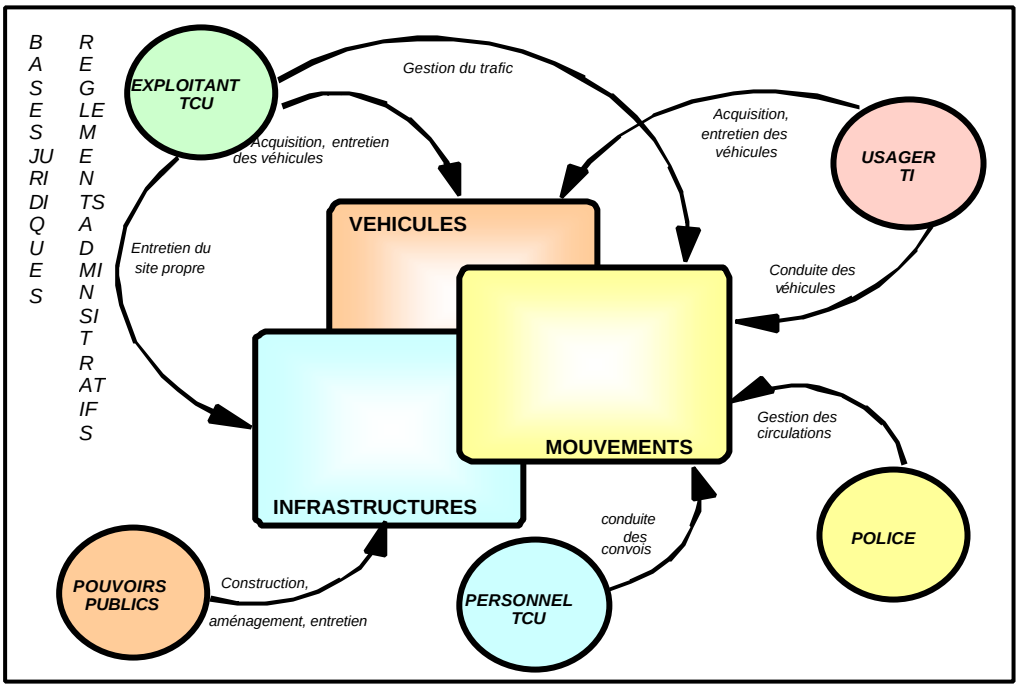

Multimodal Transportation Account with Spatial Reference

P-A Jaccard, ITEP-LEM, EPFL
R. Founou

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Dr P-A. Jaccard
LEM-ITEP
EPFL
Lausanne

Phone: 021-693-24-66
Fax: 021-693-50-60
eMail: pierre-andre.jaccard@epfl.ch

Abstract

Urban transportation is a complex field where many actors are involved and where the financial and economic impacts of the different modes must be assessed. In a first step, this paper describes the state of information in Switzerland, reviews the multimodal transportation accounts developed abroad and identifies the limit for their application in countries where the politic power is highly decentralized, like in Switzerland. In a second step, it describes a model and software that have been developed and implemented at different institutional levels (local, regional and national). Finally, it illustrates how such a tool can be used to assess current transportation system and to test different strategies and scenarios.

Keywords

Multimodal – Spatial reference – Transportation Account – Decision Support System – Switzerland – Allocation model – Economic cost - Swiss Transport Research Conference – STRC 2001 – Monte Verità

1. Introduction

Urban transportation is a complex field in which many management issues related to the operation, extension and modification of the network, to financing, to price setting, to the creation of transportation communities (their organization, fares…) etc., can not be solved without proper tools and a reliable and coherent information system. Today, we still lack good diagnostic and decision support tools that take into account the interactions between the main stakeholders of the transportation system (financing institutions, operators, public authorities, customers and users, etc) and the respective weights they put on different criteria.

