KEEPING CITIES MOVING

STRATEGIC THEME B
TECHNICAL COMMITTEE B.3

INTRODUCTORY REPORT

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EXECUTIVE SUMMARY

During the period 2008 – 2011, case studies from 57 large or medium-sized cities all over the world were scanned by the Technical Committee B3 of PIARC to find out how the strategies, methods and operations decided and implemented by the authorities have contributed to improve the mobility.

According to the components of the local policies, and to the availability of data, each of these cities case studies contributed to one or more of the three aspects that have been analysed in details: the integration of the different modes of transport, the coherence between land use planning and road transport, and the non-motorized modes policies.

In terms of integration of modes (individual vehicles, public transports, cycling, walking, electric delivery vehicles, trucks, motorcycles, …) strategies to balance their share in the transportation system of any town can be broadly grouped into two main types. Firstly, supply-related strategies, intended to promote the use of such mode through improving its attractively (capacity, comfort, safety, efficiency, fluidity, speed, …) and secondly, demand related strategies which are intended to influence the choice of the citizens towards one or the other mode (promotion, orientation, communication, pricing, parking facilities, …)

The second aspect is more oriented towards long term issues concerning new or re-organized infrastructures, in correlation with the extension of the cities. At the same time, a high density of population and employment makes more efficient the implementation of public transport networks (including rail and dedicated lanes), but is contradictory with the citizens quest for larger residential properties. The coordination strategies between land use and transport network provision often involve a high number of decision-makers. A number of situations and decisions have been explored, including private companies partnership, and friendly underground solutions.

The non-motorized modes policies came on the top of the agenda for a large number of cities during these last years. The report examines the factors influencing the use of cycling and walking, and the numerous possibilities of action which contributes to a better urban environment and a better health for the citizens.

Finally, despite the large number of tools to influence the modal share and the provision of transport facilities to the citizens, it stays unrealistic to consider that congestion can be avoided in a near future in all urban environments, even with a strong willingness of the numerous partners. Nevertheless, progressive evolutions towards an improved mobility in the cities rely on a consistent set of measures, defined on the basis of a sound knowledge of the situation, on a comprehensive assessment of the strategies, and on a wide variety of well prepared operations.

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1. URBAN MOBILITY IN FOCUS

Urban mobility is at the very heart of connected communities, thriving economies, and liveable cities. Yet it is under threat. In many cities, it is already limiting positive outcomes, as the demand for travel is unable to be met by supply – at least in the 20th century paradigm of demand and supply.

Urban mobility is reduced when populations grow. It is reduced when people increasingly choose single occupant private travel as their mode of choice. Urban mobility is considered by the public to be hindered by congestion, and there are many studies citing the cost of congestion to local, state and national economies.

But what is the solution? Is the solution to simply build one's way out of congestion? With few exceptions, this is a pathway recognised by most authorities of established urban areas in developed countries as unacceptable for the cost it imposes. In developing countries, road construction to a basic level of supply is still warranted, there, the cost can be equally as prohibitive and other options must be found, at least for the short term.

This report – and the work of the Technical Committee B.3 – Improved Mobility in Urban Areas – investigates three different angles for approaching this problem. The first relates to integration of the different modes of transport, with the objective of balancing the share of modes to reduce congestion and improve mobility. The second is making use of the relationship between land use planning and road transport, identifying transport requirements and policies associated with planning of new developments in large cities; and the third is non-motorized transport, to determine how non-motorized mobility is being assessed and encouraged in planning transport schemes in urban areas.

All three of these dimensions have the potential, in the short, medium and long term, of improving the mobility in cities. Case studies have been identified to assist with both the storytelling of practices, and the comparison of initiatives between cities.

Notice!

This introductory report has been prepared in order to present the PIARC Technical Committee B3 achievements. Some of these achievements will be discussed during the Mexico Congress in the special Session 4 "Large cities: Integration of the surface transport modes" and in the special session 6 "Transport and land use planning". Specific abstracts of the TC B3 achievements are described in the introductory reports of these 2 sessions.

2. INTEGRATION OF THE DIFFERENT MODES OF TRANSPORT

2.1. Sharing the urban transport task between modes

As mentioned in the introduction, balancing the share of modes is one approach to improving mobility in urban areas. With optimal distribution of trips across modes, overall mobility can be improved. Sometimes, balancing the share of modes may reduce congestion. Other times congestion may not change or even worsen for some road users, but by careful targeting of initiatives, overall mobility outcomes are better for the community at large.

It is this story – of balancing the share of modes – that Working Group 1 of Technical Committee TCB.3 has sought to explore. What examples exist where authorities have made a "hard call" to reallocate roadspace to higher occupancy modes with mobility outcomes in mind? What examples exist of trying to influence the demand for travel by car in the first place? Are there examples of proactive efforts to improve public transport, walking or cycling facilities to encourage greater use of these modes? What are the barriers and opportunities that exist in their implementation?

This work looks at the factors that influence urban mobility, the overarching goals of initiatives to improve it, and strategies that can be adopted by cities, at the high level, to achieve improved mobility outcomes. Types of actions are identified, that can be adopted across the range of strategies, and specific case studies investigated that adopt the strategies and types of actions. Drawing on the case studies, conclusions and recommendations are made for the broader application of these approaches.

2.2. Goals to improve mobility through balancing urban transport share

The high-level goal of any transport-related initiative must tie back to broader economic, social or environmental goals, as transport is not an end in itself but only a means to other ends. As such, the underlying quality of life, economic prosperity and social connectedness goals most people aspire to also apply to the transport system's role in achieving them. But at the specific level, the improvement of mobility, or greater accessibility, are the goals of transport-related initiatives in the urban environment.

The achievement of the mobility goal must recognise other societal expectations, and not be pursued without regard to them. For example, maintaining (and improving) safety, limiting the environmental footprint of travel to ensure intergenerational sustainability, and effective, targeted spending of public funds are underlying requirements influencing (to various degrees) the nature of the initiatives implemented.

2.3. Strategies to balance urban transport share

As outlined by FSIV (2006), strategies to balance the share of modes can be broadly grouped into two main types. Firstly, supply-related strategies, and secondly, demand related strategies. Ten different strategies have been identified in the course of this study. The demand-related strategies are promoting public transport, promoting bicycle transportation, promoting pedestrian transportation, promoting intermodal transportation, and influencing car demand. The supply-side strategies are improving the utilisation and allocation of capacity, increasing capacity utilisation of vehicles, improving the temporal spread of traffic volume, reducing the impacts of incident and more compliant handling of road works and maintenance.

