

The Role of Decision Support Systems (DSS) in Transportation Planning: the Experience of the Lombardy Region.

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Abstract

In line with EU regulations, the Italian Government started the reform of public local transport in order to transfer competences to Regional and Local Administrations and to move to a competitive tendering system.

To pursue the reform at the local level it is crucial to define a common framework (by sharing information and a quantitative methodology) where Regions and Local Administrations can operate. Decision support systems (DSS) and information systems are valuable tools to support these activities and, in general, transportation planning.

An information system, such as the one Poliedra-Politecnico di Milano is designing for the Lombardy Region and its Plan of Mobility and Transports, has to accomplish the following tasks:

- the **monitoring of the Plan**, by comparing information among different years, Administrations or fields (e.g. public or freight transport), also in relation to standard reference values;
- its **assessment**, to check the performance of the Plan as a whole and of each field and to reveal possible imbalances and critical situations;
- the **appraisal of projects**, to introduce homogeneous informative contents into the projects; this helps to carry out project assessment according to a standard and transparent procedure and provides the decision maker with appropriate tools to identify priorities;
- the **appraisal in the tendering process**, to define the tendering scheme and the criteria to evaluate offers.

Key elements of the information system are therefore: a database that catalogues the sources needed to feed the system; a set of indicators, which measure the performance with respect to the strategic objectives fixed in the Plan, in the projects and in the tenders; a methodology based upon multi-criteria analysis techniques, which allows to identify

critical and conflict-ridden features and to compare alternatives.

Background: the reform of Public Transport Services

1.1 The new competences

Since 1995 [1], the Regional Government of Lombardy has undertaken an important reform in public bus transport management; a national law in 1997 [2] accelerated this process and extended it from bus to railway network.

The leading ideas of this reform can be summarised as follows:

- decision-making for public transport planning and financing is to be transferred to more a local level: from national to regional level for railways, from regional to provincial and municipal level for bus networks;
- the concession system has to be turned into a competitive system, in which services are assigned to an operating company through tendering;
- network organisation must better meet mobility demand: new services are to be designed for suburban areas around main cities, as well as in low demand areas, where innovative services (e.g. services on demand) are also encouraged;
- economic efficiency of expenditure for transport has to be increased.

Consequently the reform reallocates tasks as follows.

The **National Government** has direct competence on the *national roads* and on *national public transport* networks (planes; inter-city, inter-regional and high speed trains; inter-regional buses; navigation). In the previous order the national Government was fully in charge of the railway network, while the reform transfers, in accordance with the subsidiary principle, the functions related to local service to the regional administration.

The General Transport Plan (PGT) defines the national guidelines of the transport policy.

The **Regional Administration** has competence on: the *strategic planning* of the whole regional transport network; planning, financing and managing the *regional train service*; money transfers to Provinces and to the eleven Municipalities to *subsidise bus services*; planning, financing and managing the *regional road network*.

Lombardy is defining the regional strategy for the next ten years in the Regional Plan of Mobility and Transports (PRMT).

Provinces have competence on: planning and financing the *inter-urban and urban bus network*, outside the large conurbations; planning, financing and managing the *local road network*.

With the reform Provinces are no longer solely in charge of administrative functions related to bus services but also of the planning ones, which were assigned before to the regional body.

At the urban policy level the main **Municipalities** have competence on planning, financing and managing *urban public transport* by bus, tram and underground.

The Lombardy Region, the eleven Provinces and the eleven most important Municipalities are called every three years to define their strategy, for the public transport services they are respectively responsible for, in Triennial Programmes of Services (PTS).

Transport companies provide the transport services, with competences completely separated from the public administrations: however today the distinction in roles is not always so clear mainly for the Municipalities where services are often supplied by municipal companies.

1.2 The reform in Lombardy

The Italian Government fixed 2004 as the deadline for bringing tendering procedures to an end: in Lombardy tendering procedures for bus networks will start next year (2002) in order to arrive on the 1st of January 2003 with all services assigned by tendering.