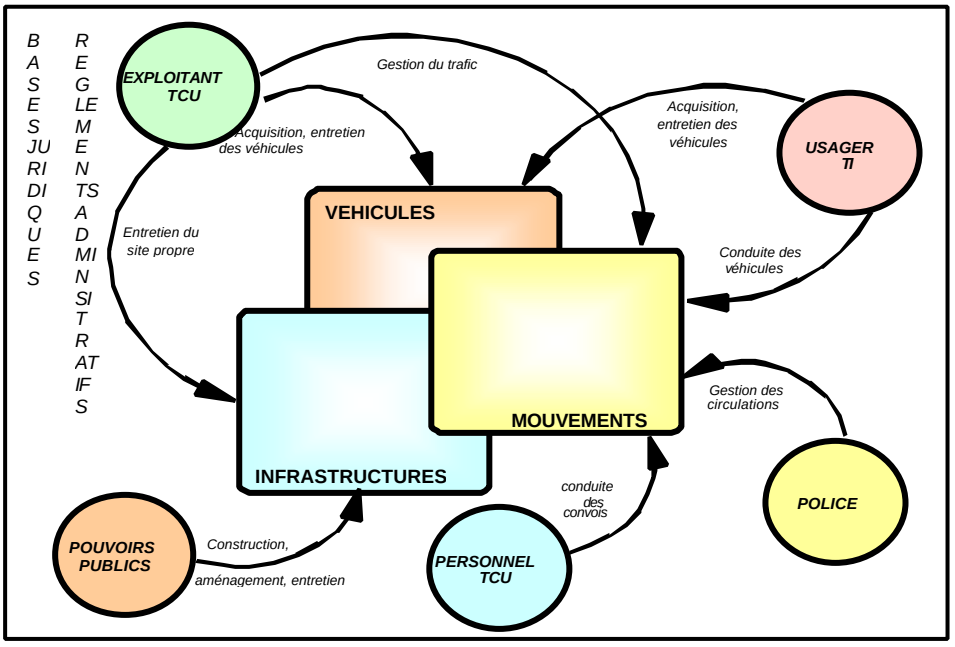
2. Objectives of the transportation account

The objective of this study, conducted in our institute, is to develop a “consolidated accounting system” that gathers costs and revenues of the different modes used for transportation in an agglomeration (multimodal account). This tool aims first to establish a diagnostic for the whole urban transportation system and secondly to test the impact of different transportation policies.

This transportation account uses as a reference the administrative borders of the towns that form an agglomeration (spatial reference) rather than the sum of the influence zones of the different modes; we made this choice in order to have a single reference for both the analysis and the implementation of decisions related to both general and transportation policies. The objective is thus to provide the analyst and the decision-takers with a mean of assessing the economic performances of different modes, of identifying the main financial flows and specifying their importance, origin and destination.

Therefore, the account with spatial reference integrates all the dimensions of urban transportation and the services linked to it (see figure 1).

Figure 1 Functional scheme of transportation



This transportation account is a communication tool, particularly suitable for discussion between technicians and politicians as an enabler for adapting transportation management strategies to make them fit the interest of the whole community. For transportation financing, it is a useful negotiation tool between managers and public authorities for example to assess the opportunity of an investment program. It is also an essential reference to point out advantages and benefits of transportation system and to confront them with the respective contributions of the different stakeholders (users, public authorities, private companies…).

3. State of information and tools in Switzerland

Today, the different organizations and services involved directly or indirectly in urban transportation (modal operators, road and rail network infrastructure operators, etc.) rely on general and analytical accounting tools and on databases designed to fit their specific needs. The law requires for example that the licensed transportation companies measure and publish, in their management reports, some performance indicators, most often expressed as performance ratios. However, their interpretation is restricted to their own activity.

Table 1 Example of indicator and ratios presented by "les entreprises concessionnaires du transport"

	INDICATORS							
	Length of network (km)	Number of vehicles of traction	Number of total places of park	Km-convoys total	Number of employee	Travelers transported	Population served	Served area (km2)
Year	RATIOS							
	Km-convoys per employee /km	Km done by convoy	Travelers per km-convoy	Income traveler, per km-convoy	Operations costs by km-convoy	Density of the served population	Number of moves per habitant.	Number of km supplied by habitant

Source: Article 5 de l'ordonnance sur la comptabilité des entreprises de transport concessionnaires du 20.6.77

This compartmentalization of the different fields related to transportation makes it specially difficult to bring together the different specific indicators and to assess the performance of the urban transportation system as a whole.

At first sight, the analysis of the information highlights some significant gaps between the data available and the requirements to ensure an efficient management of urban transportation. However, a more in-depth study of the documents published and a thorough investigation in the responsible services showed that the detailed information exist; however, getting it requires some heavy and tedious research.

