SUSTAINABLE URBAN PUBLIC TRANSPORT. A COMPARISON BETWEEN EUROPEAN AND NORTH AFRICAN CITIES

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ABSTRACT

The aim of paper is to carry out a benchmarking analysis among European and North African Cities in order to point out the improvement areas for a Sustainable Urban Public Transport System. The focus is to improve public transport performance, all aspects such as fares, operational effectiveness and attractiveness of the service.

Keywords: Public Transport, Benchmarking, Transport Performance Indicators.

INTRODUCTION

The successful of public transport in some of major cities in Europe and North Africa, that are often economic centres national and/or regional level, is linked to the organization of the urban transport system rather than other factors (i.e. social, economic, environmental, urban planning and etc.).

The urban transport is one of the emblematic local sector that knew a double evolution in the European area. On the one hand, in some European countries, the decentralization reinforced the local regulation of the public services with a “competition for the market”, by legitimating the role of the local communities (becoming authorities of transport). The reflections on the measuring instruments of the performance fall under this quite precise context of the process of decentralization. In the other hand, the liberalization, by the introduction of a European regulation with a “competition by the market” (tendering contracts), comes to upset the technical, lawful and economic conditions under which the local service is organized (M. Moudjed, 2007).

The sustainable mobility approach requires actions to reduce the need to travel (less trip; i.e. by ICT, internet shopping, tele-working and so on), to encourage modal shift (i.e. by transport policy measures), to reduce trip length (i.e. by land use and urban planning) and to encourage greater efficiency in the transport system (Banister, 2008).
According to literature, key factors that influence the development of transportation are classified by following categories:

1. *Technology*: technology can contribute to sustainable transportation by improving efficiency of service.
2. *Economic development*: transportation projects are highly sensitive to economic changes.
3. *Spatial and land-use patterns*: the travel demand and transportation system are influenced by the size of the urban area, building density, activities location.
4. *Government policy*: Authorities are strongly involved in transportation development.
5. *Social and behavioral trends*: individual behavior is a combination of habits, practical and emotional considerations. Thus, social values and norms may greatly affect the transportation choice of individuals.

The *EU Project Plume* (Planning and Urban Mobility in Europe, 2002) of the EU Commission affirms that “the essential prerequisite to guarantees the success and the promotion of public transport is the integration of transport planning and land-use policies”. The approach should be strongly linked to legislative and rules framework. Thus, as a result, best practices must be adapted to specific urban context and to needs of citizens.

In such context, the identification of a standardized set of transport performance indicators would allow to analyze quantitatively the performance of public transport services and sustainability of whole urban transport system. Transport Performance Indicators (TPIs) are standardized measures (both quantitative and qualitative) suitable for analysis in order to appraise the feasibility of a transport policy or infrastructural project and/or the performance of a urban transport system.

The legal nature of the local authority that manages public transport system and of its integration in effective and efficient way with private modes in the urban area, its skills, its operational modalities and sectors in which it operates have different characteristics that should be highlighted and analyzed. The *road pricing* as Demand Transportation Management strategy allows to reduce traffic flows and congestion; home-work plans designed by *mobility manager* for firms with more than a certain number of employees, and *park & ride* strategy for integration of transit are only some examples of policy measures to improve the management of public transport. The sources of funding for public transport operators in medium and large cities come primarily from revenues from the fares/pricing of services provided (i.e. park and road pricing, transit fares, etc.) and by national and/or regional co-funding.
The centralization in the organization and in the coordination of all public transport systems/services within the urban area can improve its attractiveness, its economic development and its role within the area and its sustainable development. The public transport system of London, for instance, has developed peculiar patterns; since it incorporates and effectively manages not only the different public transport services, but also the transport infrastructures of the city as well as various aspects of mobility, such as road congestion issues.

A good urban public transport system with an important role in the mass transit, is a crucial success key for the development economy, reducing the externalities due to the congestion and pollution emissions. Further it allows to reach objectives of sustainability even at local level as such greenhouse gases reductions.

