A participative procedure to select indicators of policies for sustainable urban mobility. Outcomes of a national test.

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Abstract

This paper advocates the use of a participative procedure to select a core set of performance indicators of policies for sustainable urban mobility. Citizen participation and stakeholder involvement are obtained through a national sample survey and a deliberative multi-criteria analysis, respectively. This procedure is applied to the Italian case, showing that the core set of indicators based on citizen evaluations 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. Results are highly sensitive to the threshold chosen for the selection. Using a lower cut-off threshold, four performance indicators are shared between the two sets: 'CO2 from transport', 'Quantity and quality of public transport', 'PMx, COVNM, NOx, CO from transport', 'Death and injuries from traffic accidents'; using a higher cut-off threshold the two sets feature no intersection. Further testing at a local scale is needed in order to explicitly consider context-specific issues; stronger interactions among experts, citizens and stakeholders are needed in order to avoid the generation of equivocal results.

Keywords: Participation; Urban mobility; Sustainability indicators; National survey

1 Introduction

Sustainable urban mobility is a well established environmental issue, not only in local plans, but also in international guidelines [1-4] and national legislations: this is the case of, among others, the French and Italian laws on Urban Mobility Plans, and 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 list[1].

Policies for Sustainable Urban Mobility (PSUM) 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 and multi-criteria analysis) are best suited for the purpose [5]. The second basic characteristic common to all environmental policies (and – among others – by PSUM) is the presence of strong uncertainty: the probabilities of future changes are not known ex-ante, nor is the set of possible changes. In these cases individuals and society feature bounded rationality [6]; hence policies can no longer be based on neutral values

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

and given preferences, and they must make room for deliberation and learning. As argued by Vatn [7, p. 2211] "We move from *aggregating* individual measures or bids to reasoning over, and potentially *agreeing* on common priorities". All these considerations led to the diffusion of participative procedures to establish environmental policies, which usually consist of a deliberation arena to involve citizens and stakeholders, combined with a structuring technique (usually a simplified multi-criteria) to achieve two equally important goals: easing mutual understanding and reaching final recommendations [8].

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 with specific reference to sustainable transport [9-11]. More specific calls for the integration of stakeholders into multi-criteria procedures in the context of policies for sustainable transport were recently added to the debate; as clearly stated in the research report of the COST Action 356 "(...) the largest potential for MCDA [Multi-Criteria Decision Analysis] in decision making on sustainable development appears to lie in a combination of MCDA algorithms with participatory techniques and in their better integration into specific transport decision making contexts." [12, p. 271].

The research we present here shares these theoretical and practical concerns and builds a participative procedure to select performance indicators for PSUM[2]. Such a procedure was implemented at a national scale, involving Italian experts, citizens and stakeholders.

The paper is structured as follows. In Section 2 the methodology of the participative procedure is analysed. Outcomes of the procedure are shown and discussed in Sections 4 and 5, respectively. The last section concludes.

2 The participative procedure: methodology

Table 1 shows the structure of the proposed procedure, which integrates top-down (expert-led) steps and bottom-up (participated) steps [14]. In Step 1, starting from a framework based on the dimensions of urban sustainability and the objectives of PSUM, we selected a first set of performance indicators. In Step 2 this framework was evaluated by citizens and by stakeholders: citizens' opinion about dimensions and objectives were collected through a national survey (Step 2a); stakeholders were involved in a "stakeholder dialogue analysis" – i.e. a participated multi-criteria analysis – in which the dimensions were used as assessment criteria and the objectives as issues to be evaluated (Step 2b). In Step 3, the results of Step 2 were used to rank the initial set of PSUM performance indicators and to select the

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http://urbanindia.nic.in/.

[2] Performance (or effectiveness) indicators are distinguished from monitoring (or status) indicators [13].

most relevant among them.

Tab. 1 – A participative procedure to select performance indicators of policies for sustainable urban mobility (PSUM)

STEP	WHO	HOW	RESULTS
1	Experts	Literature review Workshops and seminars	Conceptual framework of PSUM
2a	Citizens	National sample survey	Appraisal of dimensions and objectives of PSUM
2b	Stakeholders	Stakeholder dialogue analysis	
3	Experts	Analysis of results of Step 2	Sensitivity analysis Selection of performance indicators of PSUM

2.1 Step 1: A conceptual framework

In the first step of the procedure we further developed a framework which was already used by Isfort[3] as a conceptual tool to select performance indicators of PSUM [15], and which was based on the dimensions of urban sustainability and the objectives of PSUM. The resulting conceptual framework follows the Thematic Indicator Development [16], 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 [17].