This assessment confirms the need to develop and to implement a transportation account in Switzerland that addresses the global management of urban transportation; this account needs

to be based on a reliable and comprehensive database to legitimate its use as a proper assessment and decision support tool.

4. Examples of realization abroad

The experiences conducted in other countries, like France, show that models or prototypes developed in this field provide some interesting applications, particularly for assessing the economic and financial aspects of transportation systems and for testing different management policies.

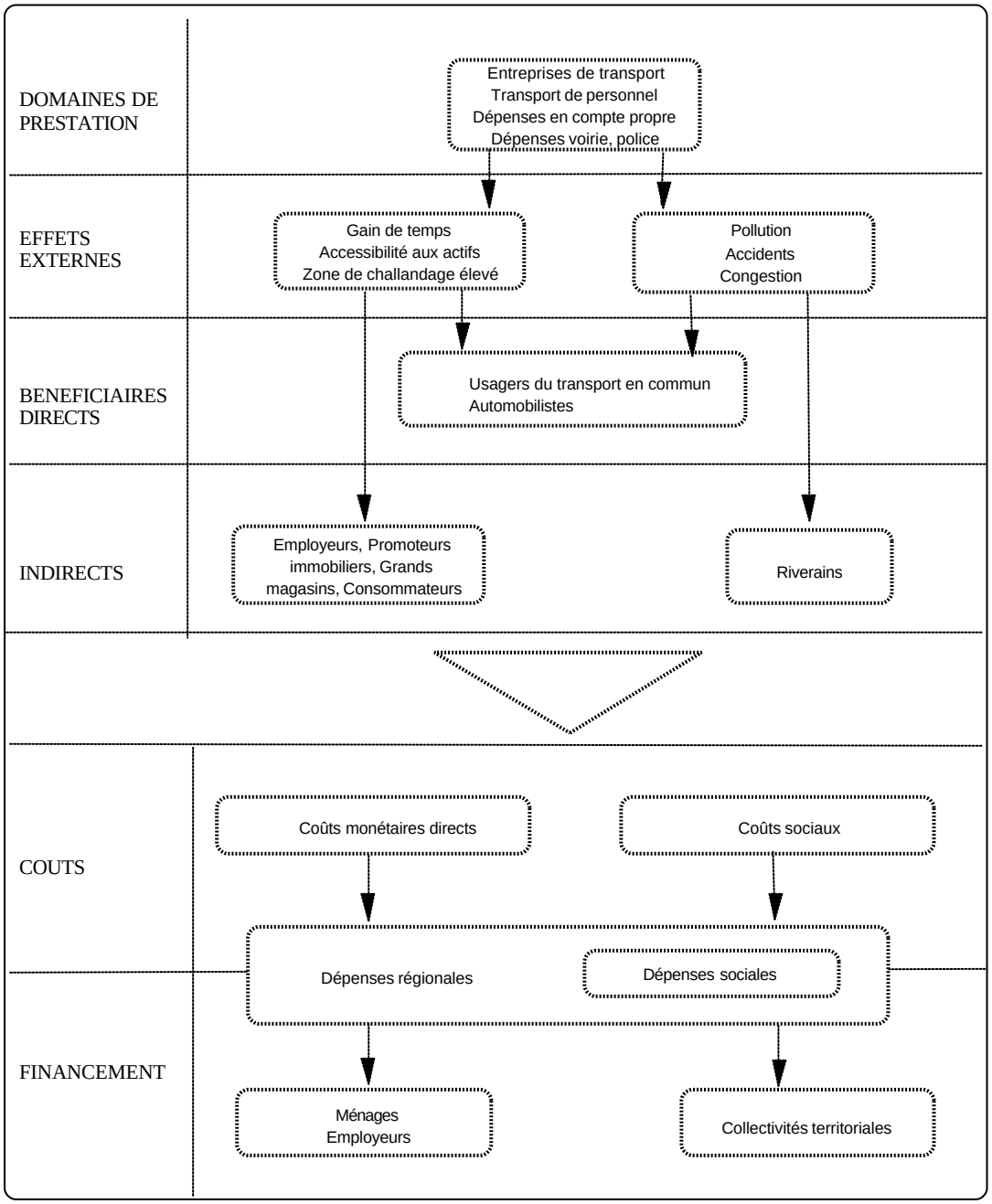
The Regional Transportation Account (RTA), applied since 1985 in the region Ile-de-France and more recently in other regions, is one of the most interesting example. It is a diagnostic and decision support tool, that aims to:

