Managing urban transportation performance: a comparison between two case studies

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Abstract

Urban Transportation systems operate in complex environments due to the interconnected influence of several factors, such as technical, social, economical and environmental ones. The organizations running this service, whether publics or privates, are called to satisfy public needs. All around the world, urban growth is a common reality which is putting in place new challenges and coming pressure on these organizations. Satisfying citizens and producing outcomes for the territory is becoming central for the sustainability of the urban transportation systems. In order to manage the transportation service, cities and regions are expected to adopt Performance Management (PM) systems that contribute in setting clear objectives, allocating resources, monitoring and measuring the results.

Introduction

Poor urban transportation services have a negative impact on the economy and development of (World Bank 2002). However, unlike other public services, in many areas of the world urban transportation is getting worse rather than better with economic development (Peňalosa 2005).

The complexity of the environment in which urban transportation insist resides in different Institutional arrangements, governance of the service, culture, economic wealth, geography are just some the characteristics that a decision maker need to take into consideration when planning a strategy sector.

Such complexity manifest itself through the presence of 'wicked' problems (Rittel and Webber 1973). term wicked does not means 'evil' but it refers to issues highly resistant to solution because of the complex environment in which they insist and that often lead to counterintuitive behaviours (Australian Public Commission 2007). In order to deal with this kind of issues, the adoption of a systemic approach suggested (Rittel and Webber 1973, Ackoff 1974, Head and Alford 2013).

Urban transportation, together with the other public services, contributes to the creation of public (Moore 1995). This is related to the value that public and private enterprises create for the community both the short and the long run. Therefore community's need satisfaction become a priority in the makers and managers agenda.

Together with the systemic approach mentioned and considering the aim of public value creation, performance perspective is needed to tackle the research question that follows:

> How to design dynamic Performance Managment system tailored to public transportation? How such systems can be adopted by managers to ensure the sustainability of the service in of both financial resources and citizens' satisfaction?

This paper represent a preliminary study aimed at answering these questions. The analysis has conducted on the basis of the comparison between two case studies: Palermo, in Italy and Buenos Aires, Argentina. Such a comparison is aimed at showing how a systemic and performance oriented method be applied to different institutional and geographical contexts.

Research Method

Due to the complexity of the environment in which urban transportation organizations operate, traditional performance management approaches appear to be excessively static in providing useful performance measures. The result is that these techniques tend to stress excessively on some of the outputs service ignoring the final outcome for the community. Also, traditional tools, which are often oriented, are often applied within organizational boundaries without considering the transportation as a whole.

The same tools do not allow one to properly assess both determinants and consequence of performance with reference to the trade offs existing between both short and long term effects. These tools, indeed, not help in understanding the process of accumulation and depletion processes of strategic resources the performance drivers effect on outcome indicators.

Back to the research questions, this paper aims at modelling a Dynamic Performance Management (DPM) framework that includes a set of indicators to measure system performance in a dynamic environment. Particularly, DPM combines traditional Planning and Control systems and System Dynamics modelling.

System Dynamics could be defined as "a perspective and set of conceptual tools that enable understand the structure and dynamics of complex systems" (Sterman 2000, Business Dynamics, Complex systems are difficult to be examined because they leads to counterintuitive behaviours, cause the frustration the policy maker incur when tries to design and implement corrective action to prevent undesired behaviours (Forrester 1961). Complex systems are characterized by multiple loop structure (Forrester 1961). A loop refers to the feedback process between two or more components of a system.

Therefore, a basic activity of SD modelling is discovering and representing the feedback processes, determine the dynamics of a system (Sterman 2000) .[1]

The focus of this paper is to make explicit the relationships between the system's strategic resources the desired end results in order to build a set of performance indicators (drivers) [2] which could improve management control activities from different governance levels.