One of the main features of the reform of the bus network system in Lombardy Region is the orientation to “**flexible**” **tendering procedures**: the public administration decides some service requirements, e.g. which municipalities must be connected or which main bus lines must be guaranteed, some quality requirements, e.g. the average age of the vehicles; the transport company decides timetables, stops and routes in compliance to the guidelines provided by the public administration.

Tendering with respect to an area [3] and not to a single bus line ("competition for the market") is the other innovation: in this way bus companies have the real opportunity to prove their management skills.

Net priced contracts (i.e. the operators keep the revenues) are promoted as to encourage operators' initiatives.

To be successful the reform needs that all the actors **transfer and share know-how**.

The Region has to pass on Provinces and Municipalities information about demand (e.g. origin-destination matrices, sold tickets, ...) and economic data (e.g. costs and revenues, employees and rolling stock) collected during the last ten years.

Little Municipalities outside the large conurbations and without Regional subsidies has to inform Provinces about the ongoing organisation of their bus urban services.

Companies should help the administrations in collecting information about user needs and they will start to periodically transfer some demand, supply and economic data to local administrations. This will be particularly relevant where clear, homogeneous and systematic data were completely missing in the past: the urban network, with urban bus companies called to transmit data to municipalities; the railway network, where the two main companies that operate local trains, FS and FNM, are called to transmit to the Regional administration.

Data and information transfer calls for the development of adequate and standardised ways of communication among all the stakeholders.

The writing out and the annual updating of the Triennial Programmes of Services asks to develop **new skills**: public administrations should improve analysis, planning and monitoring skills for the public transport services they are respectively in charge of; operators should be more aware of their choices (today if the public subsidy does not cover all the costs, at the end of the year the public administration provide the operator with some extra funds), more orientated to the user needs, and, in the case of flexible tenders concerning areas, they have to acquire an active role in programming.

Therefore to pursue the reform at the local level it is crucial to define a common framework (by sharing information and a quantitative methodology) where Region and Local Administrations can operate: this promotes participation and consensus by all the stakeholders.

To this purpose in Lombardy Poliedra-Politecnico di Milano is assisting the Regional Government in developing and implementing such tools as DSS and information systems:

- **Mistral**, an information system to support the regional and local authorities in transport planning;
- the **information system for the monitoring and assessment of the Regional Plan of Mobility and Transports** to support the Regional Government in the strategic planning and financing in order to verify, throughout the years, the correspondence between actions, regional policy and objectives stated in the Plan;
- a system for **project appraisal**, to introduce homogeneous informative contents into the projects; this helps to carry out project assessment according to a standard and transparent procedure and provides the decision maker with appropriate tools to identify priorities,
- a system for the **appraisal in the tendering process**, to define the tendering scheme and the criteria to evaluate offers.

These **tools are designed to** analyse the *ongoing situation* and define the *critical elements* also by comparison with other geographical areas or with the past. On the basis of the analysis results, they allow to identify the best dimension of the areas to be addressed by each tender and to allot the monetary resources, to define routes, stops and timetables (consistently with the degree of flexibility of the tender), to choose the best offers. They aim as well to *monitor* both the operators' performances compared with the *Contract* requirements and the overall course of the *reform* with respect to the regional objectives of efficacy, efficiency, environmental sustainability, safety, social acceptability.

The tools are **developed according to some common principles** such as: the extensive use of *quantitative indicators* to ensure fairness and transparency of decisions; evaluation procedures implemented according to *Multi-Criteria Analysis* techniques [4] to assess the best solutions among several alternatives; the relevance of *sharing data and methodology* among all the stakeholders to make the decision-making process easier; *flexibility*, as to meet the Region's need for a unique information system to better monitor the reforming process without being prejudicial to the autonomy of local administrations.

