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An acyclic outranking model to support group decision making within organizations

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ABSTRACT

A model to support group decision making within the board of any organization to select an alternative from a short list is proposed using a pairwise relation: consensus relation.

This relation avoids elementary cyclicity which is a general shortcoming of previous models and satisfies transitivity under special conditions (weak transitivity). This relation is represented by a triangle-free graph and has important implications for Public Choice Theory such as the special relevance of the 2/3 majority rule and for Multicriteria Decision Making (MCDM) to improve outranking models.

The proposed model can be easily applied as shown by the example presented.

The contributions obtained from this model do not only include the selection of the recommended alternative(s) but also very useful representations and measures of the level of cultural consensus and dissent of the board members which can be used to improve their composition and behavior.

1. Introduction

Since the fifties, the development of models to support decision making has been a flourishing field of Operations Research in three major areas:

A. Statistical Decision Theory [1,2]
B. Multicriteria Decision Making [3–5]
C. Game Theory and Negotiation Models [6,7].

Multicriteria Decision Making is often used to support organizational decision making and evaluation (see e.g. [8]), but the multiplicity of decision makers is just considered by C assuming that the game can be played by a set of $N \geq 2$ decision makers, $D=\{d_j : j \in J\}$ with $J=\{1,\ldots,N\}$ and that the outcome of the game, O

a) is defined by $O=[O_j : j=1,\ldots,N]$ where O_j is the specific outcome for player j,
b) depends on the choices made by each player within his specific set of alternatives.

Most of the results with practical applications assume that $N=2$.

The domain of group decision making addressed by this paper is substantially different because it is assumed that:

a) A single set of alternatives is defined and presented to the whole group of decision makers, $A=\{a_i : i \in I\}$ using the concept of alternative proposed by [9] and with $I=\{i:1,\ldots,M\}$ being $M \geq 3$.
b) A single decision has to be made by the whole group within A.

This problem is crucial for Welfare Economics since its very beginning on the 19th century [10] and Political Sciences [11] as it concerns the issue of integrating the values and preferences of multiple decision makers into a single group decision. In modern society, this problem is also a critical issue in Management Sciences to develop and to manage organizational systems such as corporations, municipalities, associations or networks because most problems of decision making are allocated to groups of representatives or officers (boards, assemblies, etc.) and therefore the need to develop models to support such processes of group decision making is quite obvious and critical as recognized by the seminal work of [12] according to the societal paradigm of "organizations and markets" and by many other modern authors considering the firm as a "governance structure" (page 162 in [13]).

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Group decision making within organizations has specific features such as:

A) The number of decision makers, N, is higher than 2 but much smaller than the number of voters studied by Political Sciences as in organizational problems it exceeds 15 very rarely.
B) The possibility of eliciting individual ordinal preferences for the studied set of alternatives is quite common.
C) The group decision making focus on a short list of alternatives already assessed by technical experts.
D) The expected level of consensus is higher than in other types of problems due to less conflict of values and a stronger common culture [14].

Actually, the model proposed in this paper addresses a quite common decision problem of any organization: how can its directive board (at general, sectoral or departmental level) select one alternative from a short list of alternatives already studied and analyzed by the technical staff of the organization and having enough merit to be included in the short list.

A very long list of different types of applied problems can be quoted but the author will just mention six major types of examples experienced as one of the two non-executive members of the General Board of Directors of the main Portuguese industrial group, MARTIFER (see www.martifer.com), including 9 members:

a) Which candidate to the position of CFO should be selected?
b) Which stocks should be sold?
c) Which project should be selected for a new investment on wind energy?
d) Which technology should be selected to develop solar energy products?
e) Which tender should be selected to award a contract to build a new factory?
f) Which type of international diversification?

In all these examples, each member of the board has to make a comparative judgment between alternatives using his strategic perspectives, business knowledge, professional experience and "feeling" as the most part of the analytical work was already done by the technical staff justifying the inclusion of each alternative in the short list. In this type of problem, a convenient way to elicit the judgment of each decision maker is to ask for his independent pairwise judgment between each pair of alternatives and then apply a decision model to find the group preference. The individual preferences tend to be less heterogeneous than those identified for individuals not belonging to the same organization because its management implies leadership and the development of a common organizational culture and, thus, a lower level of value conflicts and a higher level of consensus can be expected [14]. Otherwise, the organization cannot be managed efficiently, as shown by many authors since the eighties (see, e.g., [15,16]) concluding that "management consensus … is associated positively with economic performance" [15] after analyzing the behavior and outcomes of many corporate boards.

Operations Research has always given special attention to the issue of values conflict using multiple criteria (e.g., see [17] including an interesting review of MCDM papers published by Omega on 2007 and 2009) but, unfortunately and surprisingly, very few results are available to support organizational group decision making as it is recognized by other authors [18] despite a few contributions such as [19] and the model already proposed by the author of this paper [20]. Applicable proposals addressing this problem are currently much less developed (See [21]) than those published for topics A, B or C and even some very interesting and crucial results from Public Choice Theory such as the Theorem of Arrow [22] cannot be easily used to support these processes [23].

The proposed model was developed to elicit such individual pairwise comparisons and to obtain the group preferences.

Furthermore, two other key results produced by this model are the achieved levels of consensus and dissent which should be used:

a) to estimate benchmarking comparisons between different boards or between different decision problems for the same board;
b) to recommend the introduction of changes to the culture and / or to the composition of the board if a too low (high) level of consensus (dissent) index is obtained.

This model is based on a pairwise relation, consensus relation, and it fulfils important properties: absence of elementary cycles, weak transitivity, neutrality, no-negative responsiveness and qualified Condorcet criterion. Major previous results are reviewed in the next section and the proposed model is studied in Section 4 after discussing the use of pairwise relations to support decision making (Section 3). An illustration is presented in Section 5 and conclusions are included in Section 6.

2. Major previous results

Two major approaches have been pursued to study the problem of group decision making.

2.1. Cardinal measure of performance

In this case a cardinal measure of the performance of each alternative a_i according to each decision maker, $j, V(i,j)$ is known for any pair (i,j).

Then, the selection of the group decision, a^*, is studied in terms of $\sum_{j=1}^{N} V(i,j)$ for each a_i to identify a^* maximizing that sum.

Usually, $V(i,j)$ is studied in terms of multiple criteria as it is proposed by [3–5,24,25] using an additive and linear function although some outstanding examples adopting non-additive functions can be quoted too (see the well known case related to the selection of power sites by Keeney and Nair in [26]). However, obtaining a cardinal metric measure to evaluate each relevant performance can be quite difficult, particularly if strategic options should be compared despite several important and theoretical contributions (see, e.g., [27,28]).

It should be noted that some well known models such as Borda rule [29] allocating a score of $Y(i,j)$ points from M until 1 to the ranked alternatives $(i=1,\ldots,M)$ from the best to the worst one, respectively, by each decision maker, j, and then selecting a^* that maximizes the score

$$\sum_{j=1}^{N} Y(i,j)$$

is implicitly assuming that $V(i,j)$ is known and equal to $Y(i,j)$ without any particular reason or justification.

Furthermore, in this approach, decision makers tend to adopt $V(i,j)$ following the ranking ordinal scale and so they are implicitly assuming that the difference between the degree of preference on the performance of two adjacent alternatives is always the same but this is wrong in most real problems that may include both almost ex-aequo adjacent alternatives and very distant ones.