On this concern, SD approach needs to be contextualized in a Performance Management (PM) framework. The combination of SD and PM has been debated by two converging stream of literature (Bianchi, Markinkovic, Cosenz 2013): (1) a dynamic resource based view (Morecroft 1997, 2007, Warren 2002, 2008), and (2) a dynamic view of performance management (Bianchi and Riverbank Bianchi et al 2013). These two approaches both represents strategic resources as 'stock'. These variables are subjected to accumulation/depletion processes which characterize the state of the system (Sterman 2000). An example could be given by 'Number of vehicle available for the service': it is a variable measured in 'vehicle' unit and that can be observed at a given moment in time.

However, while dynamic resource based view concentrate the analysis on these variables and the relative models are designed based on the building up and decline of key core assets, a dynamic performance management view approaches to the system analysis by identifying both end results and strategic (Bianchi et al. 2013).

Endr esults are typically represented as 'flows'. A flow is what changes the stock over a time period. to the 'number of vehicle' example, one of its flow is the 'acquisition of new vehicle'. This, that measured as 'vehicle' per time, says to us how much the stock of buses has changed during the time considered thanks to the service management (i.e. new investment).

In a DPM view performance is defined and improved in relation to a specific 'product' (Bianchi [3] The desired end results are achieved by managing the strategic resources through performance drivers; will help the decision makers to adopt a 'conscious' management toward system sustainability. Drivers usually measured in relative terms by comparing the actual state of a variable with a target value. The this comparison creates, represents the intermediate result the management should monitor in order achieve the end result.

[1]An in depth overview of System Dynamics can be found in Sterman (2000) and Forrester (1961).

[2]With ‘drivers’ I refer to outcome indicators of performance (Monteduro 2006). That means the intermediate results driving the end results (Aquino 2012).

[3]By ‘product’ I refer to the output of an administrative task and not necessarily to the output of a production function.

Closing the loop, the strategic resources are fostered by the end results achieved. The model structure then realized by linking the relevant stock and flows which determine a certain behaviour of the system time (Cosenz 2010). The feedback loops built by following this approach, imply that the flows affecting strategic resources are measured over a time lag. That makes clear how the delays involved resources accumulation process represent a central issue in managing performance in a dynamic complex environment (Bianchi et al. 2013) such as the one studied here.

This approach empowers a systemic view since each decision maker has to manage such drivers in relation to the linked strategic resources in a way that all the interdependent strategic resources within the should be coordinated each other (Bianchi et al. 2013). Particularly, each strategic resource should provide the basis to sustain and foster others in the same system. For example, financial resources fosters number of vehicle available for the service through new investments; the number of vehicle available impacts on the quality of the service which determines the amount of revenues the system gets from tickets sold. Revenues increase the amount of financial resources.

