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A PARTECIPATIVE PROCEDURE TO SELECT INDICATORS OF SUSTAINABLE URBAN MOBILITY POLICIES

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WORKING PAPERS

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2009/06

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Titolo: A PARTECIPATIVE PROCEDURE TO SELECT INDICATORS OF SUSTAINABLE URBAN MOBILITY POLICIES

ISBN: 978 88 8467 529 3

Prima Edizione: Luglio 2009

ViaIsMirrionis,1
09123Cagliari
Tel./Fax070291201
www.cuec.it

A participative procedure to select indicators of sustainable urban mobility policies

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Abstract

Starting from an original framework based on four dimensions and thirteen objectives of sustainable urban mobility policies, this paper advocates the selection of a core set of performance indicators founded on a participative procedure. Citizen participation and stakeholder involvement is made possible by a national sample survey and a deliberative multi-criteria analysis, respectively. Such a procedure is applied to the Italian case and it shows that the set of indicators based on citizen evaluations radically differs from that based on stakeholders' opinions: citizens are more oriented towards reducing private transport costs, air pollution and traffic accidents; stakeholders are more in favour of improving car-free accessibility and reducing the consumption of land and public space generated by urban mobility. For further testing at a local scale, a more articulated procedure is proposed in order to increase the role of citizens and to help generate unequivocal results.

Keywords: Urban mobility; Sustainability indicators; Participation; Stakeholders; National survey
JEL Classification: Q56, Q58, L98

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1. Introduction

Sustainable urban mobility is an already established environmental issue, not only for local interventions, but also in international guidelines (CEC, 2006 and 2007; ECMT, 2002a and 2002b) and in national legislations: this is the case of, among others, the French and Italian laws on Urban Mobility Plans, and of the last generation of UK Local Transport Plans. Many large State programs are oriented towards sustainable urban mobility too: the Canadian ecoMOBILITY program and the Indian Sustainable Urban Transport Project are just two recent examples of an ever increasing list1.

This is why the use of indicators to measure the sustainability of urban mobility is studied in its theoretical, methodological and applied aspects (Barker, 2005; Costa et al., 2005; Frei, 2006; Zhang and Guindon, 2006)[2]: in more structured research works indicators are proposed to monitor urban mobility systems with regard to their environmental, social and economical impacts (Litman, 2008; Nicolas et al., 2003); more rarely indicators are explicitly used to appraise the effectiveness of sustainable urban mobility policies[3] (Lautso et al., 2004) and to involve citizens and stakeholders in such an evaluation (CIRT, 2005).

The research we present here differs from previous studies in its theoretical and methodological foundations and it is aimed at designing and experimenting a participative procedure to select performance indicators of sustainable urban mobility policies (SUMPs). The remaining part of this introduction is mostly aimed at explaining these differences.

SUMPs share two basic characteristics with all other environmental policies. The first one is their intrinsic incommensurability. Due to the co-existence of different objectives, criteria and values, the environmental, social and economic dimensions cannot in fact be compared using a common unit of measurement as suggested by standard techniques based on monetary evaluations (e.g. external costs and cost-benefit analysis). Other techniques that are able to use different metrics and explicitly take into account multiple dimensions of sustainability (e.g. indicator systems

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[1] Information on these two programs can be found respectively in http://www.ecoaction.gc.ca/ and http://urbanindia.nic.in/.

[2] For an overall analytical literature review on sustainable urban mobility indicators, see Mameli and Marletto (2009).

[3] These indicators are defined 'performance (or effectiveness) indicators' to distinguish them from 'monitoring (or status) indicators' (Pearce, 2005).

and multi-criteria analysis) are best suited for the purpose (Martinez-Allier et al., 1980). The second basic characteristic shared by environmental policies (and – among others – by SUMPs) is the presence of strong uncertainty: the probabilities of future changes are in fact not known ex-ante, nor the set of possible changes. In these cases both individuals and the society feature bounded rationality (Simon, 1982); then, evaluation can no longer be based on neutral values and given (individual) preferences, but it must give room to deliberation and (social) learning. As Vatn (2009) brilliantly synthesized, environmental evaluation becomes more about agreeing than aggregating.

All these considerations led to the diffusion of participated procedures to establish environmental policies, that is, organization of a deliberation arena to involve citizens and stakeholders, combined with a structuring technique (usually a simplified multi-criteria) to reach final recommendations (Stagl, 2007). With specific reference to sustainable transport, similar considerations in favour of involving the people in a multi-dimensional approach to policy design, implementation and appraisal have been recently proposed by authoritative researchers (Banister, 2008; May et al., 2008).