Further every application is site dependent and uses specific set of indicators. The lack of homogeneity in detection, measure, store and monitoring of standardized performance indicators often does not permit to compare different urban contexts.

In some cities in Europe and North Africa, a number of policy measures have been already applied and providing very positive results. Therefore, the aim of our analysis is understand if the current public transport system in cities of developing countries, can be improved by further organizational and management tools, comparing North Africa’s cities with European ones, using these as benchmarking models for improvement of overall urban transport system where it is poorly efficient and sustainable.

**METHODOLOGY**

Benchmarking is a technique can be used for performance management. Key themes in benchmarking include performance measurement, comparison, identification of best practices and improvement (Geerlings et al., 2006). Therefore, benchmarking is about comparing an organisation’s performance on a number of measures relative to peer organisations and from this deriving a set of appropriate targets (the benchmark) for the organisation. In other words, the process not only reveals the present performance status of an organisation against its peers but also provides information on the areas and scale of potential improvement and the best practices for implementing changes that effect improvement (Henning et al., 2011).

The figure 1 shows the development of a benchmarking process for the transport area. It shows the iterative process involved in the planning and comparison of processes and in adapting the results to define organisation’s target performance levels. Benchmarking remains
a cyclic process of continuous improvement that not only aims at improving organisation’s performance but also the benchmark process itself (Andersen, 1999).

An interesting experience in this context is EMTA\(^1\) Barometer of Public Transport, that compares the following aspects of participating city/regions:

- Basic Socio-Economic Data of Metropolitan Areas (population etc.),
- Mobility (modal split etc.),
- Description of the Public Transport System,
- Fares and Financial Aspects.

The BEST Project (2003) compares how the citizens perceive the public transport service, the focus is on customers. The objective is to strengthen public transport organizations focus on customers’ needs and expectations, and to establish a learning process among public transport professionals in Europe. The carried out survey collected data about how citizens’ perceive the following aspects of public transport: citizens’ satisfaction (overall satisfaction with public transport), traffic supply, reliability, information, staff behavior, personal security and safety, comfort, social image, value for money, loyalty.

The comparison among public transport systems in different context (cities or metropolitan areas) is not easy for the specificity of the analyzed reality. The efficiency and performance of each transport system depends on many factors among which the geography, the demographic structure and the cultural heritage of population, the travel behavior, the habits, the bounds of

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environmental capacity identified by rules, as well as by national policy in the transport sector.

Therefore, benchmarking is used in the decision process:

- to identify the areas of improvement by having a holistic view of comparisons with benchmarking partners, relative performance assessment can be undertaken for all performance areas specified in the TPIs. The focus is to improve public transport performance, all aspects such as fares, operational effectiveness and attractiveness of the services should be addressed in order to make a successful impact with improvement initiatives.

- to develop appropriate and practical performance targets or benchmarks, directing resources to particular performance areas.

- to learn from others by knowing what strategies they have adopted in their performance improvements a natural outcome of the benchmarking process is the awareness of good examples of successful policies and strategies.

Further, the assessment of the urban transport system’s sustainability by a identified set of transport performance indicators, in order to measure and hence to compare the performance of urban public transport systems, provides the opportunity for understanding its structure in its different organizational, managerial and operational aspects in order to achieve the goals of efficiency and sustainability of service.

**DATA SOURCES**

Data collection of TPIs is a crucial phase, but data detection and monitoring are not standardized at the urban level; there is not hence a standard for data collection, this aspect makes much difficult to compare different contexts. This issue is critical and can bound the carried out analysis.

One of main data sources at city level is Eurostat Database Core Cities that provides various sustainable and transport performance indicators. This dataset can be used in order to collect data from European Cities. Data are collected at a number of different levels, namely: core cities, larger urban zones and sub-city districts (for a smaller subset of indicators). The urban audit defines a city as a legal entity (administrative concept), and delineates the ‘core city’ according to political and administrative boundaries; Cities are almost 450; data are averaged over four years from 1989 to 2010. Another data source is the Mobility in City Database project (UITP, 2006 even if with obsolete data, reference year 2001) compiled and compared the data on urban transportation of over 100 cities around the world. The project was initiated
by International Association of Public Transport (UITP) with a primary focus on sustainability and public transport. Over 200 indicators relating to passenger transport, emissions and energy and demand management were reported.