- Quantify the total cost for transporting a traveler in a city, in an agglomeration or in a region
- Estimate the financing capacity of the different economic agents: users, taxpayers, public institutions, employers, other financing institutions
- Determine the economic and social cost of each mode (personal car, public transportation, bicycles) and identify the source for their funding
- Assess transportation investment projects in light of their improvement on economic and social effectiveness and efficiency.
- The methodology used by the model is the following one:
- Identify the flows (brut and net) by financing source
- Distinguish the investment and operations costs related to transportation
    - by activity “reference” (public transportation, personal car, bicycles, taxis)
    - by activity “related” (road and rail network manageement, parking, traffic police).
- Split the costs among the different financing source
    - Public organizations (allocation to the contribution by mode (individual and public)
    - Households (evolution of the contribution over time)
    - Employers (allocation of financing between investment and operations)
- Establish the balance of spending and revenues related to transportation by each of the financing organizations
- Analyze each element of the economic costs of each mode

- Monetarize the social costs related to each mode (atmospheric pollution, congestion, noise, traffic accidents…)

The different steps of the Regional Transportation Account calculations are summarized in the figure 2.

Figure 2 Regional Transportation Account (RTA) Approach



However, we can not directly apply such instruments for Swiss cities transportation management due to several particularities: strongly decentralized political structure, specific regulations, responsibility centers, transportation financing policy, etc. Actually, to ensure its validity, the tool must be totally integrated in the local organization and practices; therefore, a preliminary detailed study of the needs is a prerequisite for the development of an appropriate model.

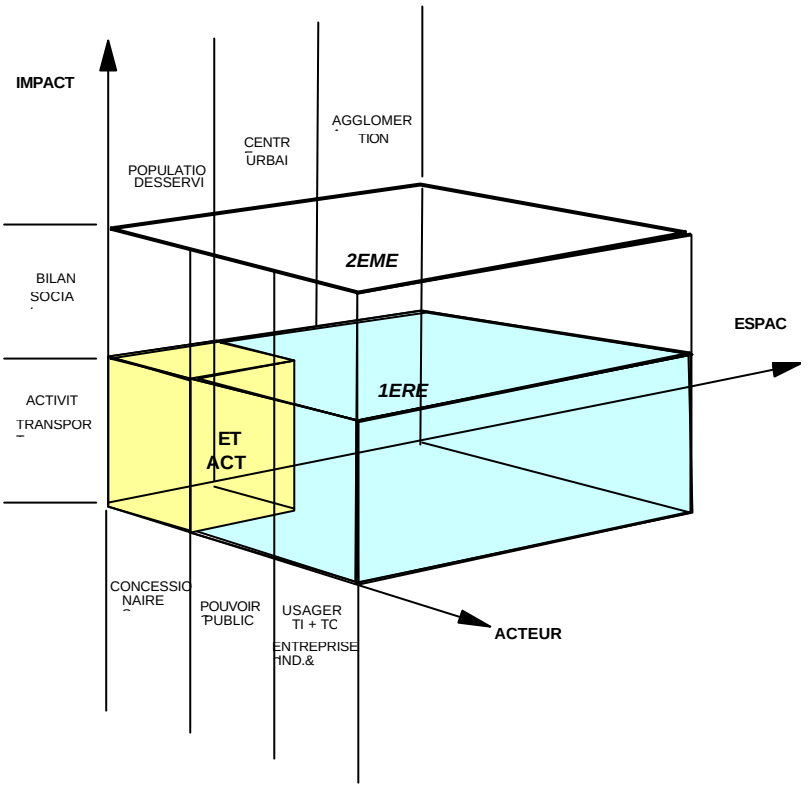
5. Requisites for the development of the model

The analysis of the conditions of urban transport management in Switzerland and the experience acquired from experimentations already done abroad allow us to define the specifications of a transportation account adapted to Swiss cities particularities.