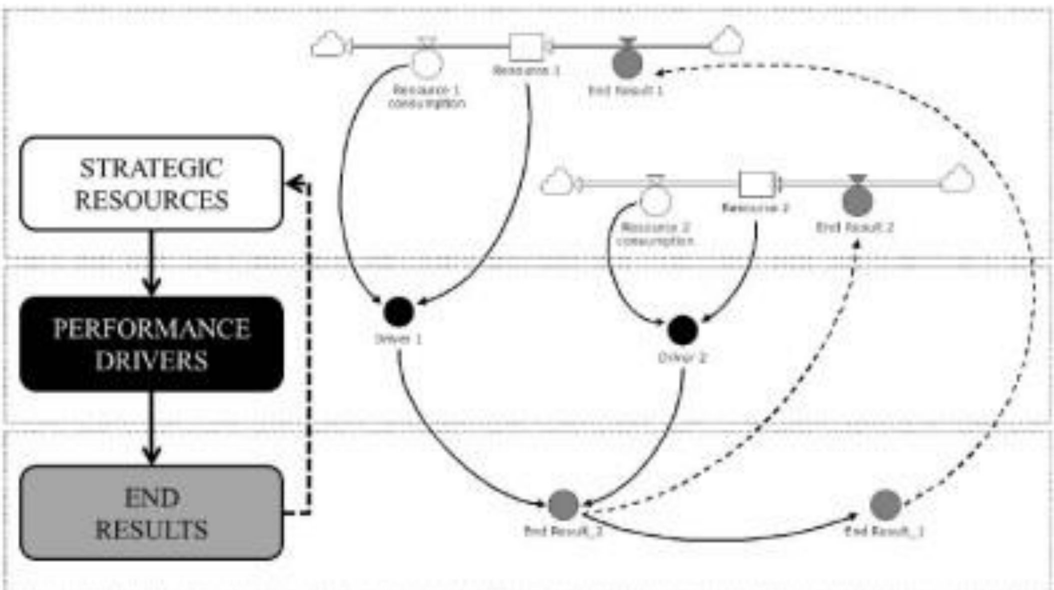

Figure 1: A Dynamic Performance Management view (from Bianchi et al. 2013)

In Figure 1 is illustrated the dynamic performance management framework. Performance drivers represented as auxiliary variables. These variables contain calculation which could be directly included

the flow variables. However showing them separately is suggested for making clear the modelling and for showing to the model user how strategic resources and end results interact in the system.
Since this research develops a case study adopting a Performance Management view, it is important remark that performance can be articulated in different dimensions (Eccles 1991, Coda 2010). Particularly Coda (2010) identify those: competitive, financial and social. This paper focus specifically competitive one which represents the process of building critical success factors.

The case studies

The aim of this research is pursued by exploring two case studies. A first case is based on the European context (Palermo, Italy); while the second explores the Buenos Aires (Argentina) urban area. transportation in Europe has been deeply influenced by the New Public Management (NPM) reform. Italian NPM was mainly characterized by a political orientation toward powers' decentralization to government and privatization of public companies (Anselmi 2003). This created, at the urban level, hybrid generation of companies, half way between being public or private. In the Palermo's case, the transportation service is run by AMAT. This, since 2005, is a joint stock company in which Municipality holds the 100% of shares. On the one hand, being formally private, the company accountable for its economic and financial performance; on the other hand AMAT faces several constraints coming from the service contracts stipulated with both the Municipality – who impose significant personnel policies – and the Sicilian Region – i.e. the Region decides how much to pay the utility for its together with the minimum ticket price this may ask to the citizens. Therefore, this peculiar multi level governance structure deprived AMAT of implementing a successful performance management raising questions of accountability and control.

Also the Buenos Aires case was highly influenced by the NPM reform. However, differently from New Public Management was implemented further and the transportation service is now run by several companies and several jurisdictions are involved at the political level. This may require even a stronger effort in coordinating and joint managing the whole system. Another level of complexity in later years been the increased level of subsidies to the public transportation system and also the fact that the service provided as a supply side policy. A more general and integrated approach for the whole system is needed.

From both the cases of Palermo and Buenos Aires emerges an intrinsic complexity of urban transportation systems. In this paper we tried to sketch a basic qualitative model able to frame the main characteristic the two cases.

As previously stated, the perspective adopted is a performance management one. That means that model may not specifically focus on some social or economic factors, but the aim is to help decision policy maker in providing a better service.

The model building process followed two steps. First of all, a Casual Loop Diagram (CLD) was sketched in order to represent the casual relationship affecting the systems. CLDs are typically used in order to the casual relationships insisting in the system and the feedback loops which determine its behavior time. Then a Stock and Flow Diagram (SFD) was built. SFD structure is necessary in order to distinguish among strategic resources and end results and to identify the relative performance drivers.

