Conveying a Management Model for Urban Mobility Systems

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Abstract: The objective of the set of two papers, of which this one is the first, is to provide the evidence on how a management model developed for urban mobility systems was applied in the Brazilian reality, highlighting the fact that whenever a model is adopted by a running system, three elements are critical to pursue such an endeavor: the model contents and underlying rationale; the political opportunity; the implementation process. This paper presents the structure and the rational for the model. A second paper deals with the implementation process. The reading of both papers is recommended for a full understanding.

Key Words: Urban Mobility, System, Management; Quality

1. INTRODUCTION

The concept of “urban” involves a series of interrelated dimensions, among which: population size and density; spatial, economic and social organization; variety of functions and institutional interactions; social values of population or degree of “civility” (often also referred as “urbanism”), etc. (Macário, 2005). A review of existing definitions of “urban area” has been undertaken by the Network for Urban Research in the European Community (NUREC) (Paddinson R., 2001, in Macário, 2005) and it concluded that the level of comparability between urban areas is very low. This is mainly because the basic geographical units, and even the functional building blocks, are substantially different and also because of the importance given to economic and social functions existing in any urban area. As a consequence of this diversity other factors result as essential for urban management, such as the dimension of urban infrastructure and other supply systems, acting all as interacting sub-systems.

A common argument around the systemic approach is that every system is part of another system, that is the existence of formal hierarchies of systems, with formal subordination of the lower level partition to the upper level partition of the more global system. In urban dynamics, and especially in urban mobility, this formal hierarchy is not so straightforward as it may be found in other disciplines. Moreover, the interpretation and definition of these formal and informal hierarchies is a key factor for how planning and control functions are designed and performed. However, this theoretical discussion is not called for discussion at this stage and for the purpose of our paper we define the urban mobility system, central object of this work, as an enabler of the
urban system. That is, a subsystem with great autonomy of organization but also with strong symbiotic relations with the other sub-systems of urban life (i.e. land-use, environment, telecommunications, security, education, etc.) as well as with the main upper system, leading to cause-effect relationships between their performances and, consequently, influencing their evolutionary capacities.

The objective of this paper is thus to provide the evidence on how a management model developed for urban mobility systems (Macário, 2005) was applied in the Brazilian reality, highlighting the fact that whenever a model is adopted by a running system, three elements are critical to pursue this endeavour: the model contents and underlying rationale; the political opportunity; the implementation process.

2. MANAGEMENT MODEL FOR URBAN MOBILITY SYSTEMS

How to deal with quality definition has always been a problem, especially in services, once the relevant concept here is the perceived quality, as explained in the previous chapter. Indeed, we can easily understand that high quality is a goal common to all countries, sectors and societies, and that everyone is able to identify it. However, the operational definition of high quality varies with a number of factors from cultural attributes of the evaluator to functional attributes of the object (service or product) being evaluated, passing through the variability of criteria used in the clients’ judgment.

Today, there is a general awareness that the existence of human life itself is dependent on a number of quality thresholds, such as temperature, air quality, food quality and so on, which is largely controlled by natural and non-natural solutions or mechanisms. These have contributed to the growth of an enormous variety of goods and services that again challenge the quality thresholds, and the evolutionary cycle continues passing on the experience from one generation to another, simultaneously increasing the sophistication, rigor and complexity in the production of goods and services and also in the associated flows of information.

2.1 Underlying rationale

Evolution of human societies is also dependent on productivity of industries and countries that also lies very much on quality control for both product and process design. Even economic growth depends on the reliability of systems such as energy, communication, transport, etc., that is, on their sustained quality. Given this importance governments have always been responsible for establishing and enforcing quality standards, through different institutions, some of them political such as national, regional and local governments, others of non-political character, like corporations, trade associations, standardization organizations, etc.