This instrument should be designed in order to satisfy several requirements.

- Vis-à-vis the current situation, it should assess the service and the impacts of urban transportation by integrating them in a same group extended in three dimensions: space, stakeholders and impact fields.
- For *space*, we must take into account not only the zone of operations and influence of public transportation (served population), but also all the towns forming the agglomeration
- The *stakeholders* are not only the operators of the public transportation system but also their customers, the users of private transport, the public authorities, the industrial and commercial companies. It includes all entities that can have an impact on transportation by their behaviors or decisions.
- The *impact fields* must focus on the impacts of transportation direct activity at first but should then address the consequences of the transportation system on the whole community (social balance).

Figure 3 Scope of the model



- It should be organized in order to manage transportation information according to a dynamic and iterative process, i.e. that ensure that the information providers receive some feed-back. This requirement is critical to make understand the purpose and the utility of the model to the different actors, to facilitate its access and to guarantee that the information shared remains meaningful, reliable and updated!

- This tool should simultaneously be a diagnostic tool helpful to the person in charge of a specific field and a decision support system that allows to simulate different scenarios. This last function implies the introduction of a limited number of relations between the variables of the model through the use of elasticity concepts and minimal/maximal values (discontinuous points for the behavior).

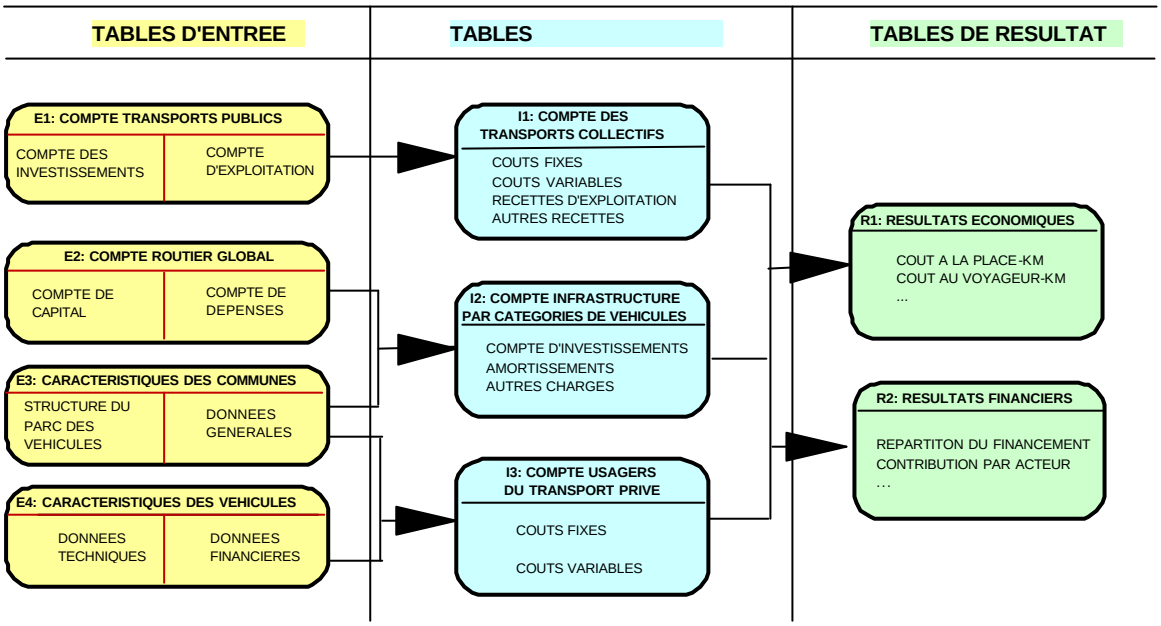
- The results coming out of the tool should express both the economic dimension of transportation, for example by comparing the respective costs of private and public transportation (unit cost per place-km or traveler-km), and the financial dimension by identifying the origins and destinations of the main financial flows and by evaluating the contribution of the different transportation partners.

6. General structure of the model

The transportation account model has been developed on a spreadsheet system that simultaneously allows the recording and the organization of different kinds of information and the constitution of relationships between them.

In the model, the information is structured in tables gathered in 3 distinct categories.

