENT MODEL ORIENTED QUALITY OF LIFE

Urban planning has left a lot to be desired as a tool for urban planning and its transformation, given the complexity of current and future urban problems afflicting the AMG and main metropolises in the country. The city's expansion is immersed in a vicious circle of increasing traffic and dispersion with social, economic and environmental negative consequences that cause an increasing deterioration in the quality of life.

If trends continue, the future is bleak scenario. The road infrastructure will become even more insufficient given the growing levels of individual motorization, affecting more impact mobility and metropolitan accessibility.

Restructuring and transformation processes must be consistent and gradual, with the support of public policies consistent with the paradigm of sustainability, and substantial reforms in process and management instruments.

In this way the government of the state and the municipality governments start to be conscious about the complexity of the problem, and the lack of formulas and traditional interventions.

Statewide they have started changes to the legal framework, normative and institutional, and government programs start to be more interested in the people rather than the objects of mobility.

In this circumstance, public investment starts to take another direction betting more on the public transport and non-motorized mobility. Some interventions on public transport are already in process in the expansion of massive transport network, and others are about to start with the change of organizational management and operational of collective public transport based on busses, through its reorganization and modernization, in the context of total implementation of an Integrated System of Public Transport. The order will be implemented with integration, feeding, substitution strategies and improvements in the current network, with actions aimed at physical integration, operational and progressive pricing, through the transformation of a *man-bus* traditional model to the business model high efficiency and quality service. The process has not turned out easy because the inertia and resistance to change from the sector, the process has not turned out easy given to the inertia and resistance to change in the sector, as well as the lack of institutional instruments that facilitate it.

In the case of non-motorized mobility, the strategy is organized based on three areas of intervention: public bike system (MiBici), 30 zones and bicycle lanes network (Provici). This strategy is similar to those implemented in many cities in the world, yet they are still to be seen real

benefits due to distortions and alterations induced by massive transportation works in progress.

Let us not lose sight of the big opportunity to implement a major project of habitability, pedestrianization, calming traffic and management of public transport in the Historic Center of Guadalajara as a direct benefit of the commissioning of line 3 urban electric train, whose intervention in order to be really successful, must go beyond urban image to a project of full urban intervention that involves a new circulation plan and collective public transport set of laws based on busses and in coordination with massive transport, area in which has and will have the best coverage of it.

The challenges for public administration, state and municipal governments are not minor, and even so when problems and needs has transcended administrative legal limits, without a question inter metropolitan coordination is inescapable, more actions will be needed to move towards a sustainable urban mobility such as the conformation of an integrated public transport system that grows in a planned way and linked with the territory, under certain sustainability criteria its forms and with the highest quality standards. Currently the Institute for Mobility and Transport of the State of Jalisco (IMTJ, for its acronym in Spanish) has just completed the General Standard technical Quality of Service of public transport in coordination with the Department of Mobility and Citizen Observatory for Mobility and Transport of the state of Jalisco[27] to set high quality standards of service to those who must abide providers of services are decentralized public agencies or private concessionaires of the service.

It is essential to the zonal and judicial conception of urban space overcome the municipal territorial barriers in order to be involved strategically as a territory- network, where the confluence of intermodal manner the public transport, private transport and non-motorized, under strategies that rationalize the use of private vehicle. In the same way it must be reconciled and logistically organized the transport of goods and services that now interrupt without temporal and spatial regulation of mobility and daily metropolitan accessibility.

27 "The Citizen Observatory of Mobility and Public Transportation of the state of Jalisco is an organization that was created by an agreement of the Governor of Jalisco published in the Official Gazette on April 8 this year. It is an independent mechanism that analyzes and evaluates the conditions of mobility and proposes policies to improve the quality of life of people. Its mission is to ensure that all people in Jalisco enjoy a public transport system worthy, approachable, humane, safe, efficient and sustainable mobility". Recovered from http://observatransporte.org.

This requires comprehensive urban planning between territory, mobility and transport overcoming the traditional zonal and specialized urbanistic conception, as the territory network is more commensurate with the complexity of urban geography in its different dimensions reality, configurations, flows and capacities adaptive, and especially their different processes of social, economic and environmental interaction.

Oriented mobility to life quality prioritize the mobility and accessibility reversing the pyramid, where the pedestrian-specially the most vulnerable-, the cyclist and public transport users have the priority and govern the rights and obligations of ownership and share use of public space. In this way the cities placed in the center to people and not cars.

The territorial organization of cities should involve all stakeholders, to promote metropolitan governance and better governance. Rule under the model of citizen participation must recognize the complexity and multiplicity of interacting elements in urban regeneration processes and assembly that are the cities. The participation of citizens and reconcile public and private interests allows a high degree of congestive efficiency because it incorporates elements of the complex and uncertain urban reality and nourishes the process of decision making (Grau- Solés, Íguez - Rueda, & Subirats, 2011).

The challenge is that the government at different levels able to establish the conditions for the different views converges in a territorial policy where the public interest prevails and sustainability.

In the AMG processes to include the vision of social actors are still emerging, but there is no denying that there is already a change brought about largely by the active participation of citizens through various civil organizations. A more open and receptive to social demands government is the first step.

After several decades of an urban paradox oriented towards individual motorization and use of non-renewal energy, there are emerging new territorial paradigms associated to integrated systems of urban transport that demands a more participative territorial and efficient planning, in which integrated and non-motorized public transport are the greatest lead actors of transformation. For that we have to change our old ways of thinking and intervene the city to progress from a disperse to a cohesive city, from the distant to the next city, from the city exclusive to inclusive city, from the city of concrete to the green city, from the city car to the city of the quality of life.

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