Quality requirements evolve in our societies as a consequence of the evolution and needs of the society with increasing demand on quality thresholds as we move from one stage to the next. Disruption in this process is only observed either when the process is interrupted by some external element (e.g. wars, natural catastrophes, etc) or when the system reaches the regeneration stage requiring then to rethink standards and thresholds which represent a stage close to exhaustion of the potential for improvement along the previous path.
From what we have observed in Public Transport there are symptoms that we are very close to this exhaustion stage of the current model. As referred in Macário (2005) the improvements made, even when they represent strong investments, only exceptionally return some positive variations on patronage and the most ambitious achievement is retention of market share. Simultaneously, a wide consensus gained prominence, that urban mobility management has to start with the location of activities, where the mobility need is generated, which is an important part of land-use strategic management as a driver for urban development. In fact, perspectives over an urban mobility system are usually diversified, and often conflicting, as they depend on which stakeholder’s view we adopt.

Objectives and policies from urban mobility authorities also reveal a high degree of variation. Worldwide we can find many urban areas where the urban mobility concept is not yet perceived and many others where, despite evidence of the understanding of the concept this has not been assumed in an integrated organizational and management structure covering all the decision levels. In fact, even in the latter cases the most common situation is a scattered distribution of responsibilities to several entities, sometimes backed up by an integrated policy document. This situation results from the fact that even where the urban mobility concept is assumed there is often a misfit between the existing institutional design and the organizational requirements for the management of such a complex system, which results in inconsistencies that influence the overall performance of the mobility system.

We define urban mobility as the aggregated result of the multiple decisions (and factors conditioning those decisions) taken by individuals and economic agents as an answer to their requirements of displacement of people and goods. Conditioning factors are: the location of social and economic activities in the urban defined spaces; the working hours of the different activities; intensity of opportunities for social interaction; other cultural elements that contribute to define the pattern of social relations in a city. The urban mobility system in then a structured and organized system that tries to provide fluidity in those displacements and access to the relevant urban activities, making use of the possibilities offered by the various transport modes envisaging an adequate balance between the several modal resources, with the ultimate aim of contributing to the preservation of a sustainable city.

In general terms we can say that the quality of the outputs of the urban mobility system depends not only of the quality of its inputs but also on the overall quality of management of that city which thus becomes an input of the system in the sense that it is part of the potential to produce outputs (Macário, 2005). Besides, the interplay between the different policies and institutions that steer the relevant urban processes, such as land-use, socio-economic development and environment, are also considered as an input of the urban mobility system.

The urban mobility system is formed by infrastructure (including superstructure and intermodal links), networks, services and agents, each of them by itself a complex whole that requires further decoupling, namely:

- the main infrastructures of the urban mobility systems are: roads, rails, parking areas, pedestrian areas and corridors, cycling areas and corridors, unimodal and multimodal stations. Some of these are only made functional by association to services provided by professional entities, while others can be explored on self-service basis, namely road and pedestrian and cycling infrastructures, although they can also support professional services;
the main services are: motorized transport services, services related with vehicle, infrastructure (and superstructure) availability and use, information services\(^1\), citizens training and education for self-service modes. Professional services can be provided in all networks even in the ones used on self-service basis;

the main agents are; authorities, service operators, users of the various transport modes and other citizens;

Finally, the main networks which are formed by the interlinkage of individual elements (infrastructure or services) are: the public transport network, that can encompass several modal networks like, road, rail and inland navigation; the network of individual private motorized transport; the network of non-motorized individual transport, each of them with potential for subdivision of modes and services.

Demands falling over an urban mobility system are very diverse and require the system to continuously adjust to the urban changes. Besides, clients are divided in segments that represent different preferences, sometimes in conflict. This means that the activities that add value to a specific segment of clients might well subtract value to other segments. Consequently part of the steering mission has to be dedicated to the management of these conflicts that are reflected since the design of the configuration of the urban mobility system where equity concerns among these groups have to be considered.