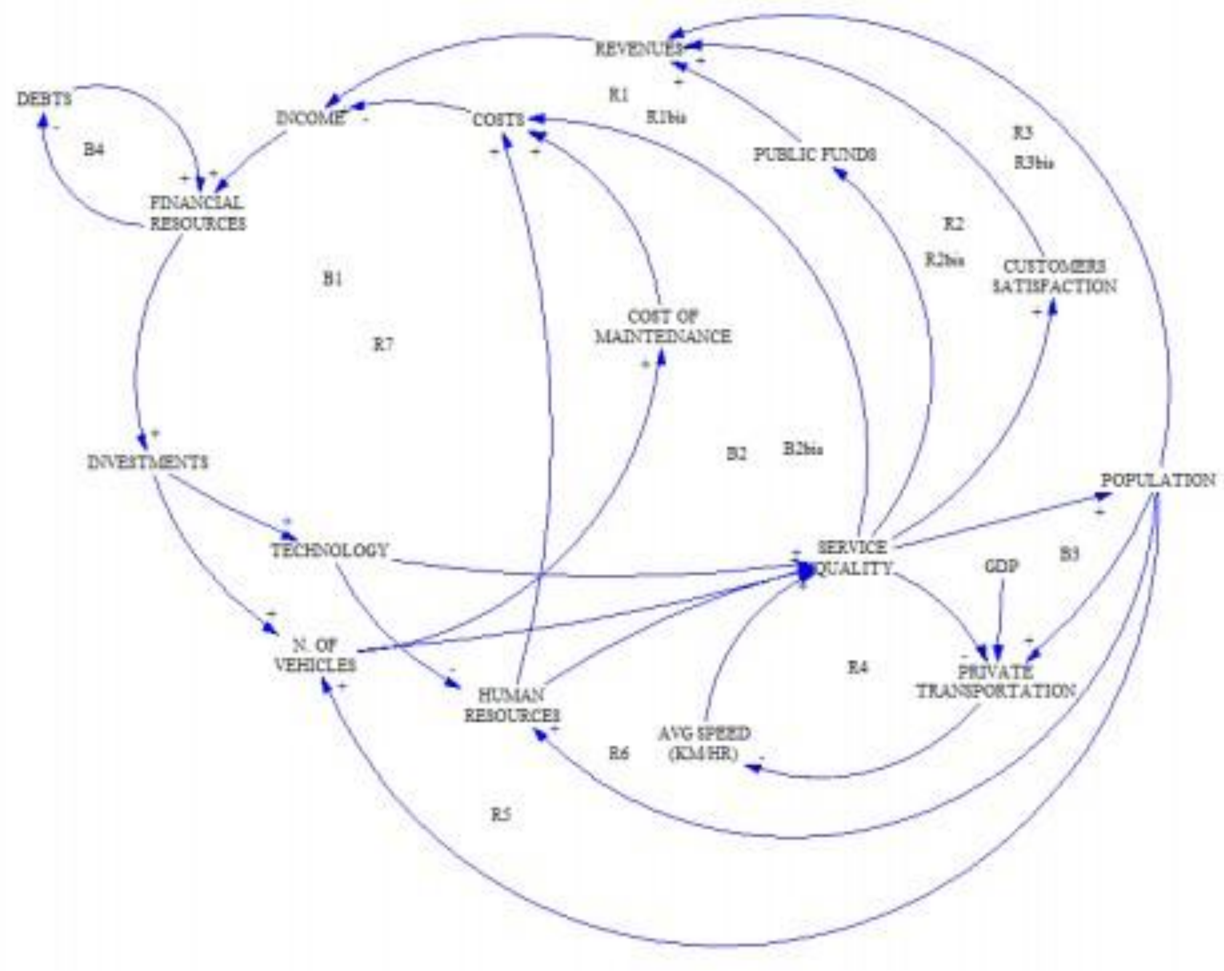

Figure 2: The Casual Loop Diagram

In Figure 2, the CLD shows three main reinforcing loops related to the dynamics generating revenues, two balancing loops concerning where the costs come from. Also, another reinforcing loop shows dynamics insisting the decision if switch to private transportation or not, while two reinforcing loops related to the activity volume. Lastly two other balancing loops refer to the debt policy and to the impact population on private transportation. Reinforcing loops lead to exponential behaviours: the growth (decline) of a certain variable pushes the growth (decline) of another one which, over a time delay, increase (decrease) the value of the first. Balancing loops, vice versa, tend to settle the system toward assuming specific value. The dominance of the different loops over time, determines the system behaviour.

