

**APPLYING SYSTEM DYNAMICS TO A
MUNICIPAL FIRM:
THE CASE OF A SMALL MUNICIPALITY'S EDUCATION POLICIES**

EXTENDED ABSTRACT

Problem Context

In the last fifteen years, the Italian public sector has experienced a tremendous stream of innovation into management culture at any level of hierarchy. The European Union (EU) rules and directives have been playing a crucial role in stimulating this innovation process. According to the *Pact on Stability in Europe*, governmental administrations are obliged to satisfy a given set of financial benchmarks. This is to guarantee financial stability to all European countries and, as a result, to the EU as a whole. Such a policy, in fact, aims to foster positive cascading effects on local public administration's financial management.

In order to implement EU principles into everyday management, the Italian national government has been introducing rules to reform the financial management in the public sector. From a local perspective, city managers and political administrators must cope with this upcoming scenario. Beside a procedural and bureaucratic approach, which only allows one to record monetary issues, financial and management accounting techniques are being adopted to introduce the 'cost-and-revenue' concepts. Moreover, budgeting and reporting tools are being implemented.

The above-said approach is intended to introduce into the public administration a new culture oriented to effective and efficient exploitation of available resources. It also aims to provide public administration decision-makers new tools to implement such a new approach.

As in the private sector (Sterman 1989, Bianchi 1996), System Dynamics could support local public administration decision makers to better understand the effect of their policies on the managing system. This paper describes the results of a project intended to apply Systems Dynamics modeling to a local government entity, i.e. the city of San Giuliano Terme in Tuscany, Italy.

From the very first meeting held at the City Hall, there was a general agreement among city administrators on the fact that, lately, they were badly performing concerning the Education-related services. Particularly interesting was the fact that nobody from the city administration had a clear vision of some potential factors causing this phenomenon. Starting from this problematic situation, we began a deep investigation on the administrative sectors involved in Education.

Mainly all the public sector in Italy is characterized by a lack of numerical and written data on available resources and performances achieved. Through a System Dynamics approach, the project team started interviewing key-function managers within the organization. This allowed the team to gather relevant information to better frame the problem itself and its dynamic complexity.

The project team involved both the authors of this paper and two managers of the firm (respectively involved in: Real Estate and Education Service management).

Reference Background

During the seventies, it was adopted a policy (defined as ‘a hamlet, a school’), which led to a relevant increase in school housing capacity, principally for those devoted to compulsory education. Later, San Giuliano experienced an unexpected population increase. This created raising managerial problems, which were mainly associated to declining performances, due to the difficulty to face the raising demand of services from population. Our research hypothesis was that such phenomenon was caused by the difficulty of decision-makers to frame the relevant system and to adopt a dynamic view of resources accumulation and depletion process. Another cause of these phenomena was recognized into the frequent turnover in the political staff ruling the city. Although, this is a consequence of democracy, as a side effect it also causes short sight planning, whereas public sector investment plans need to foresee quite ahead in the future.

To cope with the increasing demand in Education – due to the increasing population – the San Giuliano Government started to redesign the allocation of school housing capacity. To this end, the primary and intermediate school overcapacity was reallocated to nursery and kindergarten schools.

The city administrators were, obviously, aware about the short-term nature of this policy. However, they preferred it to an alternative one, implying new capacity building. They made this decision because they were not able to realize whether the increase in population was a transitory or permanent phenomenon. Furthermore, they misperceived some dynamic aspects such as time lags between decisions and system reactions, and feedback loops among key-variables, such as investments, housing capacity, population.

Based on field analysis, a System Dynamics model was built to analyze the structure of the system and, hence, to test alternative policies under different scenarios. The model was built through an iterative process, implying: gathering data, making assumptions, feedback loop diagramming, model testing with city administrators, model calibration. Such an iteration was the engine for a learning process fostered by model building.

Model Assumptions

Main assumptions around which the model was built were:

- the only relevant city administration services are those related to Education. Reference indicators for such services are: housing capacity, meals and transports;
- the migration flows are governed by the Education service level: families decide to move into and out of the community based on the availability of the above-mentioned services;
- the financial resources are strictly influenced by the stock of population living in the community: local taxes and national Government funding vary linearly according to population dynamics.

About the first assumption, a selective approach was used to make the model structure simple at this stage of the analysis. We wanted to keep simple the structure in order to start from a simple model, provided the scarcity in available data and key-actors knowledge, and the wide range of relevant variables.

The second assumption is linked with the first one. This unidimensional condition leads families to privilege the community, which better meets their preferences in public services (i.e., Education). According to Tiebout (1956), individuals and families choose to live in a given community because it best satisfies their preferences for public goods. Based on such a postulate, we inferred that the availability of school places for their children is one of the factors explaining why families decide to move into or out of San Giuliano Terme.

Concerning the third assumption, the need of a selective approach suggested the project team to start modeling financial resources based on the relationship between the stock of population and taxes which can be raised from it.

Migration flows have been modeled by a subset system, based on the Population Model (Forrester, 1969). Here, the ratio between population and carrying capacity has been adjusted to the Education system. Therefore, the demand for Education replaces the population and the housing capacity represents the carrying capacity.

In summary, the population changes because of both natural causes – births and deaths – and moves into and out of the community.

Under different scenarios, we tested the effect of two main policy levers:

- re-allocation of existing classroom capacity;
- building of new classroom capacity.

Final Results

We tried to replicate the reference behavior. Slight discrepancies were attributed mainly to two factors: model boundaries and time unit in simulation. About the first factor, it derives directly from the above-mentioned three assumptions. As for the time unit in simulation, it has been set on a monthly basis, whereas collected data referred to an annual basis, i.e. the reference time for official balance sheet.

Simulation runs allowed us to discuss with managers how system behavior could be changed through decisions aimed to act on the system structure. Such a change was envisaged through decisions and to act on the two above policy levers. Finally, we showed how apparently successful policies could fail, if initial conditions of the relevant system or the structure itself are a major impediment to the achievement of successful results in the short and long term.

Broadening decision boundaries will help decision-makers to better clarify critical trade-offs in investment allocation. Such an analysis, aimed to build an ILE, supporting the learning process, will be the core of next steps in our research.

As final remark to the work that has been conducted, the authors recognize the need to broaden the insight model that has been initially developed, in order to include other relevant sectors such as: urban development, industrial activities.

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