For an urban mobility system to maintain its value driven character along time, despite its complexity, degree of internal conflict, and instability inherent to the perception of quality, the following properties are indispensable:

- Robustness, meaning long term stability and sustainability;
- Adaptability, meaning the dynamic capacity to adapt services to evolutionary demands or new technological opportunities
- Efficiency, meaning high productivity, in the capacity to transform basic resources into service outcomes, and these into consumption units, providing the best results at the lowest possible cost;
- Diversity, capacity to respond to respond to the aspirations of the different segments of customers with different types of services in a continuous adjustment between supply and demand for urban mobility.

In this underlying logic of the proposed management model the relations between the different elements are translated into quality criteria, forming a cycle for the planned intervention, that can be either a policy, a measure or simply an action. The definition of objectives starts with the decision-makers’ interpretation of several elements, namely:

- the importance of the needs (or aspirations) of the citizens; and
- the importance of the problems to be solved, measured through their impacts on social and economic live of the city; and
- the assessment of the probability of success of each of the actions and policies envisaged as potential solutions for those needs and problems, as well as to the superior objectives of sustainable development of the urban environment.

\(^1\) Information services also require a specific infrastructure
Therefore objectives are defined upstream of the prioritization of actions and policies. Indeed, whatever the context, the formulation of a strategy always requires the establishment of a hierarchy of objectives and the setting of the level of their ambition. Cities differ substantially in their vocation and in their development strategies. Besides, even if we are dealing with similar problems, in any given moment each city is conditioned by the choices made in the past that configure a different departure point for the problem under analysis and, consequently different perceptions are derived on which are the main problems and which are the best solutions to mitigate them.

Achievability and relevance are major concerns when defining an objective. The degree of achievement of an objective is easier to recognize when it is verifiable and associated with a measurable indicator. Relevance of the specified objective, in turn, implies: attainability with the means made available for that specific purpose; and coherence with the different levels of intervention of the encompassing policy, which is achieved by aligning the decoupled objectives ensuring that the objectives set at the strategic level are correctly declined in the tactical and operational goals, as we have described in previous chapters.

The rationale underlying our proposed model lies on the assumption that a key input for the Urban Mobility System is the interaction between policies, namely between land-use, environment and socio-economic development of the urban area, since these aspects are upstream the generation of mobility requirements (through land-use) and the choices made by the citizens (through the pricing system, regulation on environmental protection, fiscal incentives, etc). The structure supporting this rationale is composed of four entities: inputs, outputs, results and impacts.

**Inputs** are the resources that are mobilized by processes to move the system towards the prescribed objectives. In this sense the concept of system’ inputs encompasses all usable resources, which can be human, material, financial, organizational, regulatory, political, etc.

There is a considerable correlation between the degree of access to information regarding these inputs, the commercial value of that information and the degree of control exercised by the authorities managing the urban mobility system, which is not necessarily equivalent to the degree of importance of the input for the management of an urban mobility system. So we can have situations where we have no control on inputs although there is good information available, as well as situations where the agent is under control of the authorities but frequently withholding information that she considers commercially sensitive. In short, we can not establish a stable relation between availability of information and capacity to control the agent who holds it.

A good illustration of this type of difficulty is provided by the interaction between land-use and mobility, where the first is a major remote cause of mobility needs with information largely disclosed, but absolutely no control is possible by the mobility management entities. Due to the high complexity of these two sub-systems of the urban system (mobility and land-use) there are good arguments to keep them administratively separate, which then imply that joint management control can only be achieved through concerted decision-making between mobility and land-use authorities.
These resource inputs are then build into processes. System process is the logical organization of agents, information and resources into activities designed to produce a specified result under integrated decision-making. The complexity of urban mobility systems causes the existence of a number of several nested processes over which the strategically defined objectives are deployed. This deployment of objectives is made in two simultaneous ways, through the activities (activity by activity) and through the process priority (or criticality) in terms of improvement of the overall system, with the ones with highest potential for the improvement of effectiveness of the overall system going first. Process quality, in turn, is measured along the following four principal dimensions:

- Clarity – enable an easy understanding of what is to be done and why and how much of a process has been accomplished in a given moment. Clarity is a major element of stimulation to maintain willingness and intensity of effort for long periods;
- Effectiveness – meeting the objective for which it has been designed;
- Efficiency – being effective at the least cost;
- Adaptability – maintaining effectiveness and efficiency under a changing environment and/or under change of requirements;

Outputs in turn are the realization obtained through the transformation of inputs supported by organized productive processes. Typically operators of services and infrastructure are responsible for outputs that can be divided in two main categories, namely:

- Material outputs, such as the construction of a road, rehabilitation of an old urban area as a consequence of traffic restraint, a walking path, etc.;
- Immaterial outputs, can be the displacement of a person or good from point X to point Y, information, training and coaching, etc.