Such a theoretical and methodological approach is applied here to the selection of performance indicators of SUMPs. Table 1 shows the structure of the proposed procedure that integrates expert-led steps and participated steps (Reed et al., 2006). In Step 1, starting from an original framework of dimensions and objectives of SUMPs, we selected a first set of performance indicators. In Step 2 such a framework was evaluated by citizens and by stakeholders: citizens' opinion about dimensions and objectives were collected through a national sample survey (Step 2a); stakeholders were involved in a participated multi-criteria analysis, in which dimensions were used as criteria and objectives as issues (Step 2b). In Step 3 we used the results of Step 2 to rank the initial set of performance indicators of SUMPs and to select the more relevant among them.

The methodology and the results of the procedure are analysed in details in the following section.

Tab. 1 – A participated procedure to select performance indicators of sustainable urban mobility policies (SUMPs)

STEP	WHO	HOW	RESULTS
1	Experts	Literature review Closed workshops	Conceptual framework based on dimensions, objectives and performance indicators of SUMPs
2a	Citizens	National sample survey	Appraisal of dimensions and objectives of SUMPs
2b	Stakeholders	Stakeholder dialogue analysis	
3	Experts	Analysis of results of Step 2	Sensitivity analysis Selection of performance indicators of SUMPs

2. Methodology and results of the participated procedure

2.1. Step 1: A conceptual framework of sustainable urban mobility policies

In the first step of the procedure we used as a conceptual reference the UNCSD (2001) Thematic Indicator Development, which is explicitly conceived to manage sustainability policy issues, instead of the more diffused – but less policy oriented – Driving forces-Pressure-States-Impacts-Response approach developed by OECD (1991) and EEA (1995). Following a top-down approach, the three standard dimensions of social, environmental and economic sustainability were articulated into thirteen objectives of SUMPs, each of which was linked to one (single or composite) performance indicator (see table 2).

In a largely original way, the social dimension of sustainability was split in two macro-objectives of SUMPs: accessibility and liveability. Accessibility is articulated in four objectives, considering that it depends on more than just transport factors, and that it can be operationalised in several ways (Geurs and Wee, 2004; Litman, 2008). The first one refers to the ease with which urban services can be used without moving; the others explicitly take the different modes of urban transport into consideration. Then, we explicitly considered that urban liveability is affected by some relevant negative effects of urban mobility: the erosion of public space caused by parked and circulating motorized vehicles, the generation of noise and air pollution, and traffic accidents. The environmental dimension of sustainability was articulated into three more standard objectives of SUMPs: reducing greenhouse-gasses, waste and land consumption

generated by mobility. Finally, the economic dimension of SUMPs is pursued by reducing public and private mobility costs.
This top-down approach generated a core set of SUMPs indicators that meets the two main criteria of indicators selection: exhaustivity (every SUMPs objective has its specific indicator) and efficiency (no redundant indicator is considered).

Tab. 2 – Dimensions, objectives and performance indicators of sustainable urban mobility policies (SUMPs)

DIMENSIONS OF SUMPs	**OBJECTIVES OF SUMPs**		**PERFORMANCE INDICATORS OF SUMPs**
Social sustainability	Accessibility	Increasing the alternatives to mobility	Public and private services accessible via telephone and computer
		Easing non-motorized mobility	Walkability and "cyclabilty"
		Easing private motorized mobility	Congestion
		Easing public transport	Quantity and quality of public transport
	Liveability	Reducing public space occupied by motorized vehicles	Vehicles- and vehicles*km per km^2
		Reducing noise generated by mobility	% of population exposed to harmful noise
		Reducing air pollutants generated by mobility	Main air pollutants from transport: PM_{10}, COVNM, NO_X, CO
		Increasing transport safety	Deaths and injuries from traffic accidents
Environmental sustainability	Reducing greenhouse-gasses generated by mobility		CO_2 from transport
	Reducing waste generated by mobility		Waste from transport
	Reducing land consumption generated by mobility		Land occupied by transport infrastructure
Economic sustainability	Reducing public mobility costs		Households expenditures for public transport
	Reducing private mobility costs		Households expenditures for private transport

2.2. Step 2a: a national sample survey on the objectives of sustainable urban mobility policies

Through the quarterly Isfort's "Audimob" national survey on passengers mobility, a representative sample of the Italian population (composed of 3.600 people aged 18-80 years) was asked to evaluate both the generic four sustainability dimensions of SUMPs and the above list of thirteen specific objectives. Their qualitative answers has been transformed in scores, generating the two rankings reported in tables 3 and 4.