If applied universally, these strategies would work together to not only encourage less use of private motor vehicles (the primary focus of the demand side strategies), but also to ensure that the road asset that currently exists is used most efficiently, resulting in reduced congestion (the primary focus of the supply side strategies).

It is recognised that a single jurisdiction may adopt one or several of these strategies at any one time, and may not consciously brand them in these categories. Over time, it is considered that most jurisdictions would adopt most of these strategies, to varying degrees.

2.4. Best practice to balance urban transport share (case studies)

Case studies fitting into these strategies have been explored by the working group. These are described below grouped as demand-related, supply-related and whole-city strategies. The latter are examples where multiple approaches have been taken together.

Encouraging the demand for alternatives to single-occupant vehicles

Encouraging demand for public transport through high-quality, high-frequency public transport services is a key component of managing mobility in large cities. Examples were reviewed by the working group from Mexico City, Portland, Istanbul and Osaka. In the call for papers, a further example from Bangladesh was presented.

The case studies all have one thing in common – they are efforts to improve public transport services in order to attract people to them. This was achieved in Mexico City and Istanbul (EMBARQ, 2011) by reallocating road space to BRT services, at the same time, providing quicker trips for BRT users, whose numbers have grown significantly. In Portland, ongoing investments in light rail over 10 years has seen significant growth in transit usage. Osaka has embedded its encouragement programs into education programs in schools and incentive programs to generate cultural expectations that using public transport is a default mode.

The working group also reviewed examples of encouraging pedestrians; the two examples are a pedestrian road in Budapest and a ring around inner Bamako, within which pedestrian accessibility is being significantly improved.
These follow the pattern of pedestrianisation of roads in the heart of other major European cities, and create many new opportunities for pedestrians to move through the central city area. In Budapest it was achieved by a new east-west road taking through traffic away, while in Bamako, amenity and functionality will be improved by a ring road designated for mini buses (Sotrama Ring) to keep them out of the inner area, complemented by one priority bus route through the centre and new pedestrian bridges and crossings (Greive-Smith, 2011).

Two case studies were identified for bicycle rental programs in Paris and Barcelona, which both started in 2007 as part of broader bicycle facility improvements such as on-road lanes. Mode share has increased for both already. Surveys indicate that these systems do reduce private vehicle use, and they are also used as part of longer multimode trips. However, these relationships have not been fully quantified (DeMaio, 2011).

Interestingly, there were parallels between bicycle rental systems and some of the demand-based measures for reducing car travel. A car sharing scheme in Montreal has proven most successful in the denser suburbs, and surveys of similar schemes have indicated that having such a scheme does allow 48 per cent of member to sell or not purchase a vehicle. There were also papers presented in the call for papers covering car sharing. Car sharing papers were offered regarding schemes in Austin, Texas, with options for one-way trips and by the minute rentals; and in Berlin, using electric vehicles.

Further measures to influence car demand have been identified in Frankfurt am Main, Perth and Osaka. In Frankfurt, the goal is primarily emissions reduction in the city centre, with access restricted for high-polluting vehicles. The program is also expected to reduce congestion (Frankfurt City Hall, 2011). In Perth, a ground-up behavioural change program called TravelSmart has resulted in a 10 per cent reduction in car trips and corresponding increases in favoured modes (John, 2006). In Osaka, to complement the encouragement of public transport, there are monthly “no private car” days in the downtown area.

Supply-related strategies

Supply-related strategies include measures to more efficiently use existing road space, including incident management, lane reallocation and use of technology to optimise system operations.

Network operating plans (known as SmartRoads) have been developed in Melbourne, Australia. These document a road use hierarchy agreed between state and local government, identifying the highest priority mode of each road section, whether it is tram, bus, pedestrian, bike or general traffic. This then becomes a reference point for all decisions made about the road network.

In Washington State, HOT lanes have been in place since April 2008, with travel time savings for HOT lane users between 3 and 8 minutes, with a toll for non-HOVs of $1.25 USD. The idea of the lanes is to make better use of HOV infrastructure, tolling single occupant vehicles with a variable toll based on traffic conditions (Washington State Department of Transport, 2010).

Supply-related strategies emerging from the call for papers included optimisation of tourist coach arrangements at events and tourist destinations from Italy, modelling of truck-only lanes in Birmingham, Virginia and of the impacts of motorbikes on traffic flow in Colombia, deriving traffic travel times from bus tracking data in Seoul, and the modelling of incident scenarios on bus operations in the UK. Many of these papers are about modelling impacts but have not yet been applied and analysed on the ground.

Overall city case studies

In addition to demand and supply-related case studies outlining where specific initiatives have been introduced, the working group also reviewed four overall city case studies. In Zurich, the mobility strategy has eight principles centred around a mobility culture. The principles are: supply (instead of demand) oriented mobility planning; adjustment of urban growth and mobility development; mobility management complementary to infrastructure; optimising overall traffic management; promoting cross-links between transport modes and cities; promoting and operating a city of short trips; co-existence instead of separation; and considering passenger transport capacity. Ongoing monitoring of any initiatives are against the context of the mobility strategy.

A French paper presented in the call for papers picks up some similar themes, providing a framework for a fully multimodal city, with two possible approaches: either low-speed, calmed roads, or separation of space. The paper will explore criteria for decision making and methods of evaluation, and addresses the challenge of how to extend this integrated approach to mode-specific schemes.

Seoul's growth from 10 to 20 million has been accompanied by 48-fold increase in vehicle numbers. Faced with a massive mobility challenge, Seoul has developed a high-technology, integrated approach to management of roads and buses. This has followed the objectives of inducing more commuters to buses and the subway, returning more space to pedestrians, more tightly controlling private vehicle usage and enforcing violations, and distributing traffic density on all available routes using traveller information. Public transport use increased 4 per cent from 2003 to 2004 and public satisfaction also increased. Seoul also increased average travel speed by 2.2 per cent and for buses by 9.5 per cent in one year (2006 to 2007).

A Spanish paper to be presented takes a similar view to the Seoul case study, proposing that integrated management of mobility requires both an organisational and technological framework to guide initiatives.

Santiago in Chile is a city of about 7 million. In 2007, faced with declining public transport share, the authorities became determined to improve its image and truly integrate the different modes. An enhanced bus system, Transantiago, was introduced as "Transantiago", including some bus rights of way. Some other recent initiatives have been subway fares differentiated by time of day, road tolls on urban motorways around the city centre, restricted hours for freight movement and bike parking at subway stations (known as bike nurseries). A new subway line, more busways and 640 km cycle paths are planned in the short term.