An important future data source at city level (since, it is actually not able to produce report) will be provided by Global City Indicators Program. It provides an established set of city indicators with a globally standardized methodology that allows for global comparability of city performance and knowledge sharing\(^2\). Concerning data of North African Cities most part of TPIs were extracted by MENA Project, (UITP, 2007) and World Development Indicators (World Bank, 2011).

**PUBLIC TRANSPORT IN NORTH AFRICAN CITIES**

North African cities have common patterns as:

- a rapid urban growth with an increasingly marked disparity between the centre and the rapidly growing and ill-equipped outlying neighbourhoods;
- 50% of the population is under 20 years old;
- 50% of travels are home-to-school trips;
- low car ownership rate;
- insufficient supply and near permanent saturation of public transport services.

Several countries in Africa have put in act a combination of policies, including traffic demand management policies as well as the provision of cleaner and more energy-efficient public transport systems. Among these the Bus Rapid Transit (BRT) system was introduced only recently to Africa’s transport system, as part of strategy towards sustainable urban transport.

The main benefit of BRT is to simulate a mass transit system using exclusive right of way lanes in line with the metro systems well known in developed countries, but using bus technology instead of rail. The BRT costs a small fraction of the modern rail-based transit system and draws on best practices from modern metro systems in managing operations, including pre-board fare collection and fare verification, enclosed stations that are safe and comfortable, clear route maps and real-time information displays. During the last decade, the Bus Rapid Transit system has attracted the attention of a number of cities in Africa. Cairo, Lagos, Johannesburg, Dar es Salaam, and Dakar have either introduced the BRT as an alternative mass transport system.

The underground mass transit system continues to be a rare mode of transport in Africa. Egypt completed the construction of the Cairo Underground Metro and started operation in 2000. The Cairo Metro, the first of its kind in Africa and the Middle East, carries an average of 2.7 million passengers per day. Following Egypt, which has been operating the system for almost a decade now, Algeria is developing an underground transport system, the first line of which is 9.5 km long. Each metro train will have 1200 seats and will run at a maximum speed of 70 km/h. Another line with a route length of about 9.5 km is expected to be opened in 2012. The service on the first line, which is planned to start in 2009, is reported to be the first heavy subway system in the Maghreb Region.

The scene in the Africa/Middle East region is very diverse in terms of the deregulation and privatisation of passenger public transport. The Egyptian state railways have been undergoing a restructuring and investment programme since 2007, due to finish in 2011, and which comprises around EUR 1.4 billion. The objective is to set up three business units (long-distance transport, local transport, freight transport) and to ensure the permanent success of their operation through new investment. In relation to this, part privatisation for rail freight transport is at least under discussion which, if it succeeded, would make part privatisation in passenger transport also likely. Urban rail transport is still in state hands and there are no signs of deregulation becoming likely (UN, 2009).

In Egypt, the Cairo metro is currently building its third line, which will provide a link to the city’s airport (34 km). Three further lines, with a total length of 63 km, are being planned for building between now and 2022. Cairo is also the scene of a vast project involving the refurbishment and modernisation of tramway networks (2 lines) and commuter railway lines operated by the national rail company, ENR.

In Algeria, numerous projects are being developed at speed. The commuter rail transport project in the suburbs of Algiers will be consolidated through the purchase of 64 new electric train cars. This fast line, on which trains will serve the 29 stations between El Affroun and Thenia every seven minutes, will be operational from September 2008. The line will be carrying some 55 million passengers by 2010 and 80 million passengers by 2020. Algiers has resumed building work on its metro (three lines, 56 km, commissioning of phase one in 2008). Once the whole of metro line 1 has become operational, the metro will be able to accommodate some 150000 passengers per day. It will have 16 stations and a length of 14 km. The two other metro lines will be subject to possible consideration between now and 2020. Building work on Algiers’s first tramway line began in July 2006. The completion deadline for this 16.3 km twin-track line serving 30 stations has been set for mid 2009. It will
link El Annasser to El Kiffan. The future tramway is expected to transport between 150,000 and 185,000 people a day.