Starting from a literature survey on indicators [18][4] and some workshops and seminars with experts, the three standard dimensions of social, environmental and economic sustainability were articulated into thirteen PSUM objectives, each of which was linked to one (single or composite) performance indicator (see table 2). The social dimension of sustainability was split in two sub-dimensions: accessibility and liveability. Accessibility was then broken down into four objectives, considering that it depends on more than just transport factors, and that it can be operationalized in several ways [19]. The first objective 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 how urban liveability is affected by some negative effects of urban mobility: the erosion of public space caused by parked and circulating motorized vehicles, the generation of noise and air pollution, traffic accidents. The environmental dimension of sustainability was translated into three more standard objectives of PSUM: reducing greenhouse-gasses, waste and land consumption generated by mobility. Finally, the economic dimension of urban sustainability is pursued by reducing public and private transport costs. This top-down approach generated a core set of PSUM indicators that meets two of the main criteria of indicator selection: exhaustiveness (every objective of PSUM has its specific indicator) and efficiency (no redundant indicator is considered). Though every indicator of the set is derived from a single objective, some indicators have implications for multiple objectives

[3] For more information about Isfort, see below the section on acknowledgements.
[4] For a synthesis of the review, see Appendix A.

and most of them have implications for multiple dimensions. It must be stressed that the detailed and operational specification of the indicators goes beyond the objectives of the present study; this is why some indicators are only broadly defined.

Tab. 2 – A conceptual framework of policies for sustainable urban mobility (PSUM)

DIMENSIONS OF URBAN SUSTAINABILITY		PSUM OBJECTIVES	PSUM PERFORMANCE INDICATORS
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_X, 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 mobility costs: public transport	Household expenditures for public transport
		Reducing mobility costs: private transport	Household expenditures for private transport

2.2 Step 2a: the national sample survey

Through the quarterly Isfort's "Audimob" national survey on passenger mobility, a representative sample of the Italian population was asked to evaluate both the generic four dimensions of urban sustainability and the above list of thirteen specific objectives. The sample was composed of 3'600 people, reproducing the main structural features of the Italian population aged 14-80 years: sex, age, professional status, region and size of the municipality of residence. The national survey employed the CATI (Computer Assisted Telephone Interviewing) technique, this is why respondents were not directly asked to rank the whole set of objectives and sustainability dimensions, nor were they asked to react to questions based on a Likert scale (both are difficult tasks for a phone interview), but they had to prioritize the importance of dimensions and objectives according to the following qualitative scale: 'Priority'; 'Important but not priority'; 'Useful but not urgent'. In order to avoid any averaging or aggregation of qualitative answers, only the percentage of respondents who rated a given dimension/objective as a "priority" was used to rank citizens' opinion.

2.3 Step 2b: the "stakeholder dialogue analysis"

The "stakeholder dialogue analysis" is a participative multi-criteria technique that is successfully used to assist stakeholders in discussing a general political issue and in reaching a common position on it [20].

Because of budget constraints, we opted for a simplified "dialogue"[5] 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.[6] Then, we asked (by e-mail or by fax) their representatives to individually weight the dimensions of urban sustainability mentioned above. Finally, we invited all stakeholders to attend a one-day meeting during which a multi-criteria scheme was used to rank the objectives of PSUM. Two sub-groups were created to collectively score all PSUM objectives against one dimension of urban sustainability at a time; stakeholders used the following scores: 1=useful, but non urgent; 2=relevant, but not a priority; 4=a priority. These evaluations generated four scores for each objective of PSUM, which were then aggregated by using the average weights assigned by stakeholders. Two sensitivity tests were carried out to check the robustness of the results of the "dialogue": in the first one, weighted average scores were calculated using the weights derived from the national survey; in the second test we lowered the magnitude of the highest scores from 4 to 3. In both cases we did not register any change in the final ranking of PSUM objectives.