B1 shows how the cost of maintenance depends from the number of vehicles. This cost impact on the cost of the system which determines, together with the system's revenues the income. A sustainable producing an 'income' allows investments in new vehicles, and so the loop is closed.

B2 and B2bis show the casual relation that the number of vehicles and technology have with the quality. This last includes characteristics such as frequency of service, numbers of lines, timeliness, etc. Of course these characteristics determine a cost. Then the loops follow as the previous one.

R1, R1bis, R2 and R2bis explain the dynamics generating revenues which depends on the service quality. This, when matching the service requirements asked by the public institutions determines the amount public funds allocated to the service. Service quality also impact on the revenues coming from the sold in the period considered. Of course total revenues influence the net income and so the financial resources, investments and number of vehicles.

R4 explain the dynamic through which an high quality of the service reduces over time the use of transportation. This is casually connected to the traffic congestion which have an impact back service quality.

R5 and R6 show how the size of population influence the number of vehicles and human resources urban transportation system needs to perform the service.

B3 is a loop having an effect on the long term. This considers the ability of the transportation service improve the attractiveness of the area, causing an increasing number of people living in that territory. course this will increase on the one side the usage of private transportation, on the other side the usage public transportation (loop R3).

B4 loop shows a basic debt policy. Simply, whenever the financial resources goes below zero, the system is willing in increase its debt. While every time the financial resources are positive the system is willing use

part of it to reduce its debt.

Lastly R7 shows that a technology improvement may reduce the need for human resources in the and so the cost related to it.

These links are built on hypothesis based on the literature and the study of the two cases. However of them need to be verified yet (i.e. service quality improve population, technology reduces resources, etc.).

The Dynamic Performance Analysis

The conversion from a CLD to a SFD model is a necessary step to go deeper in the performance analysis and to simulate the analysis result in a further step of the research. SFD allows one to identify end results, strategic resources and performance drivers of the system. In the figure below, the different system variables previously identified have been developed and framed into these three categories.

This framework allows one to read the casual relationships of the system by adopting a Dynamic Performance Management perspective.