Results are the benefits (or disbenefits) that the recipients of the services delivered by the system obtain from their utilization. It is an end state dimension, an immediate outcome, centered in the system user and internal to the urban mobility system. Results should be subject to regular monitoring and it is through the evaluation process that they provide the first information feedback for any possible adjustment required in the implementation of an action or measure. A good illustration of a result is the improvement of accessibility with the extension of an underground line, i.e. an enlargement of the territorial area that can be reached within a certain time threshold.

Impacts are consequences that can either affect the recipients of any process, action, measure or policy package, or any third parties. Impacts are spread along time, and can be any socio-economic change that accrues directly or indirectly from any implemented action or measure. Following the methodological guide for evaluation used by the European Commission (Tavistock Institute, 2003, Glossary, pp 10, former MEANS project, in Macário, 2005) impacts can be of three kinds:

- Direct impacts, that is specific impacts observed among direct beneficiaries of the system which can be reflected either in short term or in long term. These can be further disaggregated in the effect they produce on the relations between the beneficiaries and the systems:
  - First, only by changing perceptions, that can be seen as a direct effect over potential users and so influencing their choices;
Second, by introducing behavioral adjustments, as a consequence of the change in perceptions, that represents a secondary effect since they will progressively spread throughout society; and,

- Indirect impacts, which affect indirect beneficiaries;
- Global impacts, which are the ones that can be observed at macro-economic and macro-social levels.

Finally, system evolution is the structuring effect that results from all these impacts. Therefore sustainable changes act as drivers of system evolution. The feed-back cycles entail an evaluation process that enables to decide whether the system needs correction of its path and where the improvement process should be focused. Feed-back cycles assess strategic objectives against impacts and operational objectives against results, making this evaluation complementary to the one, previously referred, that is made to each inner process of the urban mobility system. This evaluation should be based on the following set of six quality perspectives, and respective meanings, in order to ensure the structural coherence of the model:

- Relevance - appropriateness of the operational objectives of the Urban Mobility System taking into account the context and the needs, problems and aspirations over the system;
- Effectiveness - capacity to achieve the expected outputs, results and impacts;
- Efficiency – capacity to be effective at a reasonable cost;
- Applicability – adequacy of means to the achievement of objectives;
- Internal coherence – correspondence between the different objectives within the different levels of the system. This implies the existence of an hierarchy of objectives within the system, with those at the lowest levels contributing to the accomplishment of the ones at a higher level;
- External coherence – correspondence between the objectives of the urban mobility system and the ones of other sub-systems of the urban system. That is for every objective of the urban mobility system there is a functional relation with an objective of the urban system and its sub-systems. This correspondence will in fact contribute to ensure the vertical and horizontal consistency of the urban system.

A set of indicators, and respective measuring methods, is required to produce this feed-back evaluation. To support the rationale of the model presented herewith we adopt the following typology:

- Resource indicators, which cover the inputs used by the system, providing information on the financial, human, material, organizational and regulatory means used, and also the ones left available for future use;
- Process indicators, which cover the efficiency and effectiveness of the processes organized to transform inputs into outputs;
- Output indicators, which cover the outcomes obtained;
- Result indicators, which measure the advantages for the beneficiaries and for the offended, that is winners and losers of any action or policy;
- Impact indicators, which represent the anticipated consequences beyond the direct and indirect effect over the ones affected by the system. These indicators should contemplate positive and negative impacts and, whenever possible (on ex-post basis), should also cover unanticipated impacts that is spin-offs of the system evolution. Besides, special care should be taken to ensure compatibility and avoid redundancies with previous indicators.
Figure 1 Rationale underlying the quality management model (source: author)
2.2 The structure of the model