In Ile de France, or greater Paris, an urban commuting plan is being developed. There are 11 million inhabitants within a 50km ring around Paris, many of the outlying areas are dependent on cars to access other regions and retail centres. Ten challenges have been identified for the plan to address, covering: institutional arrangements, making urban form and transport work together, socially inclusive transport, informed trip making decisions, and a clear role for each mode, along with facilities and service levels to support those roles. While walking, cycling and use of public transport are favoured, motorcycling is to be recognised and the use of the private car discouraged. Further, the mode used for freight transport is to be optimised.

One mode not mentioned in the Ile de France commuting plan is electric vehicles. An Austrian paper proposal tests the impact of high take up of electric vehicles in Vienna, against Vienna's transport master plan. The scope includes modelling the impact on mobility and commuter flows of different charging infrastructure and parking space arrangements.

2.5. Conclusions

The case studies exploring specific strategies, alongside those more general city-wide examples, serve to show that even cities generally considered "successful" from a mobility perspective will always have more they can do and localised success stories do not mean the whole city has reached an optimal state. Rather than be discouraged by this, however, following the model of these cities that have put in place high level strategies provides a framework, a place to start, and make use of the range of other strategies, both covered here and otherwise implemented, to achieve the desired mobility outcomes.

Much material is available, and reviewing a small selection of case studies only serves to "scratch the surface" of any particular strategy that could be implemented, and opens the door for further investigation. The committee's final report will undoubtedly identify a wide range of further topics for exploration and expansion, and identify further reading available in many of the areas touched upon. In particular, some of the initiatives are in place but outcomes not yet measured; others are developed but not yet implemented, while a further set will be interesting to watch over time to see what further outcomes are achieved.

One thing is clear, however. With the possible exception of cities that are in developing countries, and cities with high growth projections, there is little talk of "building one's way out of congestion". The role of non motorised private modes and public transport are clearly articulated by many cities as the target for achieving the city's future mobility needs. As such, "mobility despite congestion" may become the catch cry, rather than congestion reduction.

3. LAND USE PLANNING AND ROAD TRANSPORT

The following review of land use planning and road transport requirements and policies considered nine case studies which provided figures for the metropolitan areas on three continents, namely North America, Europe and Asia. The Objective of this investigation was to gather relevant key findings and identified best practices and in order to provide convenient guidance to road administrations.

Please note that the issues covered below deserve to be analysed in greater detail, and that the comments and recommendations are those of the authors only.

In this review, which considered long-term land-use and transportation plans, observed cities were divided and analyzed with respect to their size and stage of development. The analysis mainly focussed on the relationship between density (population and employment) and different transportation modes outside of the core city. The accessibility to public transportation (including buses) in the periphery of urban areas was a key question.

Metropolitan area (centre and suburbs)	**Great cities**	**Middle-size cities**
Low growth rate cities	Tokyo Paris Madrid	Toronto Stockholm Bucharest Helsinki
High growth rate cities	Mexico	Chihuahua

A comparative analysis of Tokyo, Paris and Madrid dealing with the “Relation between the development of urbanization and use of the different surface transport modes” is presented at the World Road Congress 2011, in Special Session 6, “Transport and Land Use Planning”.

3.1. Overview of main factors impacting mobility in the suburbs

The key factors impacting mobility within the suburbs and the need for and availability of public transportation are outlined below:

- Population and employment densities;
- Density and pattern of transportation infrastructure (radial vs. isotropic);
- Accessibility to transportation infrastructure; and
- Human behaviour; two microeconomic desires have the opposite effects: the quest for accessibility (which encourages a densification towards urban centres) and the quest for larger residential properties or offices (which encourages a de-densification of the urban centres).

These factors have been investigated in the case studies in order to understand the relationship between population and employment densities, transportation networks and the resulting mobility statistics.

3.2. Goals for safe and sustainable mobility in the suburbs

Labour productivity and regional accessibility are closely related, specifically:

- The existing possibilities for people to access more job opportunities,
- The ability for companies to find more qualified employees.

Improving mobility shortens the distance between goods and people and fosters a sense of well-being and stimulates economic growth. Inversely, restricting mobility and allowing traffic congestion to develop creates barriers and exclusion, destroys economic value, and wastes time, thus generating dissatisfaction amongst the general public.

When considering transportation infrastructure, appropriate and prudent choices, that are reasonable and consider available financial resources, are required to overcome the challenges of mobility and environment efficiency. The goal is to develop transportation networks that fulfil the following criteria:

- Environmental efficiency in terms of CO_2 g/passenger-km;
- Social equality and accessibility;
- Economic feasibility and coherence with long-term outlook.

Such transportation infrastructure will increase the competitiveness of cities and improve the quality of life for their inhabitants.

3.3. Key findings from the case studies

This chapter presents the key findings from the nine case studies.

- **Population and employment patterns**

Population growth has lead to an increase in urban sprawl for all of the observed cities.
Generally speaking, the employment localization has followed the urban sprawl. But there are two patterns of employment concentration as it relates to urban sprawl and residential densities:

- Urban development in Mexico City, Toronto, Bucharest and Chihuahua has not resulted in a geographical concentration of employment; the number of jobs per inhabitant has remained more or less equal throughout.

- In Tokyo, Paris, Madrid, Helsinki and Stockholm metropolitan regions; however, employment is more concentrated in the city centre. This is especially true for Tokyo, where the urban centre reaches an average of 2.7 jobs per inhabitant.

The expansion of suburban areas and the quest for accessibility have resulted in longer journeys, especially home-to-work journeys.
In Tokyo metropolitan region the total travel time increased by 150% between 1978 and 2008.
In Helsinki, the commuting area has steadily expanded and now covers an area with a radius of almost 100 km. It is these home-to-work journeys that are used in planning for the capacity of transport infrastructure.
The demand for transport in the suburbs of Paris has also risen significantly: between 1976 and 2001, travelled distances by motorized modes within the suburbs have increased from 80% to 120%.

- **Transportation networks**

All metropolitan areas feature a dense road network. For cities with rail service, the rail network tends to be dense in the centre but limited to radial connections within the suburbs. Accessibility to rail networks in central areas is good, but it deteriorates significantly with a move to the suburbs.