2.4 Step 3: Selection of performance indicators

Citizens' and stakeholders' evaluations on objectives of PSUM have been used to select the most relevant PSUM indicators among those ensuing from the first step of the procedure. 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 value is arbitrarily set to cut off the less relevant indicators of PSUM. It must be stressed that using a cut-off threshold value is more correct than selecting the first X indicators: only in the first case the evaluations of citizens and stakeholders determine which and how many indicators are selected[7]. Moreover, the threshold value can be lowered (raised) if more (less) resources are available to finance the data collection and processing activities needed to use the selected PSUM indicators. Obviously, there is no objective rule to set the

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[5] A standard stakeholder dialogue analysis consists of four meetings aimed at setting and using a multi-criteria scheme.

[6] For the detailed list of participating stakeholders, see Appendix B.

[7] For example, using the evaluations of citizens living in small and medium cities, relevant changes can be found not only in the ranking of objectives of PSUM, but also in the number of selected indicators. See below, paragraph 3.3.

threshold value, but the higher the difference between the value of the last of the selected indicators and the value of the first of the non-selected indicators, the lower the arbitrariness of the choice.

3 The participative procedure: results

3.1 Citizens' opinion

The following paragraphs describe the results of the national survey for the whole sample, according to the size of cities where citizens live and to their preferred mode of transport. Data were also analysed with reference to other demographic and social variables (sex, age, region of residence, education, profession, etc.), but those results were not significantly different from those emerging from the whole sample.

3.1.1 Results for the whole sample

According to citizens' opinion, environmental sustainability and liveability are the most relevant issues (see tables 3-4): reducing greenhouse-gasses, air pollutants, waste and accidents from transport are considered as priority by more than 58% of respondents. The objectives related to the dimension of accessibility rank low (see table 4), except for the objective of easing public transport (that ranks 6th). 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 transport costs, respectively.

Tab. 3 – Citizens' opinion towards the dimensions of urban sustainability

DIMENSIONS OF URBAN SUSTAINABILITY	Considered as a priority (%)	Ranking
Environmental sustainability	53.1	1
Social sustainability: liveability	50.0	2
Economic sustainability	48.4	3
Social sustainability: accessibility	40.0	4

Tab. 4 – Citizens' opinion towards the objectives of policies for sustainable urban mobility (PSUM)

PSUM OBJECTIVES	Considered as a priority (%)	Ranking
Reducing greenhouse-gasses generated by mobility	71.0	1
Reducing private transport costs	69.5	2
Reducing air pollutants generated by mobility	65.9	3
Increasing transport safety	61.7	4
Reducing waste generated by mobility	58.8	5
Easing public transport	49.9	6

Reducing noise generated by mobility	49.5	7
Reducing public transport costs	48.1	8
Reducing land consumption generated by mobility	45.0	9
Easing non-motorized mobility	39.2	10
Reducing public space occupied by motorized vehicles	36.8	11
Easing private motorized mobility	33.7	12
Increasing the alternatives to mobility	30.6	13

3.1.2 Results by urban scale

The most striking difference in the opinion recorded from citizens living in cities of different size (see table 5) is the share of respondents who consider a given issue to be the most relevant: the percentage of population considering an objective of PSUM as the most relevant is 78.7 in big cities, 75.5 in metropolitan belts, 71.6 in medium cities and 70.8 in small cities. Moreover, for two important objectives the ranking is correlated to urban size: easing public transport ranks 4th according to the opinion of citizens living in big cities, while it ranks 7th in medium cities and metropolitan belts, and 9th in small cities; reducing air pollutants ranks 1st in big cities, 2nd in metropolitan belts, 3rd in medium cities and 4th in small cities. Instead, the relevance of the issue of transport cost is inversely correlated to urban size: the objectives of reducing private and public transport rank 1st and 6th in small cities, and 5th and 9th in big cities, respectively.