Given all the evidences from the cities observed and the rationale developed in this work, the management model is structured along the following building blocks for the purpose of its implementation (in any city):

- Contextual agenda – the list of issues or problems to which governments, and other people outside government, but in their immediate sphere of influence, are giving attention to in the short, medium and long term;
- Purpose of the system – the definition of the territorial scope (boundaries) of the urban mobility system and its overall strategic objectives, which as we have seen in previous chapters is dependent on the political-administrative organization of the country;
- Entities – decision agents involved in the different components and stages of the system (e.g. political authorities, organizational authorities, urban authorities (political and management), sectorial entities, surveillance and enforcement entities, operators of services and of infrastructure, third party suppliers, workers, clients, citizens, etc);
- Boundaries of decision – meaning the institutional design and scope of intervention, and functional allocation of responsibilities within the system. That is the answer to the normative question “who does what” between the different existing interacting institution and agents.
- Decision processes – which at the macro level of the whole system are:
  - Strategic definition of the system;
  - Selection and design of management (steering) instruments
  - Steering process with the following sub-processes:
    - Configuration of system supply;
    - Contracting of system supply;
  - Monitoring and adjustment of system evolution
- Information – meaning information flows and channels supporting the assessment required to provide feedback to the steering function and enable corrective or preventive actions in order to keep the mobility system in its due course.

The system model is basically the organization of activities in such a way that the overall result is in line with its purpose and expectations. This is established at the outset by the entities (in democratic societies) who have the representation of the populations and consequently define the political objectives for the urban mobility system. The purpose of the model is thus to manage the urban mobility system as a whole (encompassing all modes and means) and provide the right context for a good performance, that will in fact be done by the agents (private and public).

As we have already referred urban mobility involves a wide diversity of agents and we must recognize that every agent has its own agenda and purposes which may challenge or constrain the system objectives. The inevitable consequence is that trade-offs have to be considered. Some are part of the compete-collaborate dynamics between agents but others have also to be set at system level between objectives, available resources and results. So, all this implies that the urban mobility system has to be managed with
strategic thinking, that is an implicit interactive process that steers the UMS considering that each agent will act according to her own strategy and aiming to maximize her private benefits, which sometimes will place the agent as a rival to the system objectives and in other moments as an ally.

The underlying management method lies in some basic rules defined at political level and accepted (at least temporarily) by all players, such as: every movement by one agent will provoke a reaction from the others; and, to understand possible consequences we need a prospective view of the possible moves of all the players and of an evaluation of the impact of actions and reactions over the system performance. This implies a forward thinking about these movements and feedback rationale to understand and decide which course of action is most likely to cause the reactions that will keep the urban mobility system in its due course. In fact the main challenge in Urban Mobility Management is to manage the system according to the defined objectives but ensuring that each agent sees an advantage in taking part of a system that is expected to create value for all the players engaged.

The model presented adopts a process approach, that is transformation of objectives into results and further into impacts, that is the pursuit of quality is done through management processes, which are organized sequences of activities that produce the intended quality results. In business environments quality management makes extensive use of three of those management processes, known as Juran’ trilogy (Juran, 2000, pp 2.5) that we recognize as also valid for the management of urban mobility systems:

- Quality Planning processes – that define what is to be done;
- Quality Control processes – that monitor and evaluate performances and alignment (or deviation) with planned objectives;
- Quality Improvement – that focus on improvement of results that can be achieved through many possible ways.

