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## Analysis of AHP methods and the Pairwise Majority Rule (PMR) for collective preference rankings of sustainable mobility solutions

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### Abstract

The aim of this work is to give a contribution in the field of stakeholder engagement in order to reduce the widespread conflicts arising when transport plans have to be implemented and understand the role of quantitative methods to support shared decisions. We present the results of a participation experiment, with university students as stakeholders, where the AHP method was applied to derive individual priority vectors, on the basis of their judgments of preference between all couples of alternatives regarding the mobility management of their university. The aggregation of the individual judgments was done by using different methods, some derived from AHP and other derived from voting methods, such as Pairwise Majority Rule (PMR). A discussion about the results of the different methods, before and after stakeholder interaction, and from an agent-based simulation in terms of respect of the consistency condition and degree of consensus of the collective decision will provide some recommendations that can be useful to guide effective and efficient participation process.

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### 1. Participative decision-making process in transport planning

Participation of citizens and stakeholders in transport planning is emerging as a basic component of the plan development to which human and financial resources have to be dedicated from the beginning of the decision-

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making process (Banister, 2008; Litman, 2009; Cascetta and Pagliara, 2013). The awareness of including the public in the decision-making process is a consequence of the failure of many projects because of lack of consensus building. Public involvement and participation become fundamental to find an alternative being the best trade-off between the “most shared” solution (based on consensus building) and the “optimal” one (based on the results of technical evaluations). This can determine a new rational and time saving decision-making process. In this respect, a new planning framework is proposed that draws on:

- the “ladder of citizen participation” (Arnstein, 1969) and different levels of growing involvement (Kelly et al., 2004);
- the “participation pyramid” (Le Pira et al., 2013), where experts, stakeholders and citizens contribute with different degrees of competence and interest to the decision-making process;
- the transport planning “bounded-rationality approach” (Cascetta and Pagliara, 2013), where quantitative evaluations of the planning alternatives are integrated with a participation process.

The proposed decision-making process identifies three main actors and their related roles (Fig. 1): planners and experts in charge of analysing and modelling the transport system by defining the plan structure for the final technical evaluations; stakeholders and citizens that are involved in all the planning phases for the definition of objectives, evaluations criteria and alternatives; decision-makers in charge of the final decision supported by a performance-based ranking and a consensus-based ranking of plan alternatives.

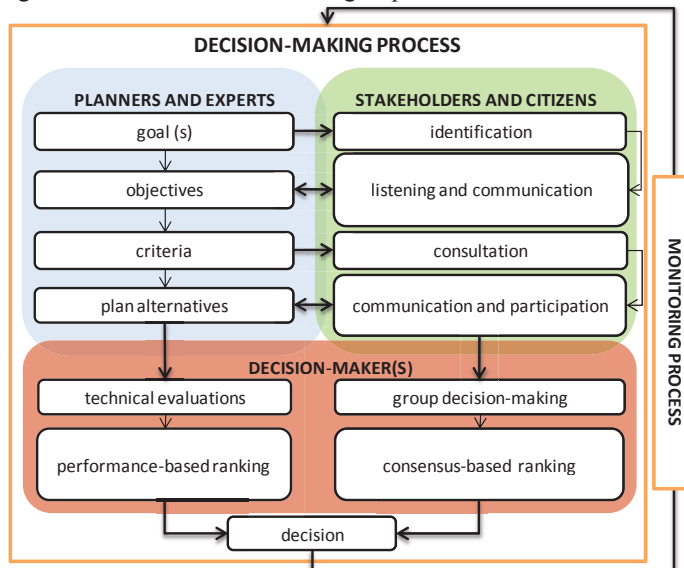


Fig. 1. Framework of the participatory decision-making process in transport planning.

A few attempts can be found in literature that effectively include the stakeholders’ opinions into the final choice as a result of an effective group decision-making process. In this respect, the use of Decision-Support Methods (DSMs), such as participatory Multi Criteria Decision Analysis (MCDA), is essential to explicit the opinion and the role that different actors play in the selection of the plan/project among competing alternatives. The Multi Actor Multi Criteria Analysis (MAMCA) by Macharis (2005) is based on a sequence of MCA each carried out with a different stakeholder group, and it represents an interesting approach to include stakeholder groups’ opinions in transport planning decisions (Macharis et al., 2010; Vermote et al., 2014). Nevertheless, there is no interaction among stakeholder groups, nor they are expected to change opinions on the transport alternatives, i.e. there is no

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