Environmental sustainability and liveability emerge as the more relevant issues in both rankings: objectives of reducing greenhouse-gasses, air pollutants, waste and accidents from transport obtained an average score of more than 3. Instead, accessibility ranks low, with the only exception of the objective of easing public transport (that ranks 7th). Economic sustainability stands in a middle position, which is the average of the 2nd and 8th positions reached by the objective of reducing private and public mobility costs, respectively.

Tab. 3 – Citizens' evaluations of sustainability dimensions of sustainable urban mobility policies (SUMPs)

SUMPs DIMENSIONS	**Average score**[a]	**Ranking**
Environmental sustainability	2.88	1
Social sustainability: liveability	2.82	2
Economic sustainability	2.77	3
Social sustainability: accessibility	2.50	4

[a] Qualitative evaluations were transformed in scores in the following way: 1=useful, but non urgent; 2=relevant, but not a priority; 4=a priority

Tab. 4 – Citizens' evaluations of objectives of sustainable urban mobility policies (SUMPs)

OBJECTIVES OF SUMPs	Average score[a]	Ranking
Reducing greenhouse-gasses generated by mobility	3.33	1
Reducing private mobility costs	3.28	2
Reducing air pollutants generated by mobility	3.20	3
Increasing transport safety	3.09	4
Reducing waste generated by mobility	3.04	5
Reducing noise generated by mobility	2.79	6
Easing public transport	2.78	7
Reducing public mobility costs	2.76	8
Reducing land consumption generated by mobility	2.69	9
Easing non-motorized mobility	2.47	10
Reducing public space occupied by motorized vehicles	2.43	11
Easing private motorized mobility	2.29	12
Increasing the alternatives to mobility	2.24	13

[a] See note in table 3

2.3. Step 2b: a "stakeholders dialogue analysis" of the objectives of sustainable urban mobility policies

The Stakeholder Dialogue Analysis (SDA) is a participative multi-criteria technique that is successfully used to help stakeholders in discussing a general political issue and in reaching a common position about it (Clark et al., 1998).

Because of budget constraints we opted for a simplified SDA[4] that can be summarized as follows. First, we selected relevant Italian stakeholders among the following categories: national and local institutions; associations of consumers/users, environmentalists, workers and companies; political parties (see Appendix A for the detailed list of participating stakeholders). Then, we asked (by e-mail or by fax) their representatives to individually weight the above mentioned dimensions of SUMPs in order to compute the mean of these individual scores[5]. Finally, we called all stakeholders to attend a one-day meeting during which a multi-criteria scheme was used to rank objectives of SUMPs; more precisely, two sub-groups were created to collectively score all objectives of SUMPs against one dimension of SUMPs at a time. These evaluations generated four scores for each objective of SUMPs that were then aggregated by using those weights that stakeholders had previously assigned to objectives of SUMPs.

Two sensitivity tests were carried out to check the robustness of the results of the SDA: in the first one, average scores were calculated using weights coming out of the national sample survey; in the second test we lowered the magnitude of higher scores from 4 to 3. In both cases we did not register any change in the final ranking of objectives of SUMPs.

Results of the SDA are summarized in table 5[6]. Easing non motorized mobility and public transport are the two objectives of SUMPs that achieved the maximum weighted score. On the opposite side of the ranking – because of both low weights and very low scores – stand the two objectives of reducing private and public mobility costs. A low weighted score is also reached by the objective of easing private motorized mobility. Other objectives connected to the dimensions of environmental sustainability and liveability scored high in the ranking; while reducing noise and waste generated by transport are perceived as less relevant objectives of SUMPs.

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[4] A SDA usually consists of (at least) four meetings aimed at setting and using a multi-criteria scheme.

[5] Each dimension has been individually scored by stakeholders (from 1 to 100); each of these scores was transformed into relative values dividing it by the sum of scores assigned by each stakeholder. A mean score was then computed across these relative values for each dimension.

[6] See Appendix B for more detailed results of the SDA.

Tab. 5 – Stakeholders evaluations of objectives of sustainable urban mobility policies (SUMPs)

OBJECTIVES OF SUMPs	Average score[a]	Ranking
Easing non-motorized mobility	4.00	1
Easing public transport	4.00	1
Reducing land consumption generated by mobility	3.63	3
Reducing public space occupied by motorized vehicles	3.05	4
Increasing transport safety	2.89	5
Reducing air pollutants generated by mobility	2.88	6
Reducing greenhouse-gasses generated by mobility	2.88	6
Increasing the alternatives to mobility	2.87	8
Reducing noise generated by mobility	2.14	9
Reducing waste generated by mobility	2.12	10
Easing private motorized mobility	1.26	11
Reducing public mobility costs	0.62	12
Reducing private mobility costs	0.62	12

[a] Stakeholders directly used quantitative scores (1=useful, but non urgent; 2=relevant, but not a priority; 4=a priority).