The adoption of a process approach in a complex system such as the urban mobility implies that each process has to be transversal to the institutional setting of the local environment where it will be applied, and that a large variety of agents participate in each process. These characteristics introduce some additional management difficulties that reinforce the convenience of using some process management principles, although adjusted to this systemic reality, namely:

- Only one institution should be responsible for each process;
- Each process has to be clearly identified with the following elements that constitute the process identity: designation and description; material and immaterial resource inputs used in the transformation into outputs and clear identification of the sources for those resources; expected outcomes (objectives); set of activities (and task within these) that constitute the process; functional institution responsible for conducting the process; how the process is declined in several decision levels; interaction with other institutions; dependencies from other processes; control points and indicators to assess quality performance of the process (i.e. efficiency, effectiveness and adaptability as already referred).
As pointed out, the starting input and main constraint for the management of the urban mobility system, and consequently to all key processes, is the political and institutional interaction between the three following sectors that are critical in the generation of mobility requirements and also in the definition of political priorities for the system: socio-economic context; land-use policy; and, environmental preservation policy. From this point forward the management function should sequentially address the key processes in the order presented in the tables below where the critical aspects of each process are highlighted. The operational and material representation of these processes, and so of the urban mobility system, varies from one city to another depending on a number of factors.

The political-administrative organization of the country and consequently of the urban area served by the system, that can be a city, a voluntary consortia of municipalities (as it can be the case in Brazil or in Spain), a formal metropolitan area (as can be found both in South America and also in Europe), or the (voluntarily formed) metropolitan planning organization (as can be found in most USA states) imposes constrains on the institutional design and consequently affects the power of institutions engaged in the system and its performance (e.g. in Hamburg we could find six different types of authorities intervening only in public transport).

The political priority given to the urban mobility aspects is materialized for example through the creation of financial means to develop implementation of public transport and infrastructures, or through the inclusion of public service obligations in contracts and its operationalisation. For example in Europe the approach typically led to the financing of public transport operators as a way to ensure mobility; in Brazil in the past the very same concept was made operational by enforcing the financing of employees through their employers, recently complemented with the creation of a Federal Fund, largely based on the redirection of taxes accruing from fuel consumption (i.e. the “CIDE – Contribuição de Intervenção no Dominio Económico”); in New Zealand the option was to create a Transport Fund supported by the additional land value created by the accessibility provided by the mobility system, etc.

The legal and regulatory framework binding public transport, road traffic and infrastructure management can also constitute a barrier for the implementation of an integrated model with these characteristics. In particular it is very common to find road traffic and non motorized (pedestrian and cycling) infra-structure under a different institutional setting leading to complex decision processes for the achievement of a concerted strategic definition of the system.

In Brazil, despite the difficulties with the institutional design and legal frameworks, a more conform solution was obtained due to the fact that the model was fully implemented through all the institutional levels\(^2\) enabling the required adjustments of all related regulatory frameworks\(^3\).

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\(^2\) Federal (Union), State, Municipalities and still Metropolitan regions

\(^3\) (e.g. Land-use and Transport integration – “Estatuto da Cidade”, regulation on Urban and Metropolitan Master Plans, regulation on energy use in transport, regulation on environmental protection, fiscal regulation, etc.)
Table 1 The three main processes for Quality Management in Urban Mobility System (source: Macário, 2005)