We have focused our attention on four North African Cities: Algiers, Cairo, Casablanca and Tunis describing their characteristics.

**ALGIERS**

ETUSA, the Algiers urban and suburban public transport company, is the main operator. The liberalization of the sector was immediately followed by the proliferation of private operators and an overall increase in supply. This led to a drop in the market share for public operators who lost their monopoly. The Ministry of Transport prepared a public urban transport plan and a master traffic plan designed to resolve the problems bedevilling the transport sector in Algiers and meet the travelling needs of the population. This plan centres on two main ongoing projects likely to improve the services offered to passengers and ensure integration and collaboration among the different modes of transport.

It concerns the following projects:

- The rail transport project in the suburbs of Algiers will link in 7 minutes the 29 stations of the El-Affroun-Thenia line thanks to the acquisition of 64 new electric trains.
- The first line of the 56 km metro project (3 lines) linking the Grande-Poste to the Hai El Badr city will go operational in late 2008. This line will be extended westwards towards the Matyrs Square for linkage with West Algiers tramway and eastwards towards El-Harrach for linkage with the Algiers suburban train. It will be able to transport 150,000 passengers per day in 16 stations on a stretch of 14 km; the other two metro lines could be realized between now and 2020.
- The tramway project comprises two lines: a 23.2 km line, linking the centre of Algiers to Dergana; construction work started on 5 July 2006 and it will go operational in late 2008. And a 16.3 km line serving 30 stations and linking El Annasser to El Kiffán.

By 2008/2009, the capital, Algiers, have a diversified and interconnected multimodal network which will possibly translate into better, more regular and quality services. Nonetheless, there are still enormous investment needs in Algiers transport networks and traffic due to high unmet demand of the urban population.
CAIRO

The population of Greater Cairo Region (GCR) has registered a rapid growth of 2.5% p.a. in the last years and reaches approximately 20 million inhabitants. This growth is accompanied by a sprawl of the city: GCR radius is about 60 km. Cairo represents 25% of the population of Egypt and 57% of the total car fleet of the country. The car ownership rate in Cairo is about 59 cars per 1,000 inhabitants. Although this rate is relatively low, traffic congestion is a crucial issue in GCR. It also hosts 51% of the total bus fleet of Egypt.

GCR metro network includes two lines: line 1 Helwan – El Marg (44 km); line 2 Shobra–El Moneeb (21.5 km); line 3 Imbaba – Cairo airport (34.2 km) is under construction. Further three additional routes are planned: line 4 Naser City– El Haram (24 Km); line 5 Naser City– Shoubra (19 Km); line 6 Maadi– Shoubra (20 Km). According to Cairo Transport Master Plan, the demand for metro trips will reach 8.7 million passenger/day in 2022 that means that metro lines 1,2 and 3 will be saturated (maximum capacity: 5.76 million passenger a day). Thus the extension of the network will be indispensable. Bus services in Cairo are suffering from a number of problems including: low tariff (due to social aspects), ageing fleet (63% of the buses fleet and 43% of the minibuses fleet exceed 12 years age), over employment and extending of service area due to the political aspects. Finally, GCR is served by 163,300 taxis and microbuses (shared taxis) which cover 2.7 million passenger trips daily.

CASABLANCA

The crisis of public transport is attributable to the following reasons:

- vehicle fleet is old;
- dissatisfaction of public transport users with the poor quality of service;
- lack of an adequate maintenance policy;
- emergence of private operators in urban transport;
- inadequate pricing policies.