Tab. 5 – Citizens' opinion towards the objectives of policies for sustainable urban mobility (PSUM) by urban scale

PSUM OBJECTIVES	Urban scale							
	Small cities		Medium cities		Big cities		Metropolitan belt[a]	
	%[b]	Ranking	%[b]	Ranking	%[b]	Ranking	%[b]	Ranking
Increasing the alternatives to mobility	30.7	13	30.1	13	29.5	13	32.3	13
Easing non-motorized mobility	39.6	10	42.4	10	37.2	12	36.2	11
Easing private motorized transportation	31.3	12	32.5	12	39.9	11	35.4	12
Easing public transport	43.5	9	47.0	7	65.7	4	55.7	7
Reducing public space occupied by motorized vehicles	34.4	11	38.4	11	40.9	10	38.5	10
Reducing noise generated by mobility	44.1	8	47.2	6	60.3	7	57.2	6

Reducing air pollutants generated by mobility	59.6	4	66.1	3	78.7	1	70.9	2
Increasing transport safety	60.3	3	58.8	4	66.4	3	64.2	4
Reducing greenhouse-gasses generated by mobility	68.4	2	71.6	1	74.9	2	75.5	1
Reducing waste generated by mobility	57.1	5	58.7	5	62.2	6	60.6	5
Reducing land consumption generated by mobility	45.0	7	43.7	8	45.3	8	45.9	9
Reducing public transport costs	50.4	6	43.2	9	45.2	9	49.1	8
Reducing private transport costs	70.8	1	70.2	2	65.5	5	69.2	3

[a] Municipalities of various dimension belonging to the same local labour system of big cities
[b] Considered as a priority

3.1.3 Results by transport mode

When considering the opinion of different user groups, the percentages behind the most relevant issue again strike as the most obvious difference (see table 6): reducing green-house gasses is the most important objective for 83.6% of users of public transportation and for 80% of cyclists, whilst reducing private transport cost is the most important objective for only 74.4% of car users. Another relevant difference concerns the issue of accessibility: easing non-motorised mobility ranks 2nd for cyclists (9th and 10th for public transport and car users, respectively); easing public transport ranks 2nd for public transport users (6th and 10th for car users and cyclists, respectively); unexpectedly, easing private transport stays at the bottom of the ranking for all user groups. Moreover, public transport users are more sensitive to the issue of reducing noise.

Tab. 6 – Citizens' opinion towards the objectives of policies for sustainable urban mobility (PSUM) by transport mode

	Transport mode[a]					
	Car		Bus, tram, tube		Bicycle	
PSUM OBJECTIVES	%[b]	Ranking	%[b]	Ranking	%[b]	Ranking
Increasing the alternatives to mobility	33.8	13	28.8	12	25.0	12
Easing non-motorized mobility	39.8	10	46.3	9	77.8	2
Easing private motorized transportation	35.3	12	27.3	13	18.8	13
Easing public transport	52.4	6	79.7	2	47.4	10
Reducing public space occupied by	38.1	11	36.9	11	41.8	11

motorized vehicles						
Reducing noise generated by mobility	46.5	8	67.2	4	54.5	7
Reducing air pollutants generated by mobility	64.2	3	76.8	3	74.6	3
Increasing transport safety	62.2	4	60.9	7	58.3	6
Reducing greenhouse-gasses generated by mobility	71.4	2	83.6	1	80.0	1
Reducing waste generated by mobility	59.9	5	63.2	5	58.6	5
Reducing land consumption generated by mobility	44.2	9	47.7	8	49.3	8
Reducing public transport costs	51.4	7	39.3	10	47.8	9
Reducing private transport costs	74.4	1	62.7	6	64.3	4

[a] Used more than twice a day
[b] Considered as a priority

3.2 Stakeholders' appraisal

Easing non motorized mobility and public transport are the two objectives of PSUM that achieved the maximum weighted score among stakeholders (see table 7). Because of both low weights and very low scores, the two objectives of reducing private and public transport costs lie on the opposite side of the rankings. 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 PSUM.[8]

Tab. 7 – Stakeholders' appraisal of the objectives of policies for sustainable urban mobility (PSUM)

PSUM OBJECTIVES	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 transport costs	0.62	12

[8] See Appendix C for detailed results.

Reducing private transport costs	0.62	12

a 1=useful, but non urgent; 2=relevant, but not a priority; 4=a priority).

3.3 The selection of indicators

In order to select PSUM performance indicators, a threshold % of 48 was applied to citizens' opinion and a threshold score of 2.85 was applied to stakeholders' appraisal.