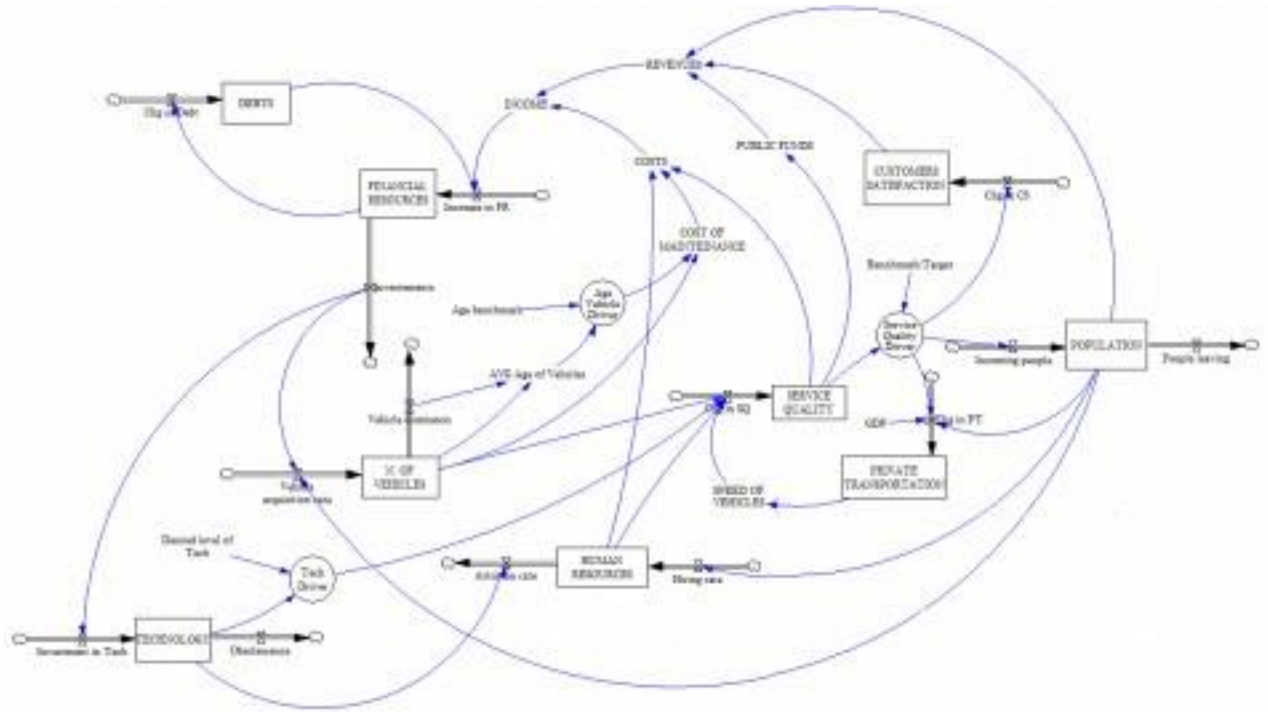

Figura 3: The Stock and Flow Diagram

Figure 3 shows the conversion of the CLD into a SFD model.

Flows variable named ‘change’ can be either positive or negative, this explain how the connected resources can both accumulate and deplete value. This is a representation usually adopted for those variables an ‘information’ value, meaning not related to physical aspect (i.e. customer satisfaction). These variables are often difficult to be quantified. In these cases SD allow one to give to them a qualitative value ranging from

0 to 1) and so to estimate the impact they have in the system.

Drivers are represented as circles. These are measured in relative terms by comparing the organizational performance and a target value fixed by the company – i.e. Desired Nr of Km Travelled a benchmark fixed in relation to best practices, or sector average (Eccles 1991) – i.e. Average Age of Benchmark. The drivers here identified belong to the competitive dimension of performance (Coda that means they are specifically oriented at monitoring how the system is able to satisfy the community needs.

In this analysis we identified three kind of drivers. The first related to the investment in technology, second related to dynamics generating costs and the third related to dynamics generating revenues.

The technology driver compares the actual level of technology (i.e. having a metro, or e ticket) with benchmark of other cities with similar characteristics.

The second category of drivers shows how the characteristic of the vehicles affect costs of maintenance. For simplicity we provided an example related to the vehicle age. The more old is the fleet (strategic resource) the more the maintenance will cost (end result). This driver is built by comparing the average of the fleet with a benchmark represented by the fleet age of virtuous cities.

The last driver category is connected to the service quality. Service quality vary on the basis of characteristics the community is expecting from the service. From the analysis of the case studies possible to identify the following:

- Ticket Price
- Capillarity (measured in number of routes)
- Frequency
- Timelines
- Integration of services (between different companies and relative vehicles)

The relative drivers compare the actual values of these variables with a benchmark taken from other (in the case of ticket price and integration) or a target value based on the community expectation case of capillarity, frequency and timeliness).

The first and the third driver categories, differently from the second one, not only influence the income so the economic sustainability of the system, but also the attractiveness of the territory (impacting migrants) and the usage of private transportation.

Conclusions

This paper presents a broad and renewed approach on how to deal with complex real life infrastructure systems. In order to develop the ideas two cases are reviewed and compared: Palermo in Italy and Buenos Aires in Argentina.

As a results a dynamic performance framework has been developed. This framework may be helpful policy makers in order to conduct a systemic analysis of the transportation system in use. Particularly, may allow decision makers in finding a balance between both public and private spheres implicit in this of service.

From the study clearly emerge the need for vertical and horizontal (this last more evident in the Aires case) coordination between the actors involved in the urban transportation system. This coordination can be achieved only if a systemic perspective is adopted. Such a perspective highlight how the different stakeholders interact between each other through the use of strategic resources.

This paper represents a first step of a research project aimed at the comparison between the two cases. The model here presented, together with the logical framework adopted, will be used in order to develop two specific and quantitative models tailored on the two urban areas. Quantitative SD models will provide simulations and give the possibility to test policies and strategies for improving the systems.

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