Figure 4 Organization of main spreadsheets of the model



- The entry spreadsheets record raw information coming from the different statistical sources available and group them in homogeneous groups;
- Intermediary spreadsheets reorganize the information in data more in line with transport reality and with the requirements for affectation and computations.
- The result spreadsheets, in line with the principles and practice of analytical accounting by product, present the values resulting from the computation as indicators of performance.

The proposed model includes also some relationships useful for assessing the effects of possible actions or events. These relationships are organized on the same logic as the one inherent of transportation companies financial reports. Therefore, there are interrelation links between the state of resources (balance sheets) and their consumption (operating account) and main transportation financial flows are the reference (nature). For example,

- Costs related to a resource consumption like energy depend on the unit market price and on the service provided(kilometre-convoy)
- Revenues of public authorities are determined by the importance of the vehicles park, the unit amount of each specific tax (general taxes, license plate stickers,…) and the volume of movements (fuel taxes).
- Revenues of public transportation companies are influenced by the fares, the demand (that depends on supply), and integrate the elasticity concept (relative demand variation vs. relative variation of fares).
- Etc.

7. Application of the account transportation in Switzerland

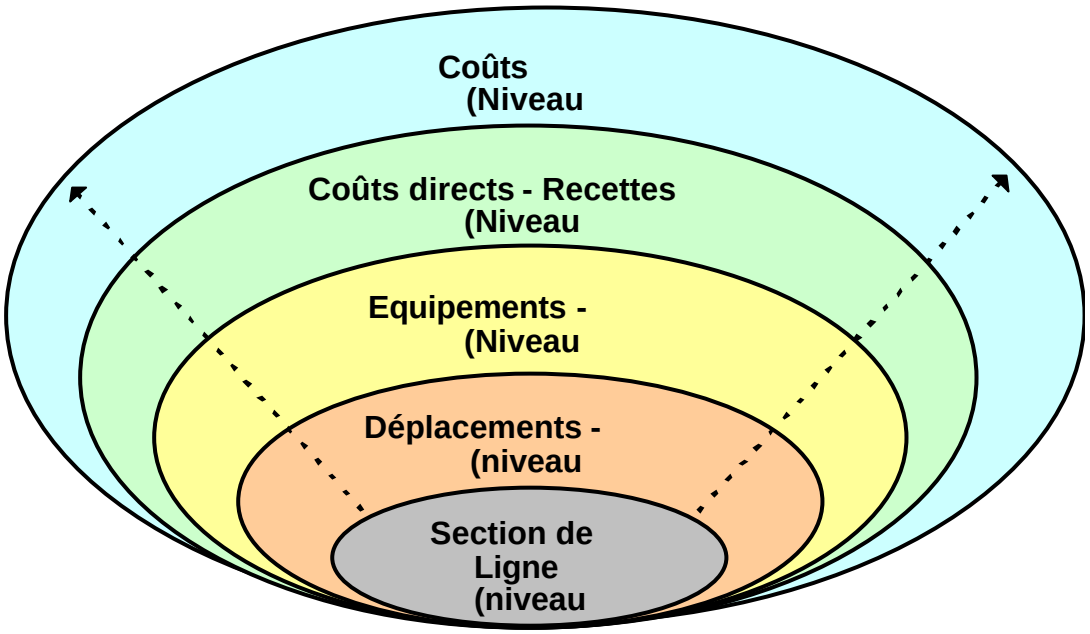
Today, the transportation account has been developed and applied at different institutional levels. In fact, a prototype has been designed at national level to obtain a synthetic image of the transportation system, to measure its main dimensions and to make compatible the information requested from the different sources. At cantonal level, a prototype has been developed for Vaud canton as a complementary tool to the cantonal transportation master plan. At urban level, Lausanne city runs such an instrument since 1994 and publishes its results annually. This latest experience is particularly interesting because the tool is well integrated in the current activities of the administrative services and has been implemented for several years.

During the collection of information, we have favored the sources which specialist experts had examined carefully before and from which the computation rules and more specifically the allocation rules are accepted by the majority of users, for example:

- Infrastructure costs and their allocation to the road users categories result from the information and computation process used in the establishment of a road transportation account;
- The ownership and use costs of the different categories of light personal vehicles come from the reviews published by the drivers' associations and those of the heavy vehicles from computation tables presented by the Swiss Association of Road Haulers to its members
- For the costs and services of the public transportation network, the information is taken out of management reports and analytical accounting systems of the respective companies.