For the Paris and Madrid metropolitan areas, the density of railway stations decreases by a factor of 100 between the central urban area and the outer suburbs.
In Paris's inner city (within 5 km from the city centre), 100% of the population lives within 10 minutes walking distance from a railway station. However, within the suburbs (over 15 km from the city centre), this figure falls to less than 10%. According to this criterion, there are 7 million people in Paris region who do not have efficient access to railway transportation networks.
Similar figures were observed for Madrid and Stockholm.

The Tokyo metropolitan region has succeeded in coordinating the development of its public transportation network and its land use planning resulting in an optimized mass transit network. Its railway network consists of 3,700 km of radial and circular lines and 75% of the population lives within 1.5 km from a station.

- **Mobility statistics**

In most metropolitan areas, passenger cars represent the most frequently used transportation solution. According to figures from Paris, Madrid, Mexico, and Helsinki, the passenger car satisfies about 55% to 70% of the transportation demand in terms of passenger-kilometres with an average distance per trip of approximately 15 km.
The metropolitan areas of Tokyo and Mexico City are particular exceptions. In Tokyo, for commuting journeys, rail share is up to 70% in the central zone. In Mexico City, buses represent 60-70% of motorized daily trips. Amongst the great cities with a low population growth rate, Madrid is remarkable. Bus travel there represents about 17% of the daily travelled distance, more than 3 times that of the Paris case study.

In Paris, Madrid and Helsinki, rail transport times are, on average, double those of road transport times for equivalent origin-to-destination distances.

Considering home-to-work trips in the Great Cities, trip distances are generally two times longer than the overall average of trip length, and non-motorized modes are rarely used.
It has been observed in the Paris case study, In Paris region, on average non-motorized modes represent 33% of all trips and 4% of the total travelled distances; however, for home-to-work trips, they only represent 11% of trips and 1% of travelled distances. For railway modes, average trip duration increases drastically with trip times reaching approximately 60 minutes per trip. Similar figures have been observed for the metropolitan areas of Madrid and Mexico City.

- **Land use planning and administrative organization**

For all observed cities, the number of local authorities (municipal governments) do not exceed 275 except for Paris Region that reaches 1,300 local authorities, resulting in complex processes and challenges for land-use and transportation planning.

3.4. Best practices to improve road efficiency in the suburbs

Based on the observations of the nine studied cities, this chapter presents a set of best practices in terms of land use planning, optimized road operations, other transportation solutions and mobility policies.

A coordination strategy between Rail and Suburban development in the Tokyo metropolitan region (TMR)

The coordinated rail and suburban development strategy consists of:

(1) Rights to suburban rail operations;
(2) Purchase of land for development by private rail company;
(3) Rail extension and/or new station coupled with development; and
(4) Choice of development pattern, creating bi-directional transportation demand.

This strategy has worked well as an urban development and transportation policy to accommodate Tokyo's increasing urban population and to provide and maintain efficient rail service avoiding over-dependence on private automobiles.

Moreover, the strategy has worked well as a business model. Rail companies can rely on non-rail revenue to expand their revenue base and contribute to the sound financial management of their rail corridors by providing funding for rail investment from the real estate sector. The ratio of non-rail revenue to overall revenue ranges between 30 to 50% for the nine major private rail companies in the TMR

As a result, the TMR has a radial and circular railway network consisting of 3,700 km of lines with 75% of the population living within 1.5km from a station. According to a recent evaluation, the strategy has failed to cover all urbanized areas: local road are required to support low-density areas.

The organization of bus networks in Madrid region

In the Madrid metropolitan area, a network of 44 bus routes is organized to collect passengers in the northwestern suburb of the city where they are connected to a railway/metro station through reversible lanes reserved for high-occupancy vehicles.

The project was developed 15 years ago in response to the population growth along the A-6 corridor and severe environmental barriers to development. An urgent solution was required to meet the growing transportation demands in this suburban area. This solution involved the construction of 16 km of HOV-bus lanes located in the centre median of the A-6 motorway. In the outer suburb, the first 12 km two-lane section is reserved for buses, car-pooling and motorbikes. Approaching Madrid, the remain 4 km is reserved exclusively for buses.

At peak periods, with a flow of 200 buses per hour, up to 8,000 riders can use the system per hour providing an efficient mobility solution for 110,000 commuters per day. The reasons this system has been so effective are:

1. a network of 44 bus routes covering the majority of the northwestern suburb;
2. a free-flowing transportation infrastructure is provided in a congested corridor during rush hours;
3. an efficient interconnection of bus routes with Madrid's extensive metro system.

The success of this initiative has resulted in the Ministry for Public Works considering similar solutions for other corridors into Madrid (the A-1, A-42, etc); some of which are already in an advanced study phase. This will allow residents living in towns throughout the greater metropolitan area to travel directly to Madrid without experiencing the traffic congestion frequent to Spanish national roads.

Underground solution for environmentally friendly integration of road infrastructure in Paris region

In Tokyo, Paris and Madrid larges sections of the expressway network have been built underground. In Madrid, around 43 km of tunnels (the “Calle M-30” project) have been put into operation under the first ring road; on a total of around 70 km of tunnels within the metropolitan region. In Tokyo, important sections of the ring roads have also been constructed underground. This section, however, focuses on an innovative solution in Paris.

Construction of the second ring road (the A86 ring road) around the Paris region started in 1968. In 2011, 43 years later, the final link in this road was achieved through an innovative public-private partnership (PPP). The 10km link consists of two stacked vehicle decks running through a tunnel excavated by a 10.4m diameter tunnel-boring machine. An underground interchange at the mid-point links the tunnel to the surface road network.

The first section of this project came into service in June 2009, and in July 2010 it scored the highest test results in a safety survey of 26 road tunnels in 13 European countries conducted by a consortium of European automobile clubs (EuroTAP tests).

On a yearly basis, the “light-vehicles only” tunnel, known as the A86 Duplex, enables 30,000 motorists to cover the 10km length at a speed of 70 kph in optimum safety and comfort, while at the same time relieving congestion on the surface road network by an equivalent numbers of vehicles. The resulting reduction in greenhouse gas emissions is in the order of 50 tonnes of CO_2 per day.

The project demonstrates a PPP best practice. The private initiative, with an estimated investment cost of €2,200 million, will be funded by toll revenues. The financing is based on the provision of a service – a guaranteed reduced trip time for urgent, high value-added trips – in exchange for a toll that provides funding for the project and relieves surface roads from a significant proportion of the vehicles responsible for traffic congestion.

At a time when society has high, and often personal, expectations regarding both environmental protection and safety, and with more and more major urban areas locked in endless debates on how to fill in a “missing link” in their primary road network, the tunnel concept offers a “win-win” solution for both the advocates of quality of life and those in favour of maintaining the nation’s economic competitiveness.

