

A PARTICIPATORY MULTI-CRITERIA APPROACH TO PROMOTE WALKING IN URBAN AREAS

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ABSTRACT

The aim of this paper is to propose a participatory approach to promote walking in urban areas based on multiple criteria decision aiding (MCDA). This methodology can be divided into three main phases: structuring the decision situation, evaluation of alternatives and recommendation. This paper emphasizes the structuring of a decision situation which could be expressed by the following question: "How can we promote walking in this area of the city?" The elements of the decision context are outlined and a participatory model is proposed. Then the structuring activities are described. Some aspects related to the evaluation and recommendation phases are also discussed. This participatory multi-criteria approach can contribute to enrich decision-making processes related to walking by: improving communication and facilitating negotiation among the actors; promoting the integration of the relevant aspects of the decision situation and its context; creating meaningful alternatives and evaluating the alternatives on the basis of an agreed set of objectives.

Keywords: participatory approach, multiple criteria decision aiding, walking

1. INTRODUCTION

Walking is not only the oldest and the most natural way of moving, but also the most important non-motorised means of transport. Non-motorised transport is any travel done by human powered vehicles (such as bicycles, skateboards and roller blades), humans, animal drawn carriages and animals (PIARC, 2008).

In Brazilian cities, walking represents about 38 % of all journeys (ANTP, 2009). Walking speed is approximately 4 - 5 km/h and the usual distance that people walk is between 0.5 and 1 km. This emphasizes the irrational use of the car for short distances (Baudrin, 2007).

There are many benefits associated with walking, mainly in the fields of health, environment and economy (Beroud and Van Den Noort, 2007; Gunnarsson, 2001; PIARC, 2008; Wunsch, 2007).

Regular walking is considered as one of the best ways to keep healthy. It contributes to reduce the risks of many health troubles such as cardiovascular diseases, overweight and osteoporosis. For the public health, the risk of accidents generated by pedestrians is negligible.

From the environmental point of view, walking does not use any fuel. It is also free of emissions and is almost not noisy. Furthermore walking promotes neighbourliness and social interaction.

Walking is a low cost means of transport as the only investments necessary are clothes and shoes, and no paying licence is required.

In spite of all these benefits, it can be observed that the concern in favour of cycling in many countries is more widespread than in favour of walking (Fleury, 2007; Wunsch, 2007).

The aim of this paper is to propose a participatory approach to promote walking in urban areas. This is a complex decision problem because it involves many actors who have different and potentially conflicting interests. Such multi-dimensional problem needs to be addressed by a multiple criteria methodology which is referred to as multiple criteria decision aiding (MCDA).

After this introduction, the needs of pedestrians are briefly described. The three phases of MCDA are presented with emphasis to the structuring phase. The different forms of actors' participation and some methods to organize their participation in the context of MCDA are also explored. A participatory multi-criteria approach is then proposed and concluding remarks are made.

2. NEEDS OF PEDESTRIANS

Pedestrians are not a homogeneous group. They can be divided into many types depending on factors such as age, physical and mental capacity, and type of equipment used (Figure 1). Special attention must be given to children, the elderly and disabled persons (Gunnarsson, 2001).

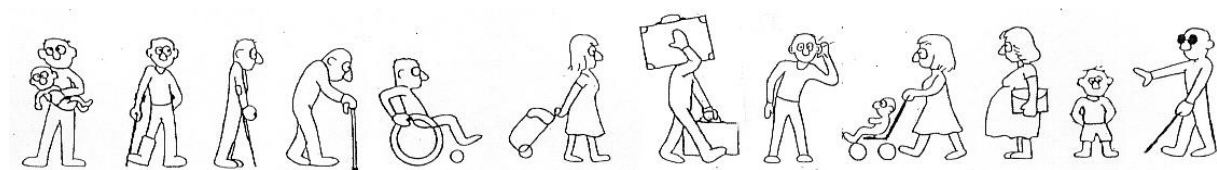


Figure 1 – Different types of pedestrians

Source: Dejeammes, 2007

In order to promote walking successfully, it is fundamental to consider the needs of pedestrians. Their main needs are accessibility, attractiveness, comfort, safety and security (Baudrin, 2007; Beroud and Van Den Noort, 2007; Fleury, 2007; Gunnarsson, 2001; Wunsch, 2007).