The eight indicators selected on the basis of citizens' opinion cover all dimensions of urban sustainability, of these three refer to the dimension of liveability (air pollutants, accidents and noise) and only one (public transport) refers to the dimension of accessibility (see table 8). Land consumption is the highest ranking indicator not selected by citizens. It must be noted that three more indicators would be cut off if we used a slightly higher threshold (50% instead of 48%).

If one consider the segmentation of citizens' opinion by urban scale and transport mode, the selection of indicators features some differences: only residents in big cities and users of public transport selected the same eight indicators as the whole sample, whilst a subset of indicators is sufficient for car users and citizens living in other urban areas (only five indicators are selected in medium cities). Cyclists added two indicators to the list (walkability and "cyclability", and land consumption) and cut the public transport indicator off.[9]

Tab. 8 – Selection of performance indicators according to citizens' opinion. Threshold: % = 48

PSUM OBJECTIVES	Considered as a priority (%)	Ranking	SELECTED PERFORMANCE INDICATORS OF PSUM
Reducing greenhouse-gasses generated by mobility	71.0	1°	COx from transport
Reducing private transport costs	69.5	2°	Households expenditures for private transport
Reducing air pollutants generated by mobility	65.9	3°	Main air pollutants from transport: PMx COVNM, NOx, CO
Increasing transport safety	61.7	4°	Deaths and injuries from traffic accidents
Reducing waste generated by mobility	58.8	5°	Waste from transport
Easing public transport	49.9	6°	Quantity and quality of public transport
Reducing noise generated by mobility	49.5	7°	% of population exposed to harmful noise
Reducing public transport costs	48.1	8°	Households expenditures for public transport
			First non selected performance indicator of PSUM
Reducing land consumption	45.0	9°	Land occupied by transport infrastructure

[9] See tables in Appendix D for detailed results of the selection of indicators by urban scale and transport mode.

generated by mobility			

Eight indicators came out of stakeholders' evaluation too (see table 9), but none of them refers to the economic dimension of urban sustainability. Three indicators of accessibility were selected, two of which (easing public and non-motorised transport) reached the maximum score. Noise ranks first among the indicators not selected by stakeholders.

The number of selected indicators is halved if one uses a slightly higher threshold (3.0 instead of 2.8).

Tab. 9 – Selection of performance indicators according to stakeholders' appraisal. Threshold: score = 2.85

OBJECTIVES OF PSUM	Weighted average score	Ranking	SELECTED PERFORMANCE INDICATORS OF PSUM
Easing non-motorized mobility	4.00	1°	Walkability and "cyclabilty"
Easing public transport	4.00	1°	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
Increasing transport safety	2.89	5°	Deaths and injuries from traffic accidents
Reducing air pollutants generated by mobility	2.88	6°	Main air pollutants from transport: PMx, COVNM, Nox, CO
Reducing greenhouse-gasses generated by mobility	2.88	6°	CO2 from transport
Increasing the alternatives to mobility	2.87	8°	Public and private services accessible via telephone and computer
			First of the non selected performance indicator of PSUM
Reducing noise generated by mobility	2.14	9°	% of population exposed to harmful noise

4 Discussion

4.1 Contribution to the relevant literature

The methodology we implemented to select PSUM indicators is based on two main tools: 1) a conceptual framework of dimensions and objectives of PSUM, which is used to select a first core set of performance indicators; 2) the participation of citizens and stakeholders, in order to rank the selected indicators and – depending on the available resources – cut off the less relevant ones. The used methodology explicitly refers to the theoretical and practical work of two research groups, led by Mark Reed and Jacquelin Burgess, respectively [14, 20].

As far as we know, no reference can be found in the literature to the application of such an integrated methodology to

the issue of sustainable urban mobility: many studies explicitly consider the dimensions of environmental, social and economic sustainability, some of them refer to objectives of policies for sustainable transport, but only two [21, 22] are based on the participation of stakeholders (and not of citizens) in order to select a limited number of indicators from a much longer initial list.[10]

We may then conclude that the main contribution of this study to the relevant literature is the integration of the participation of both citizens and stakeholders into the selection of PSUM indicators. The remaining part of this section discusses separately the three steps of the implemented procedure and its results.