2 Mistral

Mistral [5] is **an instrument to** :

- gather in a *unique database* the data the regional administration needs to monitor public transport services and to promote cross-modality;
- monitor and evaluate the local public transport system by means of *indicators* related to transport demand, bus and train supply (involving both transportation and economic aspects) and all issues affecting public transport (e.g.: distribution of public facilities such as schools, possibility of park-and-ride etc.) at different levels of detail and aggregation;
- provide *support to decision-making* and negotiation processes with methodologies based upon multi-criteria analysis for conflict solving;
- provide specific *procedures* to support analysis and programming of public authorities (e.g. to redesign the bus network);
- *monitor the contracts* for transportation services that public authorities have to stipulate with train and bus companies: monetary incentives may be granted only if goals are achieved.

Mistral would be a **shared tool** between Region and local administrations: the Region defines the main structure of the information system, but the flexibility of the system allows Provinces and Municipalities to personalise indicators; the Region establishes a common framework where local officers can operate, keeping their autonomy of analysis.

Mistral represents the main source to feed the information system for the monitoring and appraisal of the Regional Plan of Mobility and Transports. It may supply both primary data and calculated indicators.

3 The information system for the monitoring and assessment of the Regional Plan of Mobility and Transports

The information system for the Regional Plan of Mobility and Transports [6] intends to be a tool to verify throughout the years the correspondence between actions, regional policy and objectives stated in the Plan.

It aims to be a system able to produce *synthetic information*, selected through standardised criteria, to represent the course of the main phenomena connected with passenger and freight mobility as to check *the progress and performances of the Plan* as a whole and of each field (e.g. effects of the tendering system on passenger transport; advantages of a new road in terms of accessibility and congestion). The system is meant to make *critical or unbalanced situations* emerge by comparing results from different years, geographical areas or fields of intervention. Finally it is useful to classify geographical areas or fields at different levels of *intervention priority*: such a range could provide a preliminary element to appraise different policy options.

Key elements of such an information system are:

- a database that contains the necessary information to monitor the Plan;
- a set of indicators to monitor and assess the Plan;
- a system to pre-assess interventions, which aims both to provide the decision maker with enough elements to make a selection among different options according to transparent criteria and to enhance planning skills of proponents.

3.1 Database

Due to the great variety of data to be treated (e.g. demographic statistics, financial data, information about infrastructures or the organisation of public transport services) and consequent dispersion of primary sources (often external to regional archives), the optimal choice to build up a database for transportation planning and monitoring is to create and enhance synergies with other existing systems, also external to the regional administration, instead of centralising information.

In Lombardy different databases that already exist will support the system, which is not conceived to absorb them, but to promote their development whereas informative gaps need to be filled.

This approach has the following advantages:

- *feasibility*: only the most useful data to the goals of the Plan are used;
- *simplicity*: it reduces complexity and size of the data to be processed and it avoids data duplication;
- *flexibility*: it allows to draw from diversified sources and it is independent from the evolution of the original structures;
- *reliability* and updating: it allows to keep a record of the data characteristics and, in case, of their certification; it also guarantees a good quality of the information because data continue to be managed directly by whom is directly interested to their reliability;
- *low costs*: *time of implementation and management* costs are more contained, since the effort to maintain coherence with other databases is minimised.

The variety of data and the dispersion of sources make it difficult to get an overall view of the data availability and structure: Poliedra-Politecnico di Milano designed an information tool, named “Data Catalogue”, to analyse and record how the already existing data are organised, to give synthetic operative information about each database and to identify information gaps.

3.1.1 The Data Catalogue

Main functions of the data catalogue are:

- to build the database by gathering the existing data;
- to allow to go through available data, formalities and time to request them, their reliability and territorial coverage;
- to make the database easily accessible to a large number of users, even inexpert ones. Users may be officers of different administrations (Region, Provinces, Municipalities), or operators interested in a specific field (ANAS – the National road operating company; bus companies for transport services...). Different users could be granted different priorities to access the database according with the kind of data they are allowed to get into (e.g. regional employees will access all the databases, the provincial ones only the bus transport services information and so on).