<table>
<thead>
<tr>
<th>QUALITY PLANNING</th>
<th>QUALITY CONTROL</th>
<th>QUALITY IMPROVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand political, social and economic priorities.</td>
<td>Establish performance monitoring and evaluation methods</td>
<td>Justify the need to improve</td>
</tr>
<tr>
<td>Translate those priorities to the mission of the Urban Mobility System.</td>
<td>Establish an infrastructure to ensure feed-back information flows.</td>
<td>Identify the policies and measures required.</td>
</tr>
<tr>
<td>Establish quality targets.</td>
<td>Evaluate actual performance and compare it with quality targets.</td>
<td>Identify agents to trigger improvement.</td>
</tr>
<tr>
<td>Define sources for the financial means that will support the system.</td>
<td>Nurture feed-back flows.</td>
<td>Establish the required infrastructure (if any).</td>
</tr>
<tr>
<td>Identify social profiles and requirements of customers</td>
<td>Understand causes of deviations to the performance plan.</td>
<td>Establish controls on improvement</td>
</tr>
<tr>
<td>Define quality criteria that respond to customers’ needs and expectations.</td>
<td>Act on performance deviations, realign the system</td>
<td>Identify the instruments that will foster agents actions and reactions.</td>
</tr>
<tr>
<td>Design networks</td>
<td></td>
<td>Define sources for the financial means that will support system improvement</td>
</tr>
<tr>
<td>Plan infrastructures</td>
<td></td>
<td>Assess effective results and prospective impacts.</td>
</tr>
<tr>
<td>Define the regulatory and organizational framework for the provision of services</td>
<td></td>
<td>Nurture feed-back flows.</td>
</tr>
<tr>
<td>Ensure provision of services and infrastructures conform to quality criteria (e.g. concessions, management contracts, tendering, etc)</td>
<td></td>
<td>(Re)align the system, if needed</td>
</tr>
<tr>
<td>Define the instruments for the steering function.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2 Key Process in the Quality Management of UMS - Quality Planning (source: Macário, 2005)

<table>
<thead>
<tr>
<th>ACTIVITIES WITHIN THE QUALITY MANAGEMENT PROCESSES</th>
<th>DECISION LEVELS</th>
<th>SD</th>
<th>CS</th>
<th>AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand impact of political, social and economic priorities in urban mobility systems</td>
<td>Strategic</td>
<td>SD</td>
<td>CS</td>
<td>AA</td>
</tr>
<tr>
<td>Translate those priorities to the mission of the Urban Mobility Systems</td>
<td>Tactical</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish quality targets.</td>
<td>Operational</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Define sources for the financial means that will support the system</td>
<td>Strategic</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify social profiles and requirements of customers.</td>
<td>Tactical</td>
<td></td>
<td>CS</td>
<td></td>
</tr>
<tr>
<td>Define quality criteria that respond to customers’ needs and expectations.</td>
<td>Operational</td>
<td></td>
<td>CS</td>
<td></td>
</tr>
<tr>
<td>Design networks and services</td>
<td>Strategic</td>
<td></td>
<td>ES</td>
<td></td>
</tr>
<tr>
<td>Plan infrastructures</td>
<td>Tactical</td>
<td></td>
<td>ES</td>
<td></td>
</tr>
<tr>
<td>Define the regulatory and organizational framework for the provision of services</td>
<td>Operational</td>
<td></td>
<td>ES</td>
<td></td>
</tr>
<tr>
<td>Ensure provision of services and infrastructures conform to quality criteria. (e.g. concessions, management contracts, tendering, etc)</td>
<td>Strategic</td>
<td></td>
<td>ES</td>
<td></td>
</tr>
<tr>
<td>Define the instruments for the steering function (institutional design, rules and regulations, contracts, incentives and penalties, etc)</td>
<td>Tactical</td>
<td></td>
<td>SI</td>
<td></td>
</tr>
<tr>
<td>Establish process control;</td>
<td>Operational</td>
<td></td>
<td>SI</td>
<td></td>
</tr>
<tr>
<td>Transfer the plans to the tactical and operational agents</td>
<td>Strategic</td>
<td></td>
<td>SI</td>
<td></td>
</tr>
</tbody>
</table>

In Lisbon and Porto, in 2004-2005, the fact that the implementation was restricted to these metropolitan areas and the resulting legal product was applied only to public transport, limited the potential to reach wider degrees of conformity, given the overlap with other institutions such as the then DGTT (General Directorate for Land Transport), who has a jurisdiction of national scope. So, the management control processes and the information system was designed for the whole mobility system but with constraints related to a legislation of reduced scope that hinders the action of the Metropolitan Authorities. The subsequent change in government suspended all the implementation process, despite the fact that the process reached the point of public discussion with operators and was approved by the two institutions with regulatory powers.