1. **Accessibility:** Pedestrian routes should be continuous, straight and wide, and should converge towards other forms of public transport e.g. train stations and bus stops. Pedestrian access standards must also comply with the access requirements of people with reduced mobility.
2. **Attractiveness:** Pedestrians are sensible to beauty. Their routes should be pleasant, clean and well maintained.
3. **Comfort:** For pedestrians, comfort means going ahead without unnecessary extra effort and being able to freely watch the environment.
4. **Safety:** Pedestrians travel at low speeds and are the privileged victims of collisions with vehicles, since they have no protection to attenuate the seriousness of an accident. Parents are often afraid to let their children walk alone to school, because they have limited capacity to understand the complexity of the traffic. Pedestrians, especially elderly people, are also vulnerable to falls caused by slippery or uneven surfaces.
5. **Security:** Pedestrians need to feel protected against aggression and violence from other road users.

3. MULTIPLE CRITERIA DECISION AIDING

Multiple criteria decision aiding (MCDA) is a methodology which seeks to take explicit account of multiple criteria in helping individuals or groups explore decisions that matter (Belton and Stewart, 2002).

Simon (1960) considers that the decision-making process comprises three principal phases: intelligence, design and choice. Following his model, MCDA can be divided into three main phases: structuring the decision situation, evaluation of alternatives and recommendation. Although they are interacting phases, structuring precedes and prepares the other two phases.

3.1. Structuring

Structuring encompasses the following interrelated activities (Galves, 2005): identifying the decision situation, characterizing the decision context, specifying objectives and attributes, creating alternatives and assessing their performances on the attributes.

A decision situation can be a decision problem or a decision opportunity (Keeney, 1992). A decision problem occurs when there is a need to do something about a situation which is found unsatisfactory in some way (Belton and Stewart, 2002). A decision opportunity is identified by the decision-maker rather than precipitated by external events. A decision situation may be very unstructured (e.g. "How can we reduce traffic congestion in the city?") or reasonably well defined (e.g. "The location of a new road").

Once the decision situation has been identified, it is necessary to characterize the decision context, by specifying its components and understanding how they interact. The decision context helps define the situation more carefully and clearly.

When characterizing the decision context, it is important to specify such components as time and geographical boundaries, actors, existing characteristics of the decision-making process (e.g. alternatives, different points of view and conflicts among the actors) and type of *problematique*.

Time boundaries depend on the decision level. According to PIARC (2003), there are three levels of transport decisions: policy level, planning and programming level, and project level. Policy level decisions typically have a planning horizon of at least 15 years; planning and programming decisions reflect planning horizons of 5 to 20 years, while project level decisions correspond to planning horizons of 0 to 5 years. Geographical boundaries can be for example local, national or international.

Since a decision is the result of interactions among actors, it is crucial to understand who they are, what role each one plays and what they expect from the decision-making process. An actor is any participant in this process such as the decision-maker, the facilitator (an actor who supports the decision-maker and the other actors), and any individual or group interested in or affected by the decision.

The decision context is also characterized by the corresponding *problematique*. Roy and Bouyssou (1993) distinguish four different *problematiques*, i.e. broad categories of problem for which MCDA may be useful: choice of an action, sorting the actions into classes, ranking the actions, and description of the actions and their consequences.

The next activity in structuring consists in identifying the objectives of the actors. Keeney (1992) distinguishes between fundamental and means objectives. A fundamental objective expresses an essential reason for interest in the decision situation while a means objective is important for the achievement of a fundamental objective. For example, accessibility and safety are fundamental objectives of pedestrians (Fleury, 2007). However all the actors involved in the decision-making process should express their points of view so that a comprehensive list of fundamental objectives is obtained.