Then the data catalogue constitutes a common information framework for the large number of disparate stakeholders involved in the reforming process and it is a tool to share information.

The data catalogue consists of a number of synthetic forms. For each source from which data are drawn out and for each data category¹, forms describe sources, territorial coverage, the extent of georeferencing and so on (see Table 1).

¹ Categories are, for instance, transport demand, rail services supply, characteristics of the infrastructures.

Table 1

	Field name	Field description	Example
Description	Name of the source		Mistral - the territory
	Short description of the source		Territorial settlement
	Objectives	Why the source was made up	Planning, monitoring, local public transport
	Use	How data from this source are used within the Plan (to calculate which indicators)	
	Sub-categories	Different types/classes of data the source records	List of administrative units, population classes according to age and sex, ...
	Territorial coverage	Land portion for which data are available: it may be expressed descriptively (e.g. the whole region, a specific province) or numerically (percentage or absolute value, i.e. number of square kilometres)	The whole regional territory
	Georeferencing	% of georeferenced data	None
	Unit of measure		
	The highest degree of disaggregation available	How far are available data disaggregated? e.g. per administrative unit, per time of the day, etc.	On a municipal level for most of the data
Production	Calculation model/data survey method	E.g. gravitational model to estimate irregular trips; sampling/general surveys	Statistics
	Simplifications, approximations		
	Arrangement	How data are arranged to be presented e.g. Matrix/graph	
	Primary sources		
	Producer/releaser		Regional administration
	Owner		
	First issue	Date	
Updating	Formalities and method		
	First updating		From the National Statistical Institute (Istat): 1981. Population according to the registry office: 1986, ...
	How often/when		Every 10 years for data from Istat, biennial for ASPO,
	Last updating		Istat 1991, ASPO 1994, registry office 1998; ...
Certification	Certifying body		
	Date	Scheduled on/carried out on/certification not required	
Format	Type of	E.g. magnetic tape, paper tape	Magnetic tape
Software requirements	Hardware	Assess if any change is foreseen	
	Software		
Access	Formalities	How to apply for, how much time is needed	
	Cost		
	Addresses	Physical co-ordinates, web	
Reference laws			
Notes			

A user can consult the data catalogue through a system of key words to select the subject he is interested in and to check which data are available about that subject.

Key words are organised in two levels, the first one refers to whole thematic areas (for example “transport”), the second one goes into greater detail (for example “passengers” and “freight”).

The user can define the topic of interest choosing a group of key words at the first level and then specifying them with the corresponding key words at the second level. The search allows to associate different key words through logical operators like AND/OR.

Such a tool is an opportunity for the Lombardy Region to create a standardised way to access and handle data and to make the different departments within the regional administration exchange information.

3.2 Indicators

The information system for the monitoring and assessment of the Regional Plan of Mobility and Transports is based on a group of indicators conceived to monitor the state of the Plan as a whole and of each field.

Poliedra-Politecnico di Milano proposed a low number of selected indicators for each strategic objective of the Plan (effectiveness, efficiency, environmental sustainability, safety, social acceptability), summarised in Table 2.

For each indicator the following features has to be (and were) defined:

- its meaning, related to the specific objective of the plan, which it is referred to;
- how to calculate it: different approaches may be identified according to data availability;
- the data needed to calculate the indicator;
- the different levels of aggregation: the level of maximum relevant detail and further meaningful levels of aggregation;
- the reference time (short, middle, long term) for the calculation.