2.4. Step 3: A selection of performance indicators of sustainable urban mobility policies

Citizens' and stakeholders' evaluations on objectives of SUMPs have been used to select the most relevant indicators of SUMPs among those resulting from the first step of the procedure (see table 2). The two selection criteria we used are very simple: 1) the higher the position of an objective in the ranking, the higher the relevance of the indicator associated with that objective; 2) a threshold score is arbitrarily set to cut off the less relevant indicators of SUMPs. It must be stressed that using a

threshold score is more correct than selecting the first X indicators: only in the first case, both which and how many indicators are selected depends on the evaluations of citizens and stakeholders[7]. Moreover, the threshold score can be lowered (raised) if more (less) resources are available to finance the data collection and processing needed to use the selected indicators of SUMPs. Obviously, there is no objective rule to set the threshold value, but the higher the difference between the score of the last of the selected indicators and the score of the first of the non-selected indicators, the lower the arbitrariness of the choice.

Tables 6 and 7 shows how these two criteria were applied respectively to citizens' and stakeholders' evaluations; a threshold score of 3.00 was applied in both cases. The five indicators selected on the basis of citizens' evaluation cover all dimensions of SUMPs, only the dimension of liveability is measured by two performance indicators (air pollutants and accidents); the first indicator not selected (noise) refers to the liveability dimensions of SUMPs too. Only four indicators came out of stakeholders' evaluation: two of them are associated with the dimension of accessibility and none refers to the economic dimension of SUMPs. Four indicators are cut off from both lists: congestion, services accessible via telephone or computer, households expenditure for public transport and noise. Surprisingly – and unfortunately – the two selections of indicators are perfectly complementary: no indicator of SUMPs appears in both lists.

[7] For example, using the evaluations of citizens living in larger cities, relevant changes can be found not only in the ranking of objectives of SUMPs, but also in their absolute scores; the number of indicators over the threshold score 3 grows from five (that is the number of indicators based on the evaluations of the full sample of citizens) to seven.

Tab. 6 – Selection of indicators of sustainable urban mobility policies (SUMPs) based on citizens' evaluations of objectives of SUMPs (threshold score = 3.00)

OBJECTIVES OF SUMPs	**Average score**	**Ranking**	**SELECTED PERFORMANCE INDICATORS OF SUMPs**
Reducing greenhouse-gasses generated by mobility	3.33	1°	CO_2 from transport
Reducing private mobility costs	3.28	2°	Households expenditures for private transport
Reducing air pollutants generated by mobility	3.20	3°	Main air pollutants from transport: PM_{10}, COVNM, NO_X, CO
Increasing transport safety	3.09	4°	Deaths and injuries from traffic accidents
Reducing waste generated by mobility	3.04	5°	Waste from transport
First of the performance indicator of SUMPs not selected			
Reducing noise generated by mobility	2.79	6°	% of population exposed to harmful noise

Tab. 7 – Selection of indicators of sustainable urban mobility policies (SUMPs) based on stakeholders' evaluations of objectives of SUMPs (threshold score = 3)

OBJECTIVES OF SUMPs	**Weighted average score**	**Ranking**	**SELECTED PERFORMANCE INDICATORS OF SUMPs**
Easing non-motorized mobility	4.00	1°	Walkability and "cyclabilty"
Easing public transport	4.00	2°	Quantity and quality of public transport
Reducing land consumption generated by mobility	3.63	3°	Land occupied by transport infrastructure

Reducing public space occupied by motorized vehicles	3.05	4°	Vehicles- and vehicles*km per km^2
First of the performance indicator of SUMPs not selected			
Increasing transport safety	2.89	5°	Deaths and injuries from traffic accidents

3. Conclusions and further research

Our research will be continued with the aim of verifying the replicability of such a procedure in specific urban areas; but, before starting these local tests, we think that a better methodological specification of the procedure is needed to avoid some inconsistencies that emerged from its first implementation.

First of all, we need to be more confident about how citizens understand all questions that are asked in the sample survey: preparatory focus groups of citizens should be helpful in finding a comprehensible shared terminology. These focus groups could also help experts to check if the initial conceptual framework of dimensions, objectives and indicators, covers in an appropriate way all relevant issues connected to the sustainability of urban mobility (and this last point is even more crucial when the proposed procedure is to be applied in a specific urban area).