Public and private bus fleets are made up of a wide range of vehicles from 25 seats to 130 seats, although this last type (articulated buses) is rare. These vehicles are put in service according to their availability and not always on the basis of the usual demand-based principles. Furthermore, many vehicles are not adapted to urban transport which is characterized by big passenger flows at bus stops (which are many in urban areas). High bus floors and inadequate doors hinder passenger flows and significantly reduce commercial speed (which is already low due to traffic density on the routes used). Average fleet age is
above 6 years. Bus fares remained unchanged during the last years. The Wilaya of Greater Casablanca is attempting, through the new M’dina Bus Company, to minimize the thorny problems of urban transport. It intends to ease travels and reduce the wait at run-down bus stations (where they exist). Furthermore, passengers have no means of knowing when buses are to arrive. M’dina Bus cannot meet all the mobility needs of Casablanca given the steady growth of its population and the boom in economic and social activities. Lack of organization and the emergence of M’dina Bus have led to the gradual collapse of private companies. Casablanca transport system includes the Al-Bidaoui express rail network that services Casablanca and its suburbs. A month’s season ticket costs 30 euros. The airport link is not yet operational. Three tramway lines, a metro line and an express rail line (already operational) will be built under the project to improve on mass transport.

TUNIS

Tunis Public Transport Company (STT); running a fleet of buses (220 lines) and a light rail network (46 Km), providing the public transport service to around 2 million passengers.

National Rail Company (SNCFT): Providing the major service of public transport between the capital down town and the southern suburb using a railroad line of around (25 Km), also providing transport between the capital and many other sections of the republic. Tunis bus network includes 220 routes served by 1148 buses. Tunis light train offers transport within the city and connects Tunis to suburbs with 6 major lines:

RESULTS OF ANALYSIS

For analysis we have taken into account 16 cities of which 12 are European cities and 4 of North Africa. Moreover, in order to compare the effectiveness and the sustainability of urban transport systems, we have considered 11 transport performance indicators reported in table 1. This table shows the descriptive statistics for each TPI maximum, minimum, mean and standard deviation values respectively.

Table 1. Statistics of TPIs

<table>
<thead>
<tr>
<th>TPI</th>
<th>Vmax</th>
<th>Vmin</th>
<th>Vmean</th>
<th>Vstdev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population in Urban city</td>
<td>15546100,0</td>
<td>489562,0</td>
<td>3016983,2</td>
<td>3838106,0</td>
</tr>
<tr>
<td>Car thefts in Urban city - number per 1000 inhabitants</td>
<td>12,1</td>
<td>1,5</td>
<td>4,4</td>
<td>2,9</td>
</tr>
<tr>
<td>Employment/Population (of working age) Ratio</td>
<td>1,0</td>
<td>0,4</td>
<td>0,6</td>
<td>0,2</td>
</tr>
<tr>
<td>Total land area (km²)</td>
<td>1572,0</td>
<td>84,7</td>
<td>519,0</td>
<td>467,2</td>
</tr>
<tr>
<td>Population density in Urban city</td>
<td>35020,0</td>
<td>1312,9</td>
<td>7305,0</td>
<td>8576,5</td>
</tr>
</tbody>
</table>
Therefore, all TPIs have been normalize in the range [0,1] as follows:

\[ NTPI_{i,s} = \frac{TPI_{i,s} - TPI_{i,min}}{TPI_{i,max} - TPI_{i,min}} \]  

(1)

where \( TPI_{i,s}, \) \( TPI_{i,max} \) and \( TPI_{i,min} \) are the value of the indicator \( i = 1 \ldots N, \) of the city \( s \) and the maximum and minimum values of the indicator \( i \) related to all cities, respectively. Thus, for each value of TPI that falls into ranges \([0, 0.33], [0.33, 0.66] \) and \([0.66, 1] \) has been assigned ‘low’, ‘medium’ or ‘high’ respectively (as shown in table 2).