The information necessary to feed the transportation account has been organized by layer and the main difficulty of this operation is to coordinate and to match the geographical borders, each kind of information having its specific segmentation.

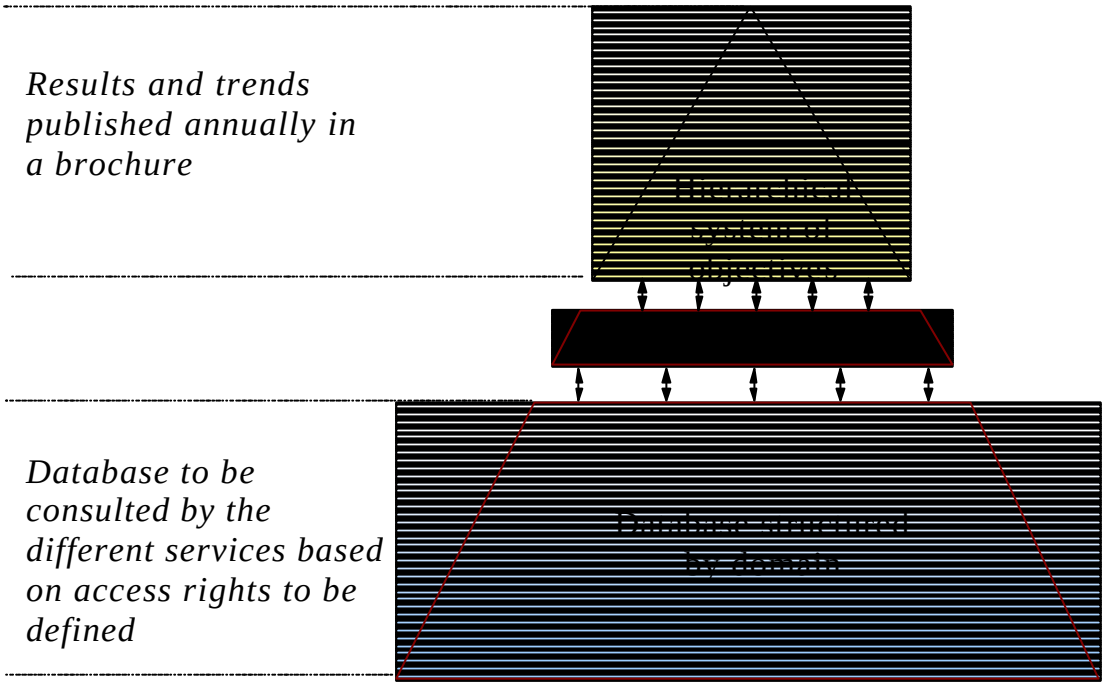
Figure 5 Logic of superposition of the different kind of information



The access to the database is regulated by the definition of privileges. For the information to be correctly used, it is important to give it the right focus so that it fits perfectly the needs of the different users. In the public infrastructure management, it is also useful to inform the population on the use of the public funds and on the transportation policy choices made by the elected people. To achieve these different requirements, the data and the results of the transportation account are presented on 2 hierarchical levels:

- The first level includes the database itself in which the different administrative services of the city can enter with pre-defined access rights and where they can find answers to punctual answer in relations to their competence fields.
- The second level gathers the synthetic results aimed to feed the scorecard of each department head regularly, in principle annually, and also to enable the publication of a document to inform a larger public it on the state and evolution of urban transportation.