Table 2

EFFECTIVENESS	EFFICIENCY	SAFETY	ENVIRONMENTAL SUSTAINABILITY	SOCIAL ACCEPTABILITY
<p>Inter-municipal accessibility</p> <p>a) to main territorial facilities</p> <p>b) to main attractive municipalities</p> <ul style="list-style-type: none"> • trip time • speed (minimum distance) • generalised cost <p>Long distance accessibility to Lombardy Region</p> <p>a) intercontinental (by plane)</p> <ul style="list-style-type: none"> • number of flights <p>b) European (by train)</p> <ul style="list-style-type: none"> • trip time • speed <p>Passenger public transport</p> <p>a) modal split</p> <p>ratio between demand satisfied by each mode of transport and the total demand</p> <p>b) punctuality for each class of distance</p> <p>c) regularity</p> <p>Long distance freight transport</p> <ul style="list-style-type: none"> • ratio between the tons transported by train, by plane, by river and the tons transported by trucks for each main connection and for each freight class <p>Crossing freight transport</p> <ul style="list-style-type: none"> • number of trucks through each toll-gates <p>Roads:</p> <ul style="list-style-type: none"> • congestion cost expressed as average delay per km and for different times of the day • speed for the different times of the day 	<p>Passenger public transport</p> <p>a) economical efficiency (ticket revenues /operating costs)</p> <p>b) transport efficiency</p> <p>c) load factor (passengers/seats offers; passengers/trips)</p> <p>d) efficiency of public funding (subsidies for the operations /passengers*km))</p> <p>Passenger private transport</p> <ul style="list-style-type: none"> • load factor for single vehicle <p>Railway freight transport</p> <ul style="list-style-type: none"> • number of empty wagons <p>Infrastructures saturation ratio</p> <p>a) roads</p> <p>b) railway flow/theoretical capacity</p> <p>Regional planning</p> <p>a) number of ongoing projects attaining certain stage /total number of planned projects weighed on the basis of</p> <ul style="list-style-type: none"> • cost • regional funding <p>a) b) average time span for each kind of project</p>	<p>Numbers of road incidents</p> <p>for each kind of involved vehicles, for seriousness (deadly or not), for road classes</p> <p>Infrastructure conditions</p> <p>(values calculated regarding to the corresponding total value)</p> <p>a) roads</p> <ul style="list-style-type: none"> • % cross-roads at ground level • state of paving (with respect to scheduled maintenance) • % road kilometres with identifying fog lamps <p>b) railway</p> <ul style="list-style-type: none"> • % level-crossing per railway km , • % railway kilometres with signalling automatic devices • % stations with ACEI systems <p>Vehicle conditions</p> <p>a) passenger private transport % of vehicles with electronic safety devices</p> <p>b) passenger public transport % of railway vehicles with a signal repeater</p> <p>Prevention measures</p> <p>a) urban traffic conditions</p> <p>b) public funding for safety</p> <p>c) speed controls through the “telepass” system</p> <p>Freight transport</p> <ul style="list-style-type: none"> • number of trucks carrying dangerous freight 	<p>Atmospheric emissions</p> <ul style="list-style-type: none"> • total amount of emissions for each type of emissions <p>Exposure to air pollution along the main roads</p> <ul style="list-style-type: none"> • total amount of CO taken in by the population <p>Exposure to noise</p> <p>a) along the train routes</p> <p>b) airport noise: number of inhabitants subject to a certain noise level (ex DM 31/10/97)</p> <p>Global amount of energy consumed for transports</p> <p>Vehicles conditions</p> <p>a) passenger public transport arrangement of rolling stock per age and according to EU norms</p> <p>b) passenger private transport arrangement of circulating stock per age and according to EU norms</p> <p>Prevention measures</p> <p>a) urban areas</p> <ul style="list-style-type: none"> • % of areas with limited and regular traffic conditions • length of cycling tracks <p>b) passenger public transport regional funding to upgrade the rolling stock</p>	<p>Perceived quality through questionnaires (public transport, Paper of Mobility, inquiry on different works...)</p> <p>Number and kind of procedures for</p> <p>a) communication towards/from the users (campaigns of information, complaint bureau)</p> <p>b) transparency, participation, social conflict management in decision-making procedures</p>

3.3 Assessment of the Regional Plan of Mobility and Transports

The system for the assessment of the Regional Plan of Mobility and Transports proposes the periodic appraisal of the plan's performance to check its progress, and particularly to control which objectives are being pursued and to which extent. For the time being the focus will be on the effects of the newly tendering scheme, to let the Regional body manage, address and monitor the reform. It is a decision support system that does not want to replace the decision maker but rather give him tools to appreciate how the Plan is performing following stated criteria and clear reference values.