Table 2. TPIs for different cities

<table>
<thead>
<tr>
<th>CITY/TPI</th>
<th>Total population in Urban city</th>
<th>Car thefts in Urban city - number per 1000</th>
<th>Employment/Population (of working age)</th>
<th>Total land area (km²)</th>
<th>Population density in Urban city</th>
<th>Share of journeys to work by car in Urban city - %</th>
<th>Registered cars in Urban city – number of cars per 1000 inhabitants</th>
<th>Number of deaths in road accidents per 10000 population</th>
<th>Average time of journey to work</th>
<th>Number of stops of public transport per km²</th>
<th>Cost of a monthly ticket for public transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bruxelles</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>København</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>Madrid</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>Paris</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
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<td>Low</td>
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<tr>
<td>Roma</td>
<td>Low</td>
<td>High</td>
<td>Medium</td>
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<td>Medium</td>
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<tr>
<td>Amsterdam</td>
<td>Low</td>
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<td>Low</td>
<td>Medium</td>
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<td>Medium</td>
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<tr>
<td>Stockholm</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
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<tr>
<td>Oslo</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
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<tr>
<td>Helsinki</td>
<td>Low</td>
<td>Medium</td>
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<td>Berlin</td>
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<td>High</td>
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<tr>
<td>Lisbon</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
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<td>London</td>
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<td>Medium</td>
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<tr>
<td>Algiers</td>
<td>Low</td>
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<tr>
<td>Cairo</td>
<td>High</td>
<td>Low</td>
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<td>Low</td>
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<td>High</td>
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<tr>
<td>Casablanca</td>
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<tr>
<td>Tunis</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
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<td>Medium</td>
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</table>
It should be noted that European cities, despite with their differences, are characterized by an efficient public transport, highlighting a low average time of journey to work and a good public transport supply. Nevertheless they have an high car ownership. Conversely, North African cities have low car ownership, but they have not controlled the urban sprawl over time. Thus they are characterized by very large urban areas with a limited public transport supply and low quality of service. This aspects is still highlighted in table 3, that shows the policies adopted by cities, in last years.

Table 3. Adopted policies in cities

<table>
<thead>
<tr>
<th>Policy/City</th>
<th>Stockholm</th>
<th>København</th>
<th>Paris</th>
<th>Oslo</th>
<th>Amsterdam</th>
<th>Helsinki</th>
<th>London</th>
<th>Lisbon</th>
<th>Berlin</th>
<th>Madrid</th>
<th>Brussels</th>
<th>Rome</th>
<th>Algiers</th>
<th>Cairo</th>
<th>Casablanca</th>
<th>Tunis</th>
</tr>
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<tbody>
<tr>
<td><strong>Urban Planning &amp; Transport</strong></td>
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</tr>
<tr>
<td>Control of urban sprawl</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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Legend: ✓ = adopted.
CONCLUSION

There are difficulties, on a theoretical as well as on a practical level, related to the implementation of policy measures in the city context. Every application is site dependent and uses specific set of indicators. The lack of homogeneity in detection, measure, store and monitoring of standardized performance indicators often does not permit to compare different city contexts. In such situation, a standardized set of performance indicators would allow to analyze quantitatively the effects of adopted policy measures.

Data collection of TPIs is a crucial phase, but data detection and monitoring are not standardized at the city level; there is not hence a standard for data collection this aspect makes much difficult to compare different city contexts. This issue is critical and bounds the analysis of benchmarking.

The outcomes of the comparative analysis are consistent and so summarized. An high value of sustainability is associated in general to small-medium cities in term both population and urban area; nevertheless, for large cities, the adoption of policy measures, from a side, to control the urban sprawl, from the other side, to manage the urban transport demand with an adequate public transport development allows to achieve a more sustainable mobility (i.e. London). North African Cities have, from an hand, a delay in the adoption of urban planning and transport demand management policies; from other hand, to reduce demand for inner-city travel, better integration of development plans with transport infrastructure can result in more effective investments. Planning for compact cities and neighborhoods shortens trip distances and makes public transport more economically viable and reduces the need for motorized travel by co-locating settlements, work and school facilities. Therefore, enhanced systems for public and non-motorized transport in well designed communities can have significant benefits for enabling access to better housing and employment options for the poor (UN, 2010).

REFERENCES


UN, 2010. A New Perspective Sustainable Mobility In African Cities, UNITED NATIONS, 1-32

World Bank, 2011. World Development Indicators, 1 – 466.