4.2 Discussion of step 1 (a conceptual framework)

Though the definition of the initial conceptual framework is not the objective of our research (nor its added value), it must be emphasized that the starting reference to an already partially developed framework constitutes the main limitation of this study. We integrated the first version of the framework on the basis of a review of the relevant literature and meetings with other experts, but we remain aware that it needs further improvement. Inter alia: the objectives of urban density and social inclusion should be explicitly considered; all indicators – especially in the case of practical applications – should be better specified in order to check the availability of data and associate quantitative targets to objectives. At the same time, we remain convinced of our choice of referring to generic objectives and not to specific actions; otherwise the acceptability of a policy, instead of its relevance, is likely to be assessed.

4.3 Discussion of step 2 (ranking of PSUM objectives)

First of all, it must be said that we had to repeat the national survey after interviewers reported that respondents found some questions hard to understand. This is why we needed to clarify, for example, the difference between greenhouse gasses and local air pollutants, and between land consumption and the occupation of urban space; moreover, we had to add some practical examples to explain what we meant by 'waste generated by mobility'.

There is one striking result emerging from the national survey: the objective of 'reducing private transport costs' ranks 2nd, which seems not so much consistent with the other high ranking objectives ('reducing greenhouse gases', 'reducing air pollutants', 'increasing safety', etc.). Actually, one should consider that most citizens are car drivers, who aspire at a more sustainable urban environment and – at the same time – are budget conscious; such an interpretation is confirmed by data segmentation: the need of reducing private costs ranks 5th in big cities (were the % of car drivers is

[10] See again Appendix A for more details.

lower) and 6th for public transport users. In more general terms, the analysis of the results of the national survey by urban size and transport mode clearly shows that opinions on objectives of PSUM strongly depend on the size of the city where citizens live and on their actual mobility behaviour. This implies that average national data are not very useful, while segmented national data could be a good reference for practical implementations[11].

Stakeholders' appraisal was more consistent: the objectives of easing private mobility and reducing its costs have been positioned at the bottom of the ranking; moreover, stakeholders did not explicitly refer to specific situations (even if one should suppose they generally refer to metropolitan contexts). Most important, though stakeholders were assigned the burdensome task of carrying out fifty-two assessments (thirteen objectives against four criteria), deliberation was easier than expected: the assignment of reaching shared evaluations pushed the mutual understanding between involved parties and the arrangement of all interests at stake. During the "dialogue", stakeholders acted as experts too; that is, they suggested some integrations to the proposed framework: in particular they asked for the explicit consideration of the issue of density[12] and a greater articulation of the dimension of economic sustainability.

4.4 Discussion of step 3 (selection of PSUM indicators)

The two selections of PSUM indicators – based on citizens' opinion and stakeholders' appraisal, respectively – depend on the level of the thresholds which are used to cut off the less relevant indicators (see table 10). When higher thresholds are used, only four performance indicators are shared between the two resulting sets: 'CO2 from transport', 'Quantity and quality of public transport', 'PMx, COVNM, NOx, CO from transport', 'Deaths and injuries from traffic accidents' (and only one indicator is cut off from both lists: 'congestion'). When a lower threshold is used, the two sets show no intersection. There is no immediate explanation for the divergence between the two selections. We can only stress one relevant difference in the composition of the selecting groups: on one side, car users are almost 85% of the sample, which implies that their opinion strongly influences the results of the national survey; on the other side, only one stakeholder (out of thirteen) directly represented the interests related to the car.

It must be said that we had planned for stakeholders to know the evaluations of citizens before starting their "dialogue", with the purpose of reducing the risk of generating equivocal results, but this was not possible because the results of the national survey were not available when the stakeholder dialogue started (a delay caused by the already

[11] We are now applying the procedure to the case of Rome and we already acknowledged that there is little difference between the results of the local survey and those emerging from the national segment of big cities.

[12] The objective of reducing land consumption ranks 3rd mainly because it was chosen by stakeholders as a proxy of the objective of increasing urban density.

mentioned repetition of the national survey).