HOV lanes in the Greater Toronto Area and HOT lanes (congestion charging) in North America

HOV lanes are a commonly used tool to optimize capacity of road infrastructures within North America. Highway agencies and toll authorities across the United States operate over 2,500 HOV lane miles with approximately 2,500 more HOV lane-miles planned over the next thirty years.

In the Greater Toronto area, peak hour traffic on the 400-series highways is becoming increasingly congested. In an effort to manage congestion and encourage more efficient use of infrastructure, the Ontario Ministry of Transportation has introduced High Occupancy Vehicle (HOV) lanes on some of its highways and roads (e.g. on Highway 404 in Toronto) .

The Government of Ontario has developed an ambitious plan to add over 450 km of new HOV lanes on 400-series highways in the Greater Golden Horseshoe (centred around the Greater Toronto Area) by 2031. This project includes some of the most heavily-congested highways in the province. The planning is motivated by the fact that an HOV lane full of buses and carpools moves many more people than a general traffic lane.

As is the case with other jurisdictions, the financing of transportation infrastructure is a challenge. Road tolls and other alternative financing mechanisms are slowly emerging to the forefront for public and political debate. Such options may be discussed by the Province of Ontario and local governments as the June 2013 deadline for the Regional Transportation Plan for the Greater Toronto and Hamilton Area, *The Big Move*, to finalize its financial strategy approaches.

In the early part of this century (2000s), in the United States, highway lanes constructed in the 1970s formerly reserved for vehicles with more than three people onboard (high-occupancy vehicles or HOVs) were transformed into free-flowing lanes open to all types of vehicles (high-occupancy tolls or HOTs). The concept evolved in response to the frustration of motorists blocked in the neighbouring (non-HOV) congested lanes, and in order to optimise the potential of road transportation infrastructure as a whole. Free flow in these lanes is guaranteed by applying a toll to vehicles with less than three occupants with a varying fee based on lane usage. This operating system offers both guaranteed flow for high added-value trips (buses, emergency services, car-pooling, etc.), freedom of choice for motorists with time demands, as well as an additional resource for public finances.

Parking policies in Helsinki

Restrictive and selective on-street parking policy in the Inner City, including residential and corporate parking, was decided in conjunction with a Master Plan in the early 1970's. The policy has remained practically the same since then. The share of public transport to the city centre is high, nearly 70 % during peak hour and 60% during the whole day. Traffic volume to the centre has increased only slightly during the last 20 years while traffic volumes on other cordon lines have increased substantially.

New commercial land-use is mainly directed to suburban centres according to the approved land-use policy. This policy in conjunction with restrictive and selective on-street parking policy in the inner city combined with large private underground parking facilities does not seem to have weakened the competitiveness of the city centre.

3.5. Recommendations

Work carried out between 2008 and 2011 was able to identify a number of key findings, and to highlight best practices related to land use planning and road transport. Research based on a representative total of nine case studies allowed a detailed analysis of the relationship between density (population and employment) and the different modes of transport outside city centres. This analysis would not have been possible without the existence of statistical data.
It is therefore recommended that data collection programmes continue in order to provide fact-based support to local authorities to aid in decision making related to transportation infrastructure.

4. NON-MOTORIZED MOBILITY

This section will report on the findings of a comprehensive set of questionnaire surveys carried out by the members of the working group 3. The survey covered a number of questions including the population, area, modal share, vehicular ownership, pedestrians and cyclists profile, including accident data, infrastructure, in 41 cities across the word. Owing to the different approaches of data collection not all the cities answered all the questions. In cases of some topic the sample contains only 15-20 cities.

city	*country*	*city*	*country*	*city*	*country*
Vienna	Austria	Bordeaux	France	Krakow	Poland
Graz	Austria	Strasbourg	France	Kaunas	Lithuania
Liege	Belgium	Toulouse	France	Vilnius	Lithuania
Santiago	Chile	Thessaloniki	Greece	Budapest	Hungary
Prague	Czech Republic	Athens	Greece	Gyor	Hungary
Brno	Czech Republic	Zagreb	Croatia	Bamako	Mali
Ostrava	Czech Republic	Patna	India	Barcelona	Spain
Chicago	United States	Nagoya	Japan	Stockholm	Sweden
New York City	United States	Niigata	Japan	Bratislava	Slovakia
Portland	United States	Calgary	Canada	Kosice	Slovakia
San Francisco	United States	Halifax	Canada	Maribor	Slovenia
Washington D.C.	United States	Montréal	Canada	Ljubljana	Slovenia
Birmingham	United Kingdom	Ottawa	Canada	Nakhon Ratchasima	Thailand
Helsinki	Finland	Vancouver	Canada		

4.1. Evolution and factors influencing the non-motorized modes share in medium-sized cities over the world

The following set of evolutions and factors influencing the non-motorized modes share represent the broad variety of situations of the cities between 0.5 and 2 million inhabitants (with some exception) which answered our survey. Although most of them belong to developed countries, the geographical and historical situation of the cities have a major influence on the modal share on which actual economical and environmental situation prevails, and with which willingness of political leaders and inhabitants themselves can hardly interfere. On that level, cost of fuel (and its variations), friendliness and aesthetics of the city are mentioned, although impossible to transform into quantitative criteria for the latter.

A threshold seems to exist between the cities which were at the end of the nineties under of 350 cars per inhabitants and those which were above. A similar threshold exists between the cities equipped or not with a significant network of metro or light rail lines.

Groups of cities can be defined according to the level of walking and cycling. Taking into account the fact that the figures are collected with different methods all over the world, we can propose the following table:

Modal share for walking:
Under 20% : Low
Between 20% and 30% : Medium
Over 30% : High

Modal share for cycling:
Under 2% : Low
Between 2% and 6% : Medium-low
Between 6% and 10% : Medium-high
Over 10% : High

On a period of 10 years, either for walking or cycling, the evolution is never more than 2%, and in general less than 0.5%, whatever the policy of the city, except for San Francisco (California) where the walking rate went from 24% up to 30%, and for Vilnius (Lithuania) where the walking rate went from 31,3% up to 38,9%. The highest rate of increase for cycling is announced in Portland (Oregon) and went from 2,1% up to 6,4%, followed by Graz (Austria): from 14% to 16% (the highest rate of our survey)

In addition to this global vision, some important local evolutions must be mentioned at the neighbourhood and street level. For example, San Francisco mentions that within 3 years, nearly 25% of the population came to ride their bike everyday and that on “Market Street”, the main downtown boulevard, there are now during morning peak hour twice the number of bicycles as there are automobiles.