Then, we should ensure that the procedure generates a serviceable result even when the evaluations of citizens and stakeholders differ radically. Even if this is an issue that needs a deeper understanding, we think that assigning a greater importance to citizen opinions could be the solution. Stakeholders should know the evaluations of citizens before starting their "dialogue"[8] or – limiting even more the influence of their opinions – they should base the multi-criteria analysis on weights coming out of the sample survey. Moreover, citizens should have "the last world" about the selection of indicators: a final "joint workshop" (Davies et al., 2003), involving citizens and experts, could close the participated procedure by generating unequivocal results.

As a result of this modification, the participative procedure to select performance indicators of sustainable urban mobility policies should be

[8] It must be said that this simple "rule of consistency" should have been used in the procedure that we tested. But this was not possible because the results of the national survey were not available when the stakeholders dialogue analysis started. And this delay was in turn due to the repetition of some questions of the national survey that needed a better specification.

more articulated, and the interaction between experts and citizens should be strengthened (see table 8).

Tab. 8 – A participated procedure to select performance indicators of sustainable urban mobility policies (SUMPs): the revised version (*added steps in italics*)

STEP	WHO	HOW	RESULTS
1	Experts	Literature review Closed workshops	Conceptual framework based on dimensions, objectives and performance indicators of SUMPs (first version)
2	*Citizens*	*Focus group*	*Shared terminology* *Changes and additions to the first version of the conceptual framework*
3	*Experts*	*Analysis of results of Step 2*	*Conceptual framework based on dimensions, objectives and performance indicators of SUMPs (second version)*
4a	Citizens	National sample survey	Appraisal dimensions and objectives of SUMPs
4b	Stakeholders	Stakeholder dialogue analysis	
5	*Experts*	*Analysis of results of Step 4*	*Sensitivity analysis*
6	*Experts* *Citizens*	*Joint workshop*	*Deliberation on the results of Step 4* *Selection of indicators of SUMPs*

Appendix A
Stakeholders participating to the "Stakeholders dialogue analysis" on sustainable urban mobility policies (SUMPs)

Stakeholder	**Representing**
Institutions	
ANCI	Municipalities
Federmobilità	Local transport authorities
Ministry of the Environment	National Government
Associations	
ANAV	Privately owned public transport companies
ANFIA	Producers of motor vehicles
ASSTRA	Publicly owned public transport companies
Comitati dei pendolari	Commuters
FIAB	Bikers
FIT-CISL	Transport workers
Legambiente	Environmentalists
ORSA	Transport workers
UIL-Trasporti	Transport workers
Political parties	
Partito democratrico	Center-left voters

Appendix B

Stakeholders evaluations of objectives of sustainable urban mobility policies (SUMPs): detailed results

OBJECTIVES OF SUMPs	**DIMENSIONS OF SUMPs (weights)**				**Weighted average score**	**Ranking**
	Accessibility (0.248)	Liveability (0.287)	Environmental sustainability (0.278)	Economic sustainability (0.187)		
	Scores[a]					
Easing non-motorized mobility	4	4	4	4	4.00	1
Easing public transport	4	4	4	4	4.00	1
Reducing land consumption generated by mobility	4	4	4	2	3.63	3
Reducing public space occupied by motorized vehicles	4	2	4	2	3.05	4
Increasing transport safety	4	4	0	4	2.89	5
Reducing air pollutants generated by mobility	1	4	4	2	2.88	6

Reducing greenhouse-gasses generated by mobility	1	4	4	2	2.88	6
Increasing the alternatives to mobility	4	2	2	4	2.87	8
Reducing noise generated by mobility	1	4	2	1	2.14	9
Reducing waste generated by mobility	1	2	4	1	2.12	10
Easing private motorized mobility	2	2	0	1	1.26	11
Reducing public mobility costs	1	0	0	2	0.62	12
Reducing private mobility costs	1	0	0	2	0.62	12

[a] Stakeholders directly used quantitative scores (1=useful, but non urgent; 2=relevant, but not a priority; 4=a priority).

Acknowledgements
The research presented here was promoted and funded by Isfort, an Italian private research body specializing in the transport sector (http://www.isfort.it/). The research was partially co-funded by the University of Sassari (Italy). Authors thank Eleonora Pieralice of Isfort for data processing.

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Finito di stampare nel mese di Luglio 2009
Presso **studiografico&stampadigitale Copy Right**
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07100 Sassari

www.crenos.it

ISBN 978-88-8467-529-3