Combining Analytic Hierarchy Process (AHP) with role-playing games for stakeholder engagement in complex transport decisions

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Abstract

This paper presents a procedure for the structuring of a transport decision-making problem and evaluation of the solutions proposed from a multi-stakeholder multi-criteria perspective. Analytic Hierarchy Process (AHP) is used as multicriteria decision technique, while a role-playing game is used to reproduce a participatory process where University students act as key stakeholders. The case study regards the building of a new metro station in Catania (Italy), which will be the nearest station to a big University district. A dedicated transit system linking the metro station and the district is under study and four different alternatives have been proposed. Students were initially informed about the objectives of key stakeholders in order to be able to play the different roles. A hierarchy of the problem was built with them and AHP was used to elicit their preferences and evaluate priorities for each stakeholder group. A comparison between a mathematical aggregation of individual priorities and a consensus vote was performed to verify the differences between the two different methods and their compliance with the stated stakeholder preferences. AHP-based participatory procedure proved to be suitable to tackle the complexity of transport decisions.

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Peer-review under responsibility of the scientific committee of the 20th EURO Working Group on Transportation Meeting.

Keywords: multicriteria decision-making; stakeholder involvement; participatory process; transport planning

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1. Introduction

Transport systems are complex socio-technical systems that affect the social, economic and environmental dimensions of a territorial community with several impacts and feedbacks not easy to be foreseen (Cascetta et al., 2015). Further complexity is added by the procedural issues related to construction and operation of the transport systems and mostly for the several actors that interact in different contexts and show different interests. Transport planning is typically a decision-making process based on rationality, aimed at defining and implementing transport system operations (Ortúzar and Willumsen, 2011). It effectively means achieving aims and objectives as a result of a technical and political process, through a set of decisions that will inevitably favor some interests and expectations at the expense of others. In fact, even if a transport plan is meant to increase the net welfare of a community, the benefits will never be equally distributed among its different actors and groups interested in influencing the planning process (De Luca, 2000). Public participation in transport planning is therefore emerging as a basic component to which human and financial resources have to be dedicated from the beginning of the planning process (Cascetta and Pagliara, 2013). The word “public” is usually referred to all those potentially affected by or interested in a decision, i.e. the potential “stakeholders”. Stakeholders in the transport sector can belong to different categories, i.e. institutions/authorities, transport users, transport operators, business and unions, local communities, media and financial institutions (Cascetta and Pagliara, 2013) with different levels of competences and interests (Le Pira et al., 2016a). Stakeholder engagement is therefore a necessary prerequisite for the success of a transport decision-making process. Nevertheless, a successful and effective participation process requires the use of appropriate decision-support methods and procedures. In this respect, the use of Public Participation GIS (PPGIS) should be promoted since it allows a simple visualization of the impacts of the solutions proposed (see e.g. Smith, 2002; Tang and Waters, 2005). Ex-ante behavioral analysis is also important to produce insights into stakeholders’ behavior and preferences for future scenarios. In this respect, stated preference surveys are well suited to investigate stakeholders’ preferences in order to forecast their individual choice behavior related to policy-making (e.g. Gatta and Marcucci, 2016). Since a collective choice is the goal of participation, it can be useful to analyze interaction processes among stakeholders aimed at consensus building. Agent-based simulations provide a useful tool to study communities of autonomous and intelligent agents, such as stakeholders linked in social networks, trying to understand the role of interaction in finding a shared decision (Le Pira et al., 2016a; 2017a; Marcucci et al., 2017). Besides, complex transport decisions requiring the evaluation of multiple and heterogeneous aspects (e.g. environmental, social, economic) need to be tackled with a multicriteria approach. Multi-Criteria Decision Making/Aiding (MCDM/A) methods are widely used in transport planning to include in a comparative assessment of alternative projects their contributions to different evaluation criteria (Figuera et al., 2005). Though stakeholders can be involved both to select the criteria and assign weights, the “rational” approach where transport planning choices are made by analysts is not always sufficient to assure that the final choice will be supported. It is necessary to involve them all along the decision-making process with the support of adequate MCDM/A methods. In this respect, the Multi-Actor Multi Criteria Analysis (MAMCA) (Macharis, 2004) is widely used in transport decision-making to gain insights in stakeholders’ objectives and evaluate how the alternatives contribute to these objectives with the possibility of adapting them. There are some useful online tools/software developed to support multi-actor multi-criteria processes (e.g. Stirling and Coburn, 2014; Keseru et al., 2016). Another important aspect to consider is stakeholder interaction that can lead to opinion change and is fundamental to reach shared decisions (Le Pira et al., 2015, Le Pira et al., 2017b). Therefore, an effective participation process should be structured so to foresee the use of MCDM/A and the involvement of different stakeholders in several phases.

Based on this premise, this paper presents a procedure for the structuring of a transport decision-making problem and evaluation of the solutions proposed from a multi-stakeholder multi-criteria perspective. Analytic Hierarchy Process (AHP) is used as MCDM technique, while a role-playing game is used to reproduce a participatory process where University students act as key stakeholders. This represents the second step of a wider procedure to support a stakeholder-driven transport decision, as it will be better clarified in the next section.

The remainder of the paper is organized as follows. Section 2 is a short introduction to the methodology, with a description of the participatory procedure adopted and of the well-known AHP method. Section 3 presents the case study with a description of the decision-making context and the participation experiment. Section 4 shows the results obtained with AHP and from a comparison between the collective result obtained by mathematical aggregation and
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