Provided that indicators are defined, the assessment of the Plan moves through the following two steps.

1. To verify the **attainment of the targets** for each indicator by the comparison:
 - among different times in order to appreciate the steps towards the full implementation of the Plan;
 - among different geographical areas to reveal unbalances, if any, in the implementation of the Plan or critical situations in some areas;
 - among different fields (e.g. infrastructures and services);
 - among different categories within the same field (e.g. the secondary road network and the highway network are two categories for road infrastructures).

Reference values for each target are chosen from standard values or from other similar contexts (e.g. the efficiency of public transport in Lombardy should achieve the same level of other European regions), from legislative references (e.g. the ratio of 35% between costs and revenues for public transport) or from social and economic considerations.

If there are no absolute reference values, it is possible to use also relative reference values defined at regional level (e.g. the average in the region or the best value found).

2. To identify critical situations or unbalances, which contributes, on one side, to reorientate the strategy of the Plan, in terms of resource allocation, and, on the other side, affects project appraisal as projects are classified according to the situation they work on.

To be able to compare performances expressed through the different indicators it is necessary to assess where they are nearer to the targets to achieve. For each indicator a **threshold of attention and one of alarm** is fixed.

These thresholds are defined, as targets are, on the basis of absolute or relative values and they are meant to identify critical or intolerable limits. Given the value the indicators score with respect to those limits, fields or geographical areas fall into one of the following priority classes:

- A. if at least one of the indicators related to the field (or to the geographical area) is over the threshold of alarm, the field is in the highest priority class;
- B. if none of the indicators related to the field is over the threshold of alarm but at least one is between the alarm and the attention limits, the field is in a middle priority class;
- C. if all the indicators related to the field is below the threshold of attention, the field is in a low priority class.

An example of step 2 is provided in the following for the provincial road network.

The evaluation among different geographical areas is based upon four objectives typical of the road-network system:

1. road safety;
2. pollution;
3. accessibility;
4. traffic congestion.

Indicators and thresholds are described below.

ROAD SAFETY

Indicator:	accidents/km-year
Reference value:	regional average of accidents/km-year on roads (0.175)
Threshold:	– alarm threshold = $2 \times$ reference value (0.35) – attention threshold = $1.2 \times$ reference value (0.21)

POLLUTION

Indicator:	equivalent noise level
Reference value:	limits provided by law: 60 dB(A) (valid for generic residential areas) or other limits for specific areas
Threshold:	– alarm threshold = 15 dB(A) over the limit – attention threshold = 5 dB(A) over the limit

• Indicator 1:	Air pollution: CO
Reference value:	limits provided by law
Threshold:	– alarm threshold = 30 mg/m^3 – attention threshold = 15 mg/m^3
• Indicator 2:	Air pollution: SO ₂
Reference value:	limits provided by law
Threshold:	– alarm threshold = $250 \text{ } \mu\text{g/m}^3$ for SO ₂ – attention threshold = $125 \text{ } \mu\text{g/m}^3$ for SO ₂

ACCESSIBILITY

• Indicator 1	Minimum trip time to main basic facilities (schools, hospitals or public offices)
Reference value:	on the basis of social and economic considerations
Threshold:	– alarm threshold: 20 minutes – attention threshold: 10 minutes
• Indicator 2	Trip time (by train or bus) to main attractive municipalities
Reference value:	railway timetable 2004-2008
Threshold:	– alarm threshold: 110 minutes – attention threshold : 95 minutes

TRAFFIC CONGESTION

Indicator :	Volume of Traffic/Capacity
Reference value:	theoretical capacity (HCM, 1985) and traffic census information (Provincial Administration, 1995; Anas, 1990)
Threshold: `	– alarm threshold = 1.5 – attention threshold = 1

The following table summarises how three different geographical areas might be classified, in terms of priority, according to the above listed criteria, indicators and thresholds.