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4 Legend for tables 5-3 and 5-4 and figure 5-10: SD (Strategic Definition); CS (Configuration Supply); ES (Ensure provision of Infrastructures and Services); SI (Steering Instruments); AA (Assessment and Alignment); MP (Monitoring Performance);

5 By then, the DGTT and the INTF (National Railways Institute), who have both subscribed the submission of the new law for further Presidential ratification.
### Table 3 Key Processes in the Quality Management of UMS – Quality Improvement
(source: Macário, 2005)

<table>
<thead>
<tr>
<th>Activities within the Quality Management Processes</th>
<th>Decision Levels (Who)</th>
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<tbody>
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<td></td>
<td>Strategic</td>
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<tr>
<td>Establish performance monitoring and evaluation methods and tools</td>
<td>SI</td>
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<td>Establish an infrastructure to ensure feedback information flows.</td>
<td>SI</td>
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<tr>
<td>Evaluate actual performance and compare it with quality targets.</td>
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<tr>
<td>Nurture feedback flows.</td>
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<tr>
<td>Understand causes for deviations to the performance plan</td>
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<tr>
<td>Act on performance deviations, (re)align the system</td>
<td>SD (re)</td>
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<tr>
<td>Justify the need to improve</td>
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<tr>
<td>Identify the policies and measures required.</td>
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<tr>
<td>Identify agents to trigger improvement.</td>
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<tr>
<td>Establish the required infrastructure (if any)</td>
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<tr>
<td>Establish controls on improvement</td>
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<tr>
<td>Identify the instruments that will foster agents actions and reactions.</td>
<td>SD (re)</td>
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<tr>
<td>Define sources for the financial means that will support the system improvement</td>
<td>SD (re)</td>
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<tr>
<td>Assess effective results and prospective impacts</td>
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<tr>
<td>Nurture feedback flows.</td>
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<tr>
<td>(Re)align the system, if needed</td>
<td>SD (re)</td>
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### 3. Final remarks

Contextual evaluation enables a first screening of the type of profile in which the city or urban area can be included and the identification of indirect factors that can condition the performance of the UMS. This evaluation should consider three domains of variables – physical, economic and institutional - since very often the conflicts of planning and policy prioritization have a central responsibility in the underperformance of the urban mobility systems.

But even if the influence of contextual factors is properly isolated, the systemic and synergetic characteristics, and inherent complexity, of the urban environment itself reveals the existence of some pitfalls that hinder the reliability of interpretations based on urban indicators. In one hand these constraints justify the need for an integrated approach, but in the other hand additional caution are required to prevent the risk of abusive and misleading interpretation. We have identified the following problems in (Macário, 2005):
• Most specific policy action (e.g. housing investment) affects not only a single area of policy concern (e.g. volume of affordable dwellings) but a wider range of domains (e.g. local employment, transport flows, etc);
• Consequently, change in one indicator may be the effect of several causes, hindering our capacity to understand which policy action is responsible for that effect;
• At the opposite of the previous, the difficulties in establishing clear cause-effect relationships between the planned policies or actions, results achieved and impacts produced, are often due to the compound nature of the urban condition itself that causes common variation of different indicators and raises the risk of multicollinearity;
• Impacts are sometimes difficult to measure because, contrary to results, these are measured outside the operational context and often not perceived in an obvious way. Moreover, and as we have already noted, some impacts occur only after considerable time lag making more difficult the clear understanding of the cause-effect relationship;
• In addition, there is also the difficulty of aggregating all indicators at the same level. That is, for example financial indicators are easy to aggregate while physical ones are extremely difficult.

Following the rationale presented a set of indicators of perceived quality for the different assessment aspects contemplated in the results and impacts of the management model are proposed in another paper, sequential to this one, where the implementation process is addressed. Is it is worth saying that for any specific implementation each of these aspects and corresponding indicators should be decoupled for the different services and infrastructures provided by the system, and tempered with the local quality perceptions.

REFERENCES

QUALITY MANAGEMENT MODEL FOR URBAN MOBILITY SYSTEMS

Figure 2 – Conceptual illustration of the Management Model for Urban Mobility Systems (Macário, 2005)