Urban Freight transportation planning as a rational decision making process:  
a cognitive model and the false friends of eco-rationality  
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Extended abstract

Objectives and motivation

Real-life experiences and the media abound in decision making failures for freight transportation. Examples include contrasted transport infrastructures (e.g. ports; intermodal transport terminal) and the related extra-costs, unrealistic business plans for freight transport companies, and so on. Problems in effective transport-related decision making are also related to the gap still existing between the traditional technical approach to transportation planning and design, and real-life processes. Obviously the complexity of decision processes in freight transportation has long been recognized together with the need of “opening” them and widening the consensus around alternative courses of action. However most of the contributions in the freight transportation literature assume that the decision making process has some form of “rationality” and that quantitative tools play a central role in it, contributing to define the decisions or at least influencing them. In this paper we argued that unfortunately sometimes, decisions on (urban) freight may be “a-rational” and quantitative methods are not used or are used in a purely “cosmetic” way. The quality of the decisions depends critically on the process followed to reach them. Planning and designing freight transportation systems should expressly be recognized as managing complex, multi-agent decision-making processes in which technical and communication abilities should both be involved in order to design solutions which are consistent, and at the same time, maximize stakeholders’ consensus. In this paper we propose an approach to urban freight planning and designing based on three parallel and intertwined processes:

a) a cognitive rational approach to the organization of the decision-making process;

b) a five levels stakeholders engagement process;

c) a technical analyses process based on an extended role of quantitative methods.

Furthermore an application case study was also performed.

General description

A cognitive rational decision-making process

Bounded rationality in individuals’ decision-making assumes that rationality is limited by the available information, their cognitive limitations, and the finite amount of time they have to make a decision. Therefore, individuals choose an alternative which is satisfying, learning from previous choices. Accordingly with this ideas, the model proposed here for decision making related to freight transportation system assumes that actors are still goal-oriented, but they implicitly take into account their cognitive limitations in attempting to achieve those goals. The decision-making model is intrinsically dynamic with several feedback loops adapting the “solutions” to their ability to satisfy objectives and constraints until reaching a “satisfactory” level of compliance. Further, the problem setting may be revised if solution satisfying previously set objectives and constraints are not found within reasonable time and resource budgets. The concept of satisfaction is necessary a fuzzy one, as no single value objective function can be referred to, and even non-quantitative objectives and constraints are included in the process. The model is “cognitive” in nature since actors learn about solutions and their effects, the achievable objectives, the possible trade-offs, during the decision-making process. It also includes the possibility of decomposing decisions in sub-sequent steps, implementing subsets of them and “learning” from their effects, both at the decision-maker and stakeholders levels. The results is a multi-step decision process based on the outputs from previous decisions monitoring and ex-post evaluations.

Stakeholders engagement process

Stakeholder Engagement (SE) can be considered as the process of involving stakeholder concerns, needs and values in the transport decision-making process. It is a two-way communication process that provides a mechanism for exchanging information and promoting stakeholder interaction with formal decision-makers and the transport project team. The overall goal of engagement is to achieve a transparent decision-making process with greater input from stakeholders and their support of the decisions that are taken. Some administrations and private operator pay little attention to SE, either in the belief that professionals are best placed to make transport decisions, considered essentially technical in nature, or because local political representatives believe that they best represent stakeholders’ interests (e.g. Decide, Announce, Defend syndrome).

Involving stakeholders in the transport decision-making process, and reconciling their views with the judgements of key decision-makers can be a challenging and difficult task. At the same time, effective management can be a rewarding experience, which enhances the decision-making process and the value of what is produced or implemented. Different levels of PE can be identified and adopted in real life public and private decision-making processes: i) Stakeholders identification; ii) Listening; iii) Information giving; i) Consultation; v) Participation.

The role of quantitative methods
In recent decades, substantial progress has been made in understanding freight transportation systems at different scales and modeling their main elements through increasingly sophisticated systems of mathematical models. Traditionally, quantitative methods have been used in (urban) freight transportation analysis to assist in the design, assessment and evaluation of transport-related plans and projects. Analyses and models have been mainly related to system performances and their impacts on the environment, activity and economic systems. This traditional approach is culturally rooted in transportation and traffic engineering. However, in spite of the unquestioned utility of traditional applications, we think that new challenges are open to quantitative methods in transportation systems analysis within the broader view of the decision-making process discussed in this paper:

- Identification and modeling of impacts relevant to stakeholders and decision-makers;
- Processing and presentation of results for non-experts;
- Assessment methods allowing the evaluation of quantitative and qualitative impacts for different actors;
- The (neglected) relevance of ex-post studies;
- Uncertainty management and risk assessment;
- Estimation of willingness-to-pay.

Application case study

Starting from the proposed approach, an application case study was also performed for urban freight distribution within the Naples metropolitan area (Italy), comparing the effects of consolidated sustainable transport policies (e.g., use light goods vehicles for urban distribution) extended to capture energy and pollutant emissions and implemented in a Decision Support System. The transport policy tested is aimed to a green gases emission reduction improving urban freight distribution. To do this a “standard” and not-rational decision making-process for city-logistics was tested (simulated), applying a set of “consolidated” freight sustainable policies: new transit-points in strategic location inside the city; new and more efficient vehicle paths (from a distribution point of view); no heavy trucks for urban delivery.

Impacts of transport policies were estimated through a Nested Logit models to take into account the influence of “lower” choice dimensions on “upper” levels: i) choice of the distribution strategy (number and type of intermediate stops); ii) choice of the possible intermediate destination d1 given the od pair; iii) choice of the loading unit (freight vehicle) for the first trip and for the subsequent trips. In demand model specification, several attributes were considered: socio-economic (e.g., resident population by market segments; employers and firms in economic activity sectors), level of service (e.g., travel time, travel cost) and dummy variables (e.g., geographic and accessibility attributes). With respect to the assignment model stochastic user equilibrium assignment was considered.

Through the simulation models implemented, the environmental effects of these interventions were estimated; the results show that, against a traffic congestion reduction (5% reduction), the main impacts are: +10% in traffic fuel consumption; +5% green gasses emission (equivalent CO2); +11% fine particles emission (PM10). This was caused by the increase in trips length and number, caused by the use of only light good vehicles for urban distribution.

By contrast the proposed decision-making process was also applied to this case study allowing to define a set of eco-rational policies able to improve the system (reduce traffic congestion and vehicle emissions).

Results and conclusions

In this paper we asserted that the quality of the decision-making process is a key factor for successful planning, and that it depends critically on how the process is structured. Planning and designing transportation systems should expressly be recognized as managing complex, multi-agent decision-making processes in which political, technical and communication abilities should all be involved in order to design solutions which are consistent, and, at the same time, maximize stakeholders’ consensus. Furthermore, the paper suggests that quantitative methods for the simulation, design and evaluation of urban freight transport related decisions could play an important role in this wider process, the larger the more they are used outside the purely technical parts of it. Finally, the assessment methods allowing the evaluation of quantitative and qualitative impacts for different actors were recognized as crucial tools to support a more robust decision-making process in the field of transportation.

References

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