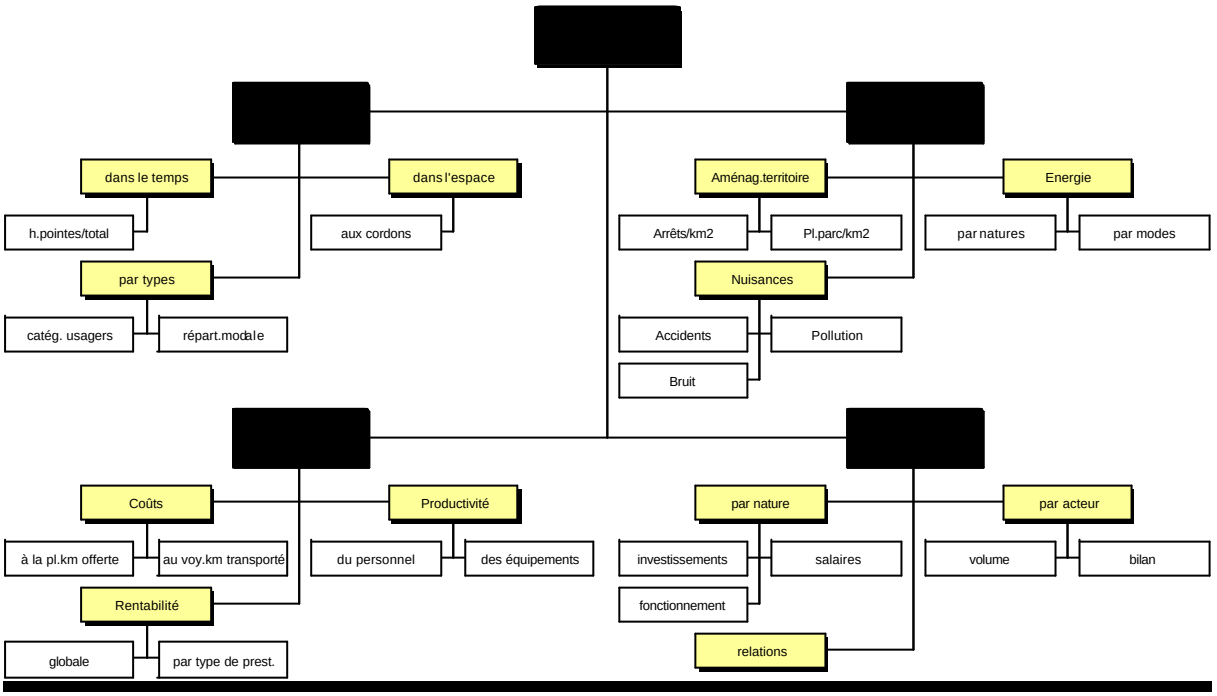
Figure 6 Use of data and results



The organization of synthetic results is based on a hierarchical system of objectives that show the main following dimensions:

- *demand* or the mobility analysis, dimension measured in space and time by counting operations or investigations.
- *economics* or the study of the rational use of resources, dimension measured by yield and productivity indicators;
- *finance* or the analysis of the flow of incomes and expenses, dimension measured by kind of flows and by actors' categories;
- *environment* or transportation impacts, dimension measured by the accessibility quality of each mode, by the energy consumed and by the production of different kinds of nuisances.

Figure 7 Main components of an urban transportation scorecard



8. Key learning

We can draw the following learning from the experience gathered throughout the implementation of a transportation account at several institutional levels and particularly at the urban level:

The increasing complexity of transportation management requires a even closer collaboration between all stakeholders in order to define a join policy and to guarantee that different or even divergent interests are properly taken into account. This new orientation requires that we can rely on comprehensive databases and on performing and reliable analysis tools. The transportation account contributes effectively to this function

The results obtained from the transportation account explicit the main dimensions and trend of transportation. They also clearly express the option chosen by the persons in charge of local transportation policy. The performance measures of the different modes of transportation and the assessment of the financial flows are meaningful and reliable indicators to focus the action.

The implementation of a multimodal accounting tool is a tricky task due to the difficulty to match different source of information which each its own context and objective. Our experience shows that this research for consistency is not an utopia if the principles and computation rules are completely transparent and based on the principles used by practitioners of the sectors.

The data collection period confirmed also that almost all data necessary to the building of a transportation account is already available, but it requires some updating and testing operations to consolidate the whole database. The variability analysis on the results demonstrate that the model is robust: the error margin on the entry variables does not have a significant impact on the results. It does not mean however that a progressive development of the database is not essential.

Finally, the learning from the development of a transportation account and its application in Switzerland demonstrate that the doubts and resistance often raised against this kind of tools are unfounded as long as some logical and transparent rules are respected. Its generalization to all the Swiss cities should contribute to the definition of a coordinated transportation policy.

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