			GEOGRAPHICAL AREAS		
CRITERIA	INDICATORS	THRESHOLDS	Area 1	Area 2	Area 3
<i>ROAD SAFETY</i>	Accidents/km·year	Alarm:0.35; Attention: 0.21	0,4	0.3	0.15
	Equivalent noise level	Alarm:15 db; Attention: 5 db	25	10	2
<i>POLLUTION</i>	Air pollution: CO	Alarm:30 mg/m ³ ; Attention: 15 mg/m ³	20	20	10
	Air pollution: SO ₂	Alarm:250 µg/m ³ ; Attention: 125 µg/m ³	200	200	120
<i>TRAFFIC CONGESTION</i>	Volume of Traffic/Capacity	Alarm:1.5; Attention: 1	1	0.5	0.5
<i>ACCESSIBILITY</i>	Trip time to main basic facilities	Alarm:20 min; Attention: 10 min	35	20	8
		Alarm:110 min; Attention: 95 min	150	70	70
PRIORITY CLASS			A	B	C

4 Project appraisal

A system for the appraisal of interventions [7] helps to overcome two limits of the decision-making process:

- It is difficult to compare projects because of the different kind of data that the projects themselves usually contain;
- there is a lack of decision support systems able to provide the political decision maker with information to identify priorities and critical elements, following criteria directly connected with the objectives of the Plan.

This system *firstly* promotes a culture of "good quality design", by enhancing proponents' skills (usually local municipalities or field operators). Dealing with consistent and coherent projects of good quality, the Lombardy Region will be able to get the adequate information to compare them. Proponents, on the other side, will take advantage of it to compete more successfully for national and European funds.

Secondly the system guarantees transparency and certainty (regarding timing, responsibilities and formalities) of the decision-making process, as it sets explicit criteria to identify priority classes. Transparency helps proponents to formulate the project itself.

These objectives can be attained:

- by defining guidelines for the standard information that a project must contain and for its presentation and submission;
- by making public the decision making and assessment criteria used to define priority classes.

An intervention has high priority if it has a positive effect in a critical area, so that a project must indicate:

- the area of intervention;
- the foreseen effects of the project on the area.

To do that the proponent must use indicators consistent with the strategic objectives of the Regional Plan.

An electronic form, to collect the data necessary to each project and to support the proponent to calculate all the indicators, has to be designed. This form is a tool to collect data according to a standard format and to go through data processing and calculations.

To evaluate a project, firstly it is *classified according to how much critical the situation it affects is*. Critical situations are identified by comparing indicators with the thresholds of attention and alarm as explained in paragraph 3.3.

Then projects are *classified in accordance with their effectiveness in solving the critical situation*: a project classified in the highest priority class according to the critical context could be dropped to the lower class if the proposed actions are either ineffective or they are mainly addressed to other problems that are not regarded as critical.

This method does not give out a ranking of the projects but it contributes to gather information about each project effectiveness.

The system for the appraisal of interventions is a decision support system that does not want to replace the decision-maker, but rather give him tools to assess projects according to a transparent and definite procedure.

It also promotes the professional upgrading of proponents by providing them with full guidelines for the projects: (data and procedures), as to harmonise designing skills among proponents.

5 Criteria to evaluate tenders

The evaluation system of the tenders [8] is completely pre-defined upon the multi-criteria analysis principles: the offering company will know the criteria in advance, and will be able to score its own tender before submission in order to guarantee the fairness and transparency of procedures.

