Modelling consensus building in Delphi practices for participated transport planning

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Abstract

Stakeholder engagement is a key issue for sustainable transport planning. Appropriate methods and tools are needed to support an efficient participation process. This study presents a combination of Analytic Hierarchy Process (AHP) with the Delphi method as a useful support for participatory decision-making processes aimed at consensus building. A case study will be presented and the results will be analysed also via an agent-based model (ABM), used to reproduce the same process of convergence of opinions, with the aim to understand the role of network topology, stakeholder influence and other sensitive variables on the emergence of consensus.

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1. The new participatory approach in transport planning

Transport planning is a complex task, mainly because transport problems are often referred to as “wicked” problems with multiple actors and conflicting interests (Cascetta et al., 2015). Involving stakeholders and citizens from the beginning and all along the planning process is a necessary condition for reaching consensus, while guarantying transparency and pursuing sustainability. The participation process should be planned well in advance, involving the actual stakeholders with appropriate methods (Banister, 2008; Litman, 2009; Cascetta and Pagliara, 2013).

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The new approach of participation in decision-making process involves several actors with different roles and it is inspired to some basic concepts, i.e.: (i) levels of growing involvement, as represented by the “ladder of citizen participation” (Arneim, 1969); (ii) a clear classification of the main actors involved, i.e. experts, stakeholders and citizens that contribute with different degrees of competence and interest to the decision-making process (Le Pira et al., 2013); (iii) an integrated transport planning decision-making model (Cascetta et al., 2015), where a “cognitive decision-making” is bounded with stakeholder engagement and quantitative analysis. In the framework of participatory decision-making process in transport planning, planners and experts define the plan structure for the final technical evaluations, stakeholders and citizens are involved in all the planning phases for the definition of objectives, evaluations criteria and alternatives and decision-makers are in charge of the final decision, supported by a performance-based ranking and a consensus-based ranking of plan alternatives (Le Pira et al., 2015b).

Appropriate methods and tools are needed to support an efficient participation process. This paper describes a group decision-making process based on sound multicriteria decision-making and participation methods aimed at finding a consensus-based ranking about cycling mobility alternatives. In particular, Analytic Hierarchy process (AHP) by Saaty (1980) was used as multicriteria method to structure the problem and to elicit stakeholders’ preferences and a Delphi-type process was set up to promote consensus building. Besides, the agent-based model by Le Pira et al. (2015a) was adapted to reproduce the same process and to investigate the phenomenon of consensus building under different scenarios.

The remainder of the paper is organized as follows: section 2 introduces the materials and methods used in the study; section 3 illustrates the case study and its related results; in section 4 the results are discussed and some general conclusions are provided.

2. Materials and methods

The study can be framed within a wider participation process that involved several phases, with different stakeholders involved and processes adopted. In particular, this paper focuses on the phase of involvement of experts and stakeholders in a combined AHP-Delphi procedure aimed at (i) structuring the decision-making problem, (ii) eliciting their preferences and (iii) make them converge towards shared solutions. Data collected from the individual actors were used to derive group preference rankings by different aggregation procedures and to evaluate to what extent interaction can contribute to achieve a more shared decision.

Some basic assumptions are necessary to understand the rationale behind the study, i.e.: (1) it is here assumed that the preferences of an individual (e.g. expert, stakeholder) are represented by an ordered list (ranking) of a set of prefixed alternatives (e.g. for three alternatives A, B and C, a possible order is A>B>C); (2) the ranking of the alternatives can be turned into a binary vector whose components assume the value +1 if the generic alternative A precedes B in the list or −1 if the opposite occurs (i.e., in the previous example AB=1); (3) the individual preference rankings must be consistent, i.e. they should derive from logical – non-random – judgments; (4) the collective preference ranking must be transitive, meaning that, if alternative A is preferred to B and B to C, then A is preferred to C; (5) in a consensus building process, the final collective preference ranking is assumed to be accepted, meaning that it reflects the individual preferences at a reasonable level (or a good degree of consensus).

Based on these premises, in this section two methods are presented - AHP to structure the problem and to elicit preferences (2.1) and Delphi method to build consensus (2.2) - together with a measure of the degree of consensus of the actors towards the collective ranking (2.3). Finally, an agent-based model is presented to simulate the same participation process (2.4). The final aim is to investigate the impact of different scenarios of interaction among stakeholders on the final degree of consensus.

2.1. AHP to structure the problem

The Analytic Hierarchy Process (AHP) by Saaty (1980) is a widely used multi-criteria decision-making method based on the representation of a decision-making problem into a tree structured decisions’ hierarchy, about the general goal to achieve, sets of specific objectives, evaluation criteria (and possible sub-criteria) and finally alternatives aimed
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