Tab. 10 – Selection of indicators according to stakeholders' appraisal and citizens' opinion and with different thresholds

SELECTED PERFORMANCE INDICATORS OF PSUM	Lower threshold		Higher threshold	
	By stakeholders	By citizens	By stakeholders	By citizens
Walkability and "cyclabilty"	X		X	
Quantity and quality of public transport	X	X	X	
Land occupied by transport infrastructure	X		X	
Vehicles- and vehicles*km per km^2	X		X	
Deaths and injuries from traffic accidents	X	X		X
Main air pollutants from transport: PM_X, COVNM, NO_X, CO	X	X		X
CO_2 from transport	X	X		X
Public and private services accessible via telephone and computer	X			
Households expenditures for private transport		X		X
Waste from transport		X		X
% of population exposed to harmful noise		X		
Households expenditures for public transport		X		

5 Conclusions and further research

In the research project presented here, the direct participation of citizens and stakeholders was used in order to manage the high level of uncertainty and incommensurability featured by environmental issues. A national survey and a "stakeholder dialogue analysis" (based on a multi-criteria technique) were integrated into an original procedure aimed at selecting a core set of performance indicators of policies for sustainable urban transport. The procedure proved valid in showing that citizens' opinion is context- and behaviour-specific, and generates a selection of indicators which diverges from that emerging from stakeholders' appraisal.

Most insights which result from this first national test stress the need of more widely shared basic concepts and less equivocal results, thus asking for a closer interaction between experts, citizens and stakeholders and for a more context-based approach. This is why a more articulated procedure is now proposed for future testing at a local scale (see table 11).

First of all, a new 'step 2' is added at the beginning of the procedure to check if the starting conceptual framework is exhaustive and widely shared, that is, if it covers all relevant issues connected to the sustainability of urban mobility, especially those which are context-specific. This new step would also be helpful for finding a widely understood terminology to be used in the national survey. Then, a new 'step 3' should help in making the basic framework more operational: a specific indicator should be associated to every objective, and data should be provided about its current

status and realistic target. Finally, it must be ensured that the procedure is able to effectively manage the evaluations of citizens and stakeholders, even when they are divergent. Though this is an issue that needs deeper understanding, we think that assigning greater importance to citizens' opinion could be a solution. Stakeholders should know the evaluations of citizens before starting their meetings or – limiting even more the influence of their opinions – they should base the multi-criteria analysis on the weights obtained with the national survey. Moreover, citizens may have "the last word" about the selection of indicators: a final "joint workshop" [23], involving citizens and experts, could close the participative procedure with the ambitious goal of generating serviceable results.

Tab. 11 – A participative procedure to select performance indicators of sustainable urban mobility policies (PSUM): the revised version (added steps in italics)

STEP	WHO	HOW	RESULTS
1	Experts	Literature review Workshops and seminars	Conceptual framework (first version): dimensions, objectives and generic indicators
2a	*Citizens*	*Focus groups*	*Amendments to the first version of the conceptual framework*
2b	*Stakeholders*	*Stakeholder dialogue analysis (preliminary meeting)*	
3	*Experts*	*Analysis of results of Step 2*	*Conceptual framework (second version): dimensions, objectives, specific indicators and targets*
4a	Citizens	National sample survey	Appraisal of the dimensions and objectives of PSUM
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 PSUM*

Appendix A

Comparison between studies on transport indicators: synthesis of the literature review (1/2)

Ref.	Focus	Scale	Key transport-related indices/ indicators			Brief description
			Number	Sustainability dimensions/categories		
				Explicitly considered	Mostly represented	
[21]	Sustainable urban transport	Urban	52	Accessibility, economic, environment, health, safety, governance	Transport	The study is aimed at selecting a limited number of indicators which may fulfil stakeholders' expectations of a sustainable urban transport system.
[22]	Sustainable transport	Regional	15	Transport, social, environmental, economic	Mobility	A stakeholder survey based on a multi-criteria technique is used to select the 15 best performing sustainable transport indicators out of an initial long list of 233
[24]	Sustainable transport	National	40[a]	Transport, environmental	Environmental	Indicator-based yearly reporting mechanism which monitors the integration and effectiveness of transport and environment strategies in the EU.
[25]	Sustainable urban transport	Urban	47	Economic, social, environmental, transport activity.	Environmental	Reviews the adequacy/deficiency of transport planning in Lahore (Pakistan) and recommends some measures for developing a more sustainable urban transport system.
[26]	Sustainable urban mobility	Urban	19	Economic, Social, Environmental, mobility	Economic, mobility	Develops a set of indicators for measuring the sustainability of Lyon's urban travel system (estimations are mainly based on households' travel survey data).
[27]	Sustainable urban transport	Urban	35	Economic, social, environmental	Social	Integrated approach based on land-use transport models, spatial disaggregation of the data, economic/social evaluations, and multi-criteria analysis.
[28]	Sustainable urban transport	Urban	1	Mobility	Mobility	Evaluates the sustainability of the transportation system in San Antonio (Texas) using 'vehicle travel miles' as a key indicator.