Criteria are related to the cheapness for the commissioning authority, the coverage and the capillarity of the supplied service, the quality, the information to clients.

More than one **indicator** is defined for each criteria. The operating plan, which the tendering company has to submit, supplies the data for the indicator measurement. These are the same data that will feed Mistral and, in part, the information system for the Regional Plan of Mobility and Transports.

Table 2 shows some indicators.

Table 2

CRITERIA	INDICATORS
CHEAPNESS	Underbid percentage
QUALITY	Average/maximum age of the vehicles
	Eco-vehicles percentage

	Engagements in favour of regular and on time service (number of trips run as scheduled, number of trips in time)
	Topics related to the ticket system (automatic or not, level/time of implementation, related procedure to count users)
.....	
COVERAGE AND CAPILLARITY OF THE SERVICE	Number of bus*km for each connection for different times of the day
	Length of the bus network
	Number of trips co-ordinated with railway services for different times of the day
	Number of trips for each connection for different times of the day

INFORMATION TO CLIENTS	Number of stops on the total with information to users about route, timetable, main points for cross-modality, nearest ticket shops
	Number of stops on the total with real-time information

	Average number of days to answer to claims

To translate the performance with respect to each indicator into degree of satisfaction, expressed on a conventional scale from 0 to 1, a **utility function** associates a utility (a non-dimensional value between 0 and 1) to each admissible value of the indicator. For example, in the case of the quality criterion, the utility function related to the indicator “percentage of eco-vehicles” could be linearly increasing from 0, in correspondence of the minimum requirement of the Contract, e.g. 10 eco-vehicles, to 1 in correspondence of a 40% increase with respect to the minimum, i.e. 14 eco-vehicles.

It is then necessary to weigh indicators, giving each of them a relative importance. In the above-mentioned example, coverage and capillarity could have the greatest importance (40%), followed by quality (25%) and information to clients (25%) and lastly by cheapness (10%): the Region aims in fact to encourage quantity and quality of services instead of their cheapness.

It is now possible to sum normalised indicators up to obtain a weighted sum that gives an overall score to each offer. The offer with the highest score wins the bid.

To guarantee transparency the call for tenders must declare the utility functions and relative weights of the criteria which will be used for the tender appraisal.

The evaluation system constitutes a common framework for the local administrations, who could personalise criteria and indicators by evaluating only some of them or by adding new ones or by defining specific procedures to calculate the indicators, in accordance with peculiarities of their area and with the level of flexibility they choose for the tenders.

6 Conclusions

The paper focuses on the description of information systems and decision support systems designed and developed by Poliedra-Politecnico di Milano to support and carry on the ongoing reform of public transport in Lombardy.

These information tools constitutes a common framework where the Regional and the Local Administrations and, more generally, all the stakeholders, may share information and a quantitative methodology.

Each proposed tool has specific characteristics and goals, but they are all joined by some transverse issues:

- they aims to promote a reform with the participation and consensus of all the actors involved;
- they let the regional body manage, address and monitor the reforming process;
- they are a common point of reference (above all Mistral and the appraisal system of the tenders), but their flexibility allows Provinces and Municipalities to personalise analysis;
- the tools offer similar and harmonised information to programme activities to all the stakeholders; they decrease the present gap in know-how between Region and Provinces on one side and Municipalities on the other side as well as between authorities administering larger areas with a high density of inhabitants, which are usually more organised in Lombardy, and authorities administering low density areas, more inexperienced in the management of public transport services;
- they represent an opportunity to better link the information systems of the different regional departments and to start a standardised flow of data between the regional and local administrations (e.g. Mistral)

In order to appreciate the proposed tools it is important to provide potential users with adequate training.

Tools will gain a great added value through the extensive use of the web services: for instance the data catalogue will be accessed on-line, data updating for Mistral will be managed by e-mail on real time. This will strengthen the ideas of co-operation and participation.

7 References

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