Objectives can be structured in a fundamental objectives hierarchy and a means-ends objectives network. An attribute, which is a measure of the degree to which an objective is

met by the various alternatives, should be specified for each of the lowest-level fundamental objectives of the hierarchy (Keeney, 1992).

Creating desirable alternatives is the result of the preceding activities. In MCDA the alternatives are not defined *a priori* but they are constructed and shared by the actors through the whole process. Assessing the performances of the alternatives on the attributes is the last activity in structuring. This means that, on each attribute, a level on a preference scale that may be qualitative or quantitative is assigned to each alternative.

The fundamental objectives and the corresponding attributes, the alternatives and their performances are the results of a constructive process that prepares the evaluation phase.

3.2. Evaluation and Recommendation

In the evaluation phase, a MCDA method is applied to aggregate the performances of the alternatives according to the preferences of the actors. Roy and Bouyssou (1993) distinguish three operational approaches for aggregating performances. The first one synthesizes the performances into only one criterion by means of an aggregation function (single synthesizing criterion). This approach supposes that the preferences are transitive (preference or indifference relations). Methods belonging to this approach are MAUT, MAVT, AHP and MACBETH.

The outranking synthesizing approach employs pairwise comparisons of the alternatives according to the different criteria. In this approach the preferences can be modelled using different relations such as indifference, preference and incomparability relations. ELECTRE I was the first method that used an outranking synthesizing approach and was followed by many others like the different ELECTRE (IS, II, III, IV and TRI) and PROMETHEE methods.

The third approach is based on interactive local judgements with trial-and-error. This means that the aggregation does not result from any explicit rule but from a sequence of judgements formulated by the decision-maker. Examples of such methods are STEM and PREFCALC.

The results of the evaluation can be subject to uncertainty concerning the parameters of the aggregation method applied. These parameters are for example scaling constants and value functions in MAVT or preference and indifference thresholds in ELECTRE. For this reason, it is important to conduct sensitivity and robustness analyses in the third phase of MCDA.

4. PARTICIPATION OF ACTORS

4.1. Forms of Participation

Information, consultation and deliberation are different terms used to frame the participation of various actors in a decision-making process.

The first form of participation refers to providing information to the actors likely to be affected by a decision. Information should be complete, clear and understandable.

Consultation is a form of participation used to seek the viewpoints of actors in order to know their ideas, expectations and needs. However the actors are not sure if their contributions will be taken into account in the decision-making process.

Deliberation on the other hand means that the decision-maker engages in dialogue with the other actors. A deliberative discussion should be open, accountable, reciprocal and integer, and involve learning through iterative dialogue (Hager and Versteeg, 2005 cited by Isaksson *et al.*, 2009).

Openness and accountability are recognized as fundamental qualities of a successful participation process (PIARC, 2003). Reciprocity means a two-way dialogue. Being integer suggests that the dialogue should be respectful and involve speaking in turn, and listening. Learning through iterative dialogue is understood in terms of openness to new ideas, i.e. change.

The participation of actors in decision-making processes is often limited to information or consultation. However, as pointed out by Isaksson *et al.* (2009), a “shift towards more deliberative approaches has characterized large sections of planning theory and policy literature during the last decade” (p. 295).

Considering that the aim of multiple criteria decision aiding is to facilitate actors’ learning about and understanding of the problem faced to guide them in identifying a preferred course of action (Belton and Stewart, 2002), deliberation can also be seen as a form of participation compatible with MCDA.

4.2. Methods to Organize the Participation

Encouraging the participation of multiple actors in a decision-making process inevitably entails dealing with the difficulties of organizing such participation. This section presents two methods developed in the context of MCDA that can help organize the participation of actors, especially deliberation. These methods are value-focused thinking and cognitive mapping.

Value-focused thinking, proposed by Keeney (1992), consists in identifying, structuring and measuring the objectives of the actors. They should be selected jointly by the decision-maker and the facilitator so that the different perspectives of the decision situation are represented.