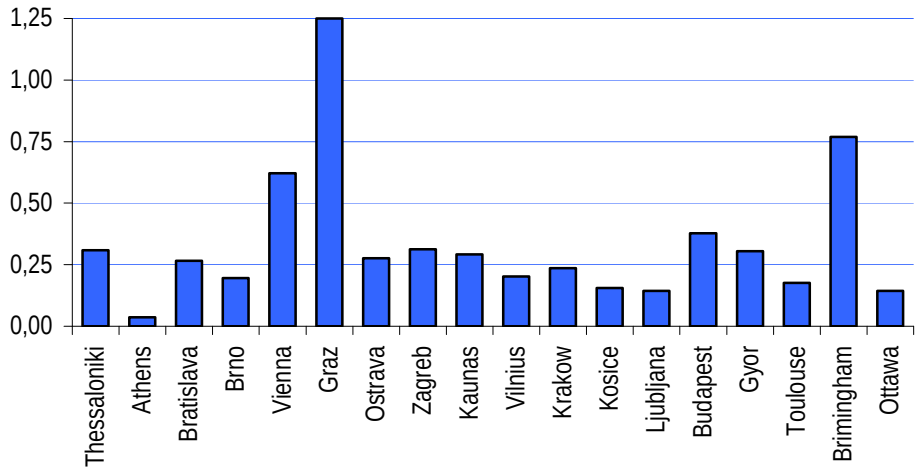
Factor A: Geography and land use

Two geographical elements make a distinction:
the fact the city belongs to a flat or hilly region
the area extension or density of the town.
Nevertheless even if the city has only 50% of its surface considered as flat, it can offer an interesting rate of non-motorized mobility. On the other hand, when the extension area of the town is important, urban sprawl and a low density of housing and employment corresponds to a low rate of walking and cycling. In this aspect, land use planning regulations is a long term factor, which seems able to influence non motorized share on time periods well over 10 years.

Factor B: Quality of the network

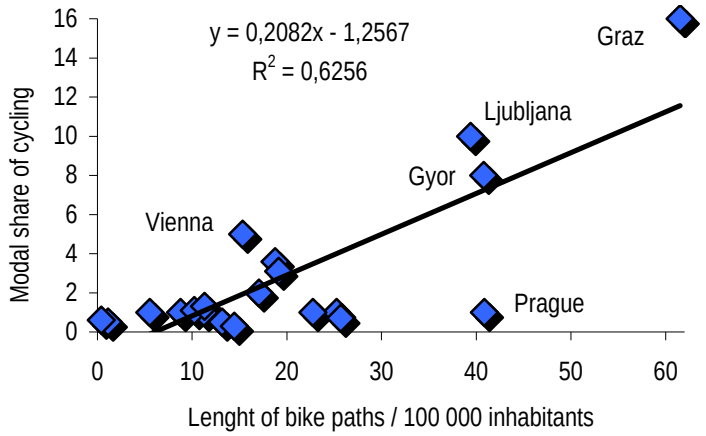
The physical quality of the network is a major incentive. Even if the cycles are mixed with the general traffic on the pavement, the road surface quality is much more important for the comfort and safety of the cycles than for that of the cars. When reserved or separate lanes for cyclists exist, the quality, equipment, signing and continuity of the itineraries are important. This is the same for pedestrians, and specifically for disabled people.

The equipment of the cycling network is mentioned especially concerning the bike parking facilities. In our survey the highest density of the bicycle road network is in Graz, Vienna and Birmingham, although Thessaloniki, Zagreb, Gyor and Budapest also reach the average of all sites (see graph below).



Length of cycle routes (km) / surface of the city (km^2)

In the following graph we have correlated the modal share of bikes with the length of bicycle road network per capita. As the graph shows the correlation is middle high in the surveyed 22 European cities. Outside Europe no correlation can be found between the density of bicycle road network and modal share.



Correlation between the density of bicycle road network and modal share

Factor C: Global transportation policy

The global transportation policy appears in the following category. A strong effort on public transport is coherent with an increase of walking (access to stations, etc.) and can be combined with an increase of cycling, provided that the global policy includes also parking restrictions for cars. It has also been mentioned that increase in public transport fares leads often to a raise in the cycling rate. On the other hand, some cities mention low taxes on new cars, which favour the motorized mobility.

Factor D: Public awareness

The social activity of groups of citizens in terms of opinion leading, lobbying, dissemination of information, educational interventions (including adult training), safety promotion, can be encouraged and supported by authorities. They can be helpful in raising the use of non-motorized modes. The impact of walking and cycling on health through a physical activity is often mentioned as a positive topic of information. Some cities organise festive events to promote walking and cycling, such as Car Free Day, European Mobility Week, Walk to School and Bike to work campaigns.

Factor E: Legal and financial incentives

Favourable traffic rules and budget given to non-motorized modes have an influence in raising their modal share.

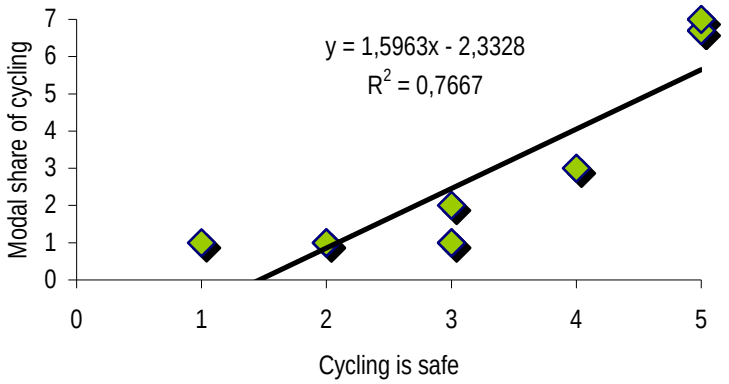
Factor F: Transportation demand management, rent-a-bike

Some cities launched mobility centres, able to give information to citizens about rules and facilities offered, and automatic cycle renting systems, sometimes with more than 2.000 publicly available cycles, e.g. Bordeaux, Helsinki and Montréal or with some hundreds of bikes like in Budapest, Niigata and Ottawa. It appears that launching a renting system produces an incentive effect on personal cycle-owners who dare now use their bicycle.

