Simulating stakeholder interaction for sustainable planning of transport systems

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Extended abstract

Objectives and motivation

Public participation is an essential part of planning according to sustainability principles. Transport systems require special attention, in particular at the urban scale, since their planning affects the liveability and economy of a city and usually there are many stakeholders with conflicting objectives. In this respect, it is fundamental to involve citizens and all the interested stakeholders, both from the point of view of passenger and urban freight transport (UFT) policies. In particular, UFT stakeholders go from the private side (retailers, private companies, transport providers) to the public one (end consumers, citizens, public authorities) with diverging interests (economic sustainability vs environmental and social sustainability) and multiple decision-makers. It has been demonstrated via an agent-specific approach (Stathopoulos et al., 2012; Gatta and Marcucci, 2014) that knowing behavioural aspects related to stakeholders can increase decision-makers’ awareness and help them taking better decisions. Moreover, a transparent and inclusive decision-making process can help taking the ‘most shared’ decisions rather than the ‘best’ one.

In the framework of public participation, identifying all the actors and listening to their different points of view are the first two primary steps (Cascetta and Pagliara, 2013), followed by the real participation phases. The interaction among stakeholders and between them and the decision-maker(s) is a crucial point, since it influences the final decision, and a good management of it is fundamental for the success of the decision-making process. Moreover, an extended use of Multi Criteria Decision Analysis (MCDA) methods to include and quantify stakeholders’ opinions is advisable to add transparency to the process (Macharis, 2005). However, if this kinds of participation are not monitored, they can hide some pitfalls.

General description

When stakeholders are asked to rank different alternatives there can be two main problems connected with the final collective preference order that derives from aggregation: (1) it cannot reflect the individual preferences and (2) it can be intransitive, i.e. it is possible to fall into the so-called ‘Condorcet paradox’ or ‘Condorcet cycle’ (Condorcet, 1785). This means that, for instance, among three alternatives A, B and C, the collective preference order can be A>B>C>A.

It is important to understand how to manage this kind of problems avoiding the unfeasibility and unfairness of a decision that derives from a democratic but uncontrolled participation. To this purpose, a methodology that investigates the complex phenomenon of interaction in group decision-making has been set up. Agent-based simulation is used to model networks of stakeholders (agents) endowed with own properties (such as opinion or influence) that can act according to simple behavioral laws, reproducing the opinion exchange flows. The simulation is supported by the theory of Social Network Analysis (SNA) and opinion dynamics models, the former to provide insight on the relative influence/importance of stakeholders and the latter to reproduce the interaction among them in order to make predictions about the final decision (Le Pira et al., 2013). In particular, from typical UFT stakeholders, homogeneous communities can be identified on the base of the similarities of interests and the process of preference ranking can be simulated. The opinion dynamics model is based on majority rule, since each agent at time t can interact with its neighbors and decide to change its opinion according to the preference order of the majority of them. The Pairwise Majority Rule (PMR) is used as aggregation procedure of individual preference lists and the degree of consensus is monitored in terms of overlap between the lists (Le Pira et al., 2015). The simulations are performed within the software environment NetLogo (https://ccl.northwestern.edu/netlogo), particularly suitable for agent-based modeling.

Results and conclusions

The results show that the model is able to suggest to what extent interaction supports a consistent and transparent group decision-making process. It is confirmed that, starting from an intransitive collective list, it helps to escape from the ‘Condorcet cycle’, as already demonstrated (Raffaeelli and Marsili, 2005; Columbu et al., 2007). Furthermore, the repeated interaction increases the degree of consensus towards the collective decision, therefore it allows to find a decision better reflecting on average the individual preferences; moreover, topology affects to a high degree the level of general consensus.

In conclusion, this methodology helps to understand how to manage a good participation process. It can represent a useful tool for decision-makers and planners to support participation into the whole UFT policy-making process, avoiding time (and cost) waste and supporting the delivery of sustainable and shared plans.
References


Keywords: public participation; urban freight transport policy-making; stakeholder interaction modelling; agent-based simulation.