Actors should be involved early in the decision-making process. This increases their willingness to cooperate, since it lets them see that the decision has not already been made. Keeney (1992) suggests that the facilitator organizes an initial meeting with all actors to explain the purposes of their participation, how they were selected and the principles that will be used to elicit their objectives and to combine them.

Then each actor is asked to provide a written list of objectives. This list will probably include means and fundamental objectives. In order to separate them, for each objective the facilitator asks “Why is this objective important in the decision context?” If the answer is that the objective is one of the essential reasons for interest in the situation, such an objective is a candidate for a fundamental objective. If the answer is that the objective is important because of its implications for another objective, it is a means objective.

The fundamental objectives of each actor can be structured in a hierarchy. The lower-level objectives under any higher-level objective in the hierarchy are the answer to the question “What aspects of the higher-level objective are important?”

Once the individual hierarchies have been obtained using a common overall objective, it is necessary to combine them. To do so, the facilitator can list all the top-level objectives (those immediately under the overall objective) in each hierarchy. Objectives that are essentially the same should be aggregated. The process is repeated for the other levels of the individual hierarchies until all of the objectives have been accounted for. Figure 2 illustrates a combined hierarchy for the problem of the new bus station in Campinas, Brazil (Peixoto Neto *et al.*, 2008).

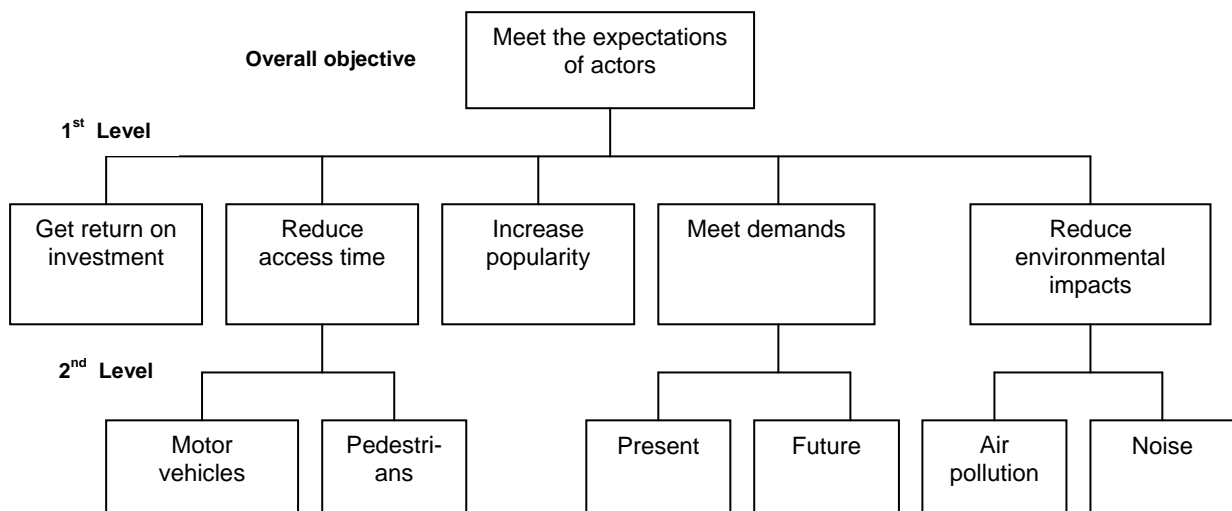


Figure 2 – Example of a combined fundamental objectives hierarchy

Source: Peixoto Neto *et al.*, 2008

The combined fundamental objectives hierarchy should be appraised in terms of the desired properties of objectives hierarchies (i.e. essential, controllable, complete, measurable, operational, decomposable, non-redundant, concise and understandable) and appropriate revisions should be made.

Then the hierarchy is presented to and discussed with the actors. Their suggestions to improve it should be incorporated so that the combined hierarchy represents all that is fundamentally important for them. For Keeney (1992, p.98), a “crucial role of the objectives hierarchy is to provide a constructive mechanism for communication between groups about significant aspects of the problem.”