4.2. Cyclist's and pedestrian's safety

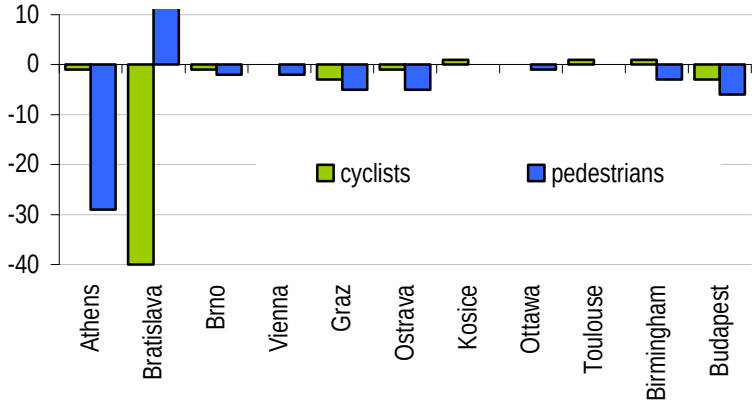
With raising the modal share of cyclists and with reduction of the modal share of cars the traffic safety is automatically improving, as some examples of western European cities show. The traffic safety can be measure objectively by accident data, but in some cases the subjective feeling of safeness can be even observed. In our survey we have studied both approaches.

According to the next graph there is a middle high correlation between the feeling of safeness and the modal share of cycling in ten European cities. Cities from other continent did not show any interrelation between the two characteristics. One reason can be the small size of samples.



Correlation between the feeling of safeness and the modal share of cycling

On the following graph the last ten years' change of the number of the pedestrian and cyclist's fatalities can be seen. Most cities were able to decrease the number of non motorized fatalities marginally.
In the further analysis of the database we did not find any correlation between the accident data and the existence of cycling and walking infrastructure.



Change of the number of the pedestrian and cyclist's fatalities in the last decade

4.3. Lessons learned about key issues and key decisions about cycling and walking

Priority to non motorized mobility

According to experiences of Washington D.C., San Francisco and other US cities cycling is indeed part of the transportation future of the city and needs to be considered at the same level, or above motor vehicle traffic. Therefore the planning process needs to be altered to move away from a reliance on motor vehicle level of service when determining what project options move forward. Internally, planners need to be vested with more decision making authority and engineers need to be trained in innovative bikeway design. The decision of integrating the needs of public transit and bicycling with pedestrian safety requires a comprehensive multi-disciplinary view and a systems perspective.

Bicycle and pedestrians friendly infrastructure, soft measures

Many cities (e.g. Krakow, Vienna, Graz, Budapest, Gyor, Calgary, Portland) agree that it is a very important issue to provide our cities with an adequate bicycle and pedestrian friendly infrastructure, which contains not only safe bike routes, but also bike parking and storage facilities, city wide bike rental system (or at least smaller bike rental spots).

Cycling Network Plans

According to the Ottawa Cycling Plan, the main lesson learned about cycling and walking is that the City has been lacking in cycling/pedestrian network plans to guide implementation. Without a network plan, many of the facilities, particularly on-road segments, have been implemented in a piecemeal approach and therefore do not necessarily provide ideal connections. Learned from this lesson, the primary goal of Ottawa Cycling Plan is to build upon existing cycling initiatives by linking, connecting and expanding existing cycling facilities in the City to establish a complete, integrated and readily accessible city-wide network serving both urban and rural areas.

Beside Ottawa, Stockholm, New York, Birmingham, Vilnius, Gyor and Calgary also emphasized the importance of having comprehensive Cycling Plan, which all of them have already worked out in the last years.

Restricting car traffic, parking policy

According to San Francisco's opinion in the US on-street parking is very difficult to remove for creating space for transit, pedestrians and bicyclists. There are several national and state design regulations that make many of the European style bicycle and pedestrian improvements very difficult.

In Europe Vilnius, Maribor and Ljubljana agree, that a restrictive parking policy should be implemented. Furthermore implementing of congestion tax can, and increasing taxes on new cars can be also effective measures to increase cycling in a city. Graz has the highest cyclist and pedestrian modal share of all developed cities. One reason of their success is due to implementation of the speed limit of 30 km/h in the whole city. They are certain of that car traffic has to be restricted in speed and in numbers. Paid parking places are essential to make it less attractive to enter the city from the surroundings by car.

Land use policy

For walking, the critical environmental factors seems to be a connected network of walkable routes, a relatively dense mix of land uses, many destinations within walking distance, and buildings and sites at a human scale. Good transit is also highly correlated with walkability (Portland). In Calgary for example bicycle parking is incorporated in the Land-use By-law (2008).

Education

In our survey Niigata, Chicago, Ottawa and Thessaloniki stress the importance of safety education. Enforcing proper cycling behaviours, training in safe cycling, promoting the mode and providing programs to encourage cycling must be undertaken, as it is recognized that more than cycling infrastructure is necessary to increase cycling.

Cycling education must start very early to establish a culture for cycling. For that reason Graz offers programmes for kindergartens and schools even for pre birth courses.

Involvement and funding

To provide a high quality of cycle (non motorized) infrastructure and to promote the cycling to the population requires high level of political support (Birmingham). There is also need to involve more the business and residents in the earlier stage of the planning and to have advocates in the process too to provide the support to approve the projects (San Francisco)

The greatest room for improvement is in funding which is the critical factor in the success of implementing of walking and cycling plans (Portland).

4.4. What are the key objectives and measures in the next 10 years in improving of pedestrians and cyclists?

Here are the summaries of answers to the above question regarding key objectives and measures in the next 10 years. We particularly asked questions concerning modal share, traffic safety, length of bicycle route, bicycle rental.

Modal Share

Many cities answered that the modal share of bicycle will increase, but few specified numerical target. There was no answer with target of bicycle share at 20% and over in the next 10 years.

Portland (USA) is a city whose bicycle share increased significantly in the last 10 years, and aims to raise it to 15% by 2020 (currently 6%). “Portland Bicycle Plan 2030” set the target at 25% of bicycle share in 20 years as well. Maribor (Slovenia) set the target of bicycle share at 10% and over.

Besides modal share, New York (USA) is to double the number of bicycle commuters from 2007 to 2015, and triple the number by 2020. (Note: “The number of bicycle commuters” means the number of bicycle traffic that goes in and out of Manhattan core.)

Best practice from UK is in cities called Cycling Demonstration Towns that increased bicycle use by 27% in 3 years. If the investment continues, cycle trips can double every 10 years in these towns.

On the other hand, some cities consider keeping the current level of car share a success with a trend of increasing car use and given level of financial aid. Political support and securing funding are the key factors to improve modal share of bicycle.