[a] Not all indicators are published every year

Comparison between studies on transport indicators: synthesis of the literature review (2/2)

[29]	Sustainable urban mobility	Urban	24	Transportation and environment, mobility management, Infrastructure and transportation technologies, Spatial planning and transportation demand, Socio-economic	Environmental	Employing multi-criteria analysis, this study identifies a set of indicators (and their relative importance) suitable for monitoring the urban mobility conditions of selected cities in Brazil and Portugal.
[30]	Sustainable transport	National	1 index	Transport modes, social, environmental, economic	Transport and non-transport	The sustainability index results from a two-steps aggregation of composite and individual indicators. All indicators are elasticities between non-transportation and transportation variables.
[31]	Sustainable urban mobility	Urban	8 (1 index)	Mobility	Mobility	With the aim of monitoring mobility conditions in medium-sized cities, this study develops a so called "Sample Mobility Index" (composed of indicators related to walking, vehicle-use and cycling).
[32]	Sustainable urban transport	Urban	4	-	-	Suggests a methodology for quantifying land-use/urban-form based indicators based on remote-sensing technology, basic statistics, spatial analysis and modelled processes.
[33]	Sustainable urban development	Urban	42	Urban transport, urban design, urban management, urban environment	Mobility	Harmonized set of indicators that could to be used for assessing the sustainability of an urban environment. Indicators are identified by taking into account a number of urban development-related concerns
[34]	Sustainable transport	-	34	Economic, social, environmental	Environmental	List of recommended indicators disaggregated by relevance and dimensional category – based on a review of studies and best practices.

Appendix B

Stakeholders participating to the "stakeholder dialogue analysis" on policies for sustainable urban mobility

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	Cyclists
FIT-CISL	Transport workers
Legambiente	Environmentalists
ORSA	Transport workers
UIL-Trasporti	Transport workers
Political parties	
Partito democratrico	Center-left voters

Appendix C

Stakeholders' appraisal of the objectives of policies for sustainable urban mobility (PSUM): detailed results

PSUM OBJECTIVES	DIMENSIONS OF PSUM (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 transport costs	1	0	0	2	0.62	12
Reducing private transport costs	1	0	0	2	0.62	12

a 1=useful, but non urgent; 2=relevant, but not a priority; 4=a priority.

Appendix D

Selection of performance indicators according to citizens' opinion (by urban scale). Threshold: % = 48

SELECTED PSUM PERFORMANCE INDICATORS	Ranking by urban scale			
	Small cities	Medium cities	Big cities	Metropolitan belt[a]
Households expenditures for private transport	1	2	5	3
CO_2 from transport	2	1	2	1
Main air pollutants from transport: PM_X, COVNM, NO_X, CO	4	3	1	2
Death and injuries from traffic accidents	3	4	3	4
Waste from transport	5	5	6	5
Quantity/quality of public transport	6	-	4	7
% of population exposed to harmful noise	-	-	7	6
Households expenditures for public transport	-	-	-	8

[a]Municipalities of various dimension belonging to the same local labour system of big cities

Selection of performance indicators according to citizens' opinion (by transport mode). Threshold: % = 48

SELECTED PERFORMANCE INDICATORS OF PSUM	Ranking by transport mode[a]		
	Car	Bus, tram, tube	Bicycle
CO_2 from transport	2	1	1
Quantity/quality of public transport	6	2	-
Main air pollutants from transport: PM_X, COVNM, NO_X, CO	3	3	3
% of population exposed to harmful noise	-	4	7
Waste from transport	5	5	5
Households expenditures for private transport	1	6	4
Death and injuries from traffic accidents	4	7	6
Walkability and "cyclabilty"	-	-	2
Households expenditures for public transport	7	-	9
Land occupied by transport infrastructure	-	8	8

[a] Used more than twice a day

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