Cognitive mapping, developed by Eden (1988), is one of the problem structuring methods stemming from the fields of Operational Research and Systems, and collectively referred to as “Soft OR” (Belton and Stewart, 2002). It aims to represent a given situation as each actor perceives it and is usually generated using a one-to-one discussion.

In a cognitive map, each node expresses an idea, represented by a phrase and, if necessary, a contrasting phrase to clarify its meaning. In this case, the phrases are separated by dots which are read as “rather than”. Nodes are linked by arrows, indicating that one idea influences or leads to another idea. In Figure 3, for example, “reduce environmental impacts” is important to “protect the environment”.

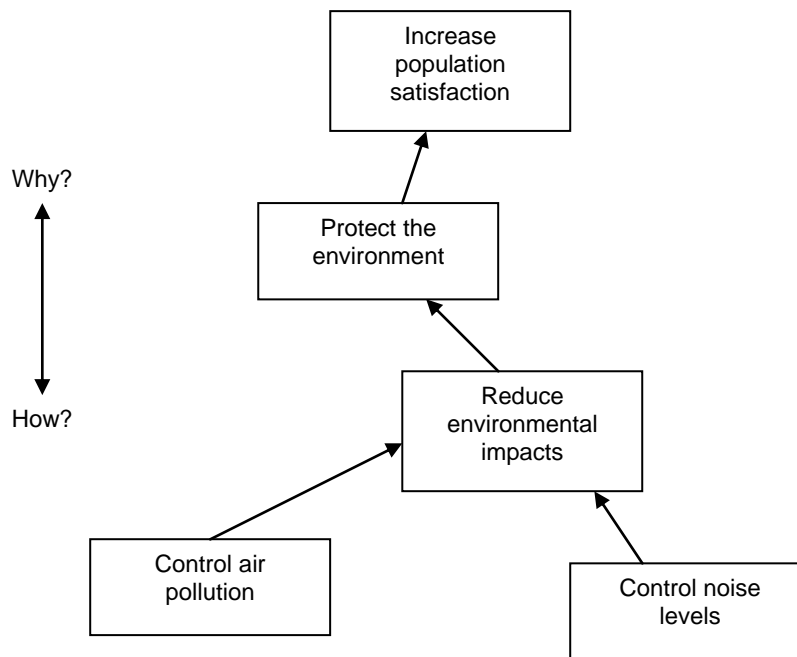


Figure 3 – Portion of a cognitive map

Source: Peixoto Neto *et al.*, 2008

The cognitive map of a group of actors can be constructed using the same procedure described for obtaining the combined objectives hierarchy. However, unlike the hierarchy, the cognitive map has a complex means-ends structure.

5. A PARTICIPATORY MULTI-CRITERIA APPROACH

In this section, a participatory approach to promote walking in urban areas based on multiple criteria decision aiding is proposed. The phases of the MCDA process are considered but the emphasis is on the structuring phase.

5.1. Structuring

The decision situation dealt with here could be expressed by the following question: “How can we promote walking in this area of the city?” It is a neighbourhood level project comprising some streets, with a short term planning horizon. The decision *problematique* is the choice of one or several measures to promote walking in the area.

The decision-maker could be the local public authority responsible for urban roads and mobility. Actors would be selected jointly by the decision-maker and the facilitator (Keeney, 1992). They include for example inhabitants, pedestrians, shopkeepers, schools and parents, transport operators and citizens’ associations.

The envisaged form of actors’ participation is deliberation because it is compatible with the objectives of MCDA. In such deliberative decision-making process, the decision-maker and the other actors are partners who will be supported by the facilitator through the whole process.

This group of actors has the following tasks to accomplish in the structuring phase: drawing up a diagnosis of the area, identifying their objectives, structuring the fundamental objectives, selecting the attributes, proposing alternatives and assessing the performances of the alternatives.

The diagnosis aims at searching for traffic problems and road dysfunctions in the area. It is based on interviews with road users, such as pedestrians, cyclists and drivers, and on technical information about traffic flows and road functions. The diagnosis will help the actors establish mutual understanding of the problems at hand, identify their objectives and think about measures adapted to the local context.