Traffic Safety

If modal shares shift toward more bicycles' and less vehicles', situations of traffic safety could be improved. All responded cities believe that traffic accidents will either stay at the current level or decrease, but not many cities put down numerical targets. Ottawa (Canada) set the target of 30 % reduction in fatalities and serious injuries compared to approximately 10 years ago. Toulouse (France) aims at 20% fewer accidents with personal injuries, and New York (USA) aims at reducing 50% of traffic fatalities. Hardly any city indicated numerical target regarding bicycle and pedestrian in relation to traffic safety.

There was response stating improving perception of safety is the key to encourage bicycling/walking in addition to reduction in injuries and fatalities. As bicycle share increases, education of traffic safety becomes eminent.

Development of bicycle route, etc.

Many cities are keen on developing cycling routes and bicycle parking. At the formulation of "Ottawa Cycling Plan" of Ottawa (Canada), total length of bicycle route (including bike lanes, paved shoulders, wide curb lanes, etc.) was 541km. The Plan proposed new cycling routes 896 km in the first 10 years, then, 1,071km in the next 10 years, resulting in 2,508km of cycling routes at completion. Vilnius (Lithuania), Brno (Czech Republic), and Washington D.C. (USA) are planning to double the length of bicycle routes.

Providing bicycle-friendly environment is also essential. Some cities plan to build roads with speed limit of 30km/hr and to expand calming areas. Providing car-free areas, prioritizing pedestrians and cyclists, and cooperating with land use are some of the essential factors.

Although bicycle route has been developed, they may not be used as expected in some cases, due to lack of bicycle parking, adequate access, or tradition of bicycle use.

Planning for bicycle transport with concrete targets, and monitoring the level of progress are essential to advance bicycle route development and to promote bicycle use. As stated earlier, both Portland and Ottawa have Bicycle Plans. Niigata (Japan) also develops bicycle riding space and bicycle parking based on "Niigata City Environmental Plan for Bicycle Use."

Bicycle Rental

There are cities planning to increase rental bicycles considerably. Vilnius (Lithuania) plans to increase to 2,000 bicycles, and Washington D.C. to 1,000 bicycles. Brno (Czech Republic) and Thessaloniki (Greece) are about to introduce bicycle rental system. San Francisco (USA) will introduce bicycle sharing program with 200 bicycles at first, then, conduct feasibility study to realize bicycle sharing program at full-scale with 3,000 bicycles.

There are different types of operation for rental bicycles such as by public, or private. It is important to select suitable type depending on size of the city. Previous effort such as Paris, gives us ideas that bicycle rentals could be a promising instrument in promoting bicycle use near future.

BIBLIOGRAPHICAL REFERENCES

- DeMaio, Paul (2009) Journal of Public Transportation, Vol. 12, No. 4, 2009 *Bike-sharing: History, Impacts,Models of Provision, and Future* accessed at www.metrobike.net/ 16 January 2011
- EMBARQ (2011) Istanbul – Metrobus. A solution that scales. http://www.embarq.org/en/project/istanbul-metrobus accessed 16 January 2011
- Frankfurt City Hall (2011) Frankfurt am Main low emission zone. http://www.frankfurt.de/ Accessed on 16 January 2011.
- FSIV (2006) – Forschungsschwerpunkt Integrierte Verkehrssysteme der TU Darmstadt (*Centre of Research Excellence "Integrated Traffic and Transport Systems" of the TU Darmstadt*): Hauptstudie „Vision Staufreies Hessen" – Schlussbericht Arbeitspakete 1 und 2. *Main Study „Vision of Congestion-Free State of Hessen" – Final report work packages 1 and 2.* Darmstadt 2006.
- Grieve-Smith (2011) Coming Soon to Bamako – A Minibus Ring and A Busway http://grieve-smith.com/transportation/blog1.php/2009/09/05/coming-soon-to-bamako-a-minibus-ring-and accessed 16 January 2011
- John, Gary (2006) *TravelSmart: Ten Years On* Department of Planning and Infrastructure. Accessed at www.transport.wa.gov.au/ts_tenyearson.pdf on 16 January 2011.
- Washington State Department of Transport (2010). *SR 167 HOT Lanes Pilot Project Second Annual Performance Summary May 2008 – April 2010*. Accessed at wsdot.wa.gov 16 January 2011.

DRAFT CONCLUSIONS

This report shows how large is the scope of actions that are implemented in various cities over the world to improve urban mobility. All these actions refer to specific situations and to general principles.

They contribute to a development trend which will be more and more sustainable, provided that the actions are carefully combined to cope with the objectives of an efficient modal share in respect with the social needs of the citizens, the economical life of the public and private institution and the preservation of the environment, taking into account the land use evolution in the city and its suburbs, this combination being validated during a process involving all the components of the stakeholders of the city, at the first rank of them the citizens themselves.

But it is not so simple to do. And the Committee achievements show that some more progresses in knowledge and methods are still to be done.

First, it should be mentioned that the comparison and the benchmarking of the various urban strategies must be made on the basis of coherent data, surveys, models and assessment tools. It means that a benchmarking of these elements must be made before a benchmarking of the strategies. The work done by the committee during the 2008-2011 period reflects more a comparison of "case studies" than a way of proposing consistent methods and effective evaluations.

Second, it reveals that there is a need to develop tools to implement the principles of modal share evolution in terms of infrastructure design. This infrastructure design must at the same time encourage the needed evolution of the modal share towards the objective, and also allow a safe and fluid execution of the urban trips. It means to control the capacity, the speed, and all the parameters of traffic for the various modes. The modal share is also a share of the public space, offering accommodation to all modes such as electric vehicles, motorcycles, delivery trucks, and looking at the period of sustainable construction of the infrastructure and efficient maintenance possibilities with adapted methods and means.

Third, the promotion of non-motorized mobility should include a vision of the future sustainable neighbourhoods in terms of built environment, density and organisation of housing, working places, commercial and leisure equipment, in the new development areas and in the existing ones as well.

An overall principle about streets and public spaces - in terms of design , maintenance and control of use - as well as about urban developments should be giving strong priority to public transport and " active " travellers , freeing them from car traffic congestion , from car dependency ... which is better for car users too .

Finally, the proposals to implement an improved urban mobility must respect the local culture and “spirit” of the city. This mean that road networks, public transport infrastructures and vehicles, design of public space to favour pedestrians and cycles, must be imagined taking into account the architectural characteristics of the city and the way of life of the citizen, in order that they feel better in a better city.