The identification of the actors’ objectives and the construction of a combined fundamental objectives hierarchy are carried out by means of the method proposed by Keeney (1992) and described in section 4.2. In order to help the structuring of objectives, the cognitive mapping method can also be used. For example, the node “reduce environmental impacts” in Figure 3 was considered as a fundamental objective and broken into two sub-objectives in Figure 2, namely air pollution and noise.

The selection of the attributes and the corresponding measurement scales requires technical knowledge. For example, which attribute could be chosen to measure pedestrians’ safety in the area? Then it is suggested that experts help the group of actors accomplish this task.

Measures to promote walking aim at meeting the fundamental objectives of pedestrians. They can be grouped into regulation measures, pricing measures, road design and maintenance measures, and education and information measures (Galves, 2009). These measures are frequently complementary. This indicates that each proposed alternative should combine different types of measures.

In order to assess the performances of the alternatives on the attributes, the participation of experts is also suggested. The performances are in fact the consequences of an alternative. It can be useful to present the alternatives and their performances in a table. The facilitator can use this performance table as a communication tool to foster debate among the actors.

A public meeting can be organized to present the results of the structuring phase to people who live or work in the area, and receive their contributions. It is possible that, at the end of this phase, the group of actors are able to identify a preferred alternative. If this is not the case, a formal evaluation of the alternatives will be necessary.

5.2. Evaluation and Recommendation

In the evaluation phase, the actors express their preferences so that the parameters of the aggregation method chosen by the facilitator are obtained. If the method belongs to the single synthesizing criterion approach, these parameters are scaling constants and value or utility functions. If it is an outranking method, the parameters are weights for the attributes and thresholds.

Before applying the aggregation method, it is important that the facilitator explains to the group of actors the principles of the method and the procedures that will be used. Once the parameters have been obtained, the method is applied to the performance table and the outcome is the evaluation of each alternative on the attributes.

At this stage, the facilitator can conduct sensitivity and robustness analyses, and discuss them with the actors. Thus they understand the impacts of varying some parameters of the evaluation model or the performances of the alternatives on the results of the evaluation. Instead of recommendations, the expected outcome of this deliberative process is an agreement about the alternative to be implemented.

6. CONCLUSION

Given the complexity of decision-making processes related to urban mobility, the aim of this paper is to propose a participatory approach to promote walking based on multiple criteria decision aiding (MCDA). Initially the advantages of walking were presented as well as the needs of pedestrians. Their main needs are accessibility, attractiveness, comfort, safety and security.

Then the phases of MCDA (namely structuring, evaluation and recommendation) were described. Since this methodology seeks to help various actors involved in a decision-making process express their points of view, some forms of participation such as information, consultation and deliberation were explored.

In order to show how MCDA can be used as a methodological approach to promote walking in urban areas, a hypothetical decision situation was considered. It can be characterized as a neighbourhood level project comprising some streets, with a short term planning horizon.

The envisaged form of actors' participation is deliberation because it is compatible with the objectives of MCDA. In such deliberative decision-making process, the decision-maker and the other actors are partners who will be supported by the facilitator.

The activities of the structuring phase were proposed. They consist in drawing up a diagnosis of the area, identifying the objectives of the group of actors, structuring their fundamental objectives, selecting the attributes, proposing alternatives and assessing the performances of the alternatives on the attributes. For some activities, methods to organize the participation of the group of actors, developed in the context of MCDA, were suggested.

The proposed alternatives should take into account the needs of pedestrians. They are evaluated by means of a multi-criteria aggregation method chosen by the facilitator. Instead of recommendations, the expected outcome of this deliberative process is an agreement about the alternative to be implemented.

This participatory multi-criteria approach still needs to be tested. However we hope it can contribute to shed light on decision-making processes related to walking by: improving communication and facilitating negotiation among the actors; promoting the integration of the relevant aspects of the decision situation and its context; creating meaningful alternatives and evaluating the alternatives on the basis of an agreed set of objectives.

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