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Modelling complex ethical decision problems with operations research ☆

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ABSTRACT

This paper discusses the practical contribution of operations research (OR) techniques to modelling decision-making problems with ethical dimensions. Such problems are frequent in the global world: they frequently appear today in sustainability issues, e.g., in conflicts in the triangle of society, economy and environment. We show that the prerequisites for ethical problem-modelling are: the definition of moral principles, the evaluation of the decision context, the participation of stakeholders, the multidisciplinary collection of data, and the understanding of systemic interconnections. Classical OR instruments, mainly used in logistics and optimisation problems, are not entirely satisfactory for coping with the new ethical dimensions of sustainability. It is recommended to use and to develop more advanced, or combined instruments from the multi-criteria/multi-stakeholder and systemic streams of OR. It is argued that an important added value of using OR techniques for modelling today ethical issues lies at least as much in the discovery of open questions as in finding closed-form solutions.

1. Introduction

In previous papers published in this special issue [1–3], different aspects of promoting ethics in operations research (OR) practice have been developed. [1] is the umbrella introduction to all four papers. In [2] it is shown that good practice of OR, with the primary objective of quality control regarding the analyst's work already includes ethical considerations. The idea that good practice is necessary, but not sufficient is developed in [3]. Other dimensions of the ethical process in OR are discussed, evidencing difficulties and ambiguities in the relationships to be established between the OR practitioners and his/her clients, decision-makers or stakeholders. It shows that neither the analysis and modelling work nor the choice of analytical tools are entirely ethically neutral; incomparability, incommensurability and uncertainties must be dealt with, and contribute to the existence of ethical values.

Both articles [2,3] are centred on ethical dimensions to be found in the work and interaction of analysts and decision-makers in solving problems. This article concentrates on if, and how, OR instruments can significantly contribute to solving ethical problems in modern human societies. Put shortly, 'ethics in OR modelling' addressed in [2,3] is completed by the reverse point of view, i.e., 'OR modelling for ethics', in the present article. This paper primarily discusses how much, and by which techniques, OR may contribute to solving ethical challenges of our time. Many of them are located in the issues of 'sustainable development', i.e., according to [4]: 'sustainable development is development that

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meets the needs of the present without compromising the ability of future generations to meet their own needs'.

The idea that OR techniques can provide a useful contribution to important community issues is certainly not new. The British mathematician Lewis Fry Richardson [5] built the very first mathematical model of conflicts between nations—the arms race—in the thirties of the last century. This model is comparable to the well-known predator–prey model of Lotka–Volterra [6], developed at about the same time with a similar purpose of gaining insight into complex systems.

The founding fathers of OR during WWII were also very much conscious of the social and ethical issues to be addressed by OR techniques and models [7,8]. In the 1970s and early 1980s in the aftermath of the first oil crisis in 1973 many OR papers were produced on energy issues (see [9] with many references on energy planning studies in this period). Although not yet coming under the label of sustainable development, this work has to be understood as a desire to contribute to a crucial issue in modern industrial societies.

Later on, there were significant debates about the social and ethical role of OR (see for example [10–12]), also as part of the agenda of the Critical Systems Thinking movement (see [13–17]). An important contribution to OR modelling is the collection of papers in [18], of which several are mentioned in [2]. A recent paper [19] reviews contributions of OR to ethics, and discusses recent attempts to revive the ethical debate within EURO from 2000 on.

With the present article we hope to present a modest contribution pursuing similar lines of thought of our predecessors to better address important societal challenges with quantitative OR techniques.

The article is organised as follows:

Section 2 discusses several analyses that are prerequisites for modelling complex society problems with OR techniques. These preliminary tasks are made in interaction between OR practitioners and decision-makers, according to the principle of ethics in modelling detailed in [2,3]. In these steps several of the complex dimensions of ethical problems should be accounted for: the identification of moral principles; the societal context of the decision; the multidisciplinary and multiple-stakeholders aspects; and the systemic dimension of the problem.

Section 3 characterises OR techniques that are useful in evaluating decision-making problems, and how they may contribute in modelling problems with ethical dimensions.

Section 4 gives conclusions.

2. Prerequisites for modelling ethical decision problems

Much information and data must be made available prior to modelling with OR techniques. This is true in general for any problem. In the case of 'ethical problems'—several example of such problems will be provided in our text—additional analyses are needed, however.

Most of the time OR analysts are called in to provide assistance to decision-makers, or policy-makers, in solving 'well-defined problems', generally optimisation problems, like in supply-chain management, transportation logistics, location problems, etc. The moral values, or opinions, of different stakeholders are neglected, or of minor importance. Models are mainly, or entirely static, and only loosely, or not at all, connected to other problems, like the availability of raw material, the CO_2 emissions, etc. To solve these problems mathematical technicalities and skills are mainly required. In ethical problems new dimensions are present. Many problems of this kind appear in conflicts between economic, societal, and environmental aspects, as set out in [3]. An example of such conflicts would be the decision to extend a local airport on which low-cost airplane companies would operate. The conflict is between employment, travellers' enjoyment, etc., on one hand, and increased CO_2, fuel consumption, noise pollution, etc., on the other hand. In such problems the moral values and opinions of decision-makers and stakeholders' are central. In addition many connections exist with other aspects, which cannot be ignored in the modelling, because they may induce consequences on the society as a whole during a long time frame.

Thus ethical problems are much harder to address than logistical problems, and different skills and techniques are needed. The main issues are not primarily the technicalities or heuristics. The definition of the human context, the identification of stakeholders and their moral values, the systemic analysis of all connections and entanglement with society impose in-depth recurrent analyses. Table 1 gives a summary of these analyses and the sub-sections in which they are addressed.

2.1. Defining moral principles

Analysts and decision-makers must agree on moral principles, which lead the decision-making process. First let us define what is understood under moral principles. Morale and ethics are practically synonymous words. Ethics refers to the search of 'good' and 'fair' attitudes in human conducts, while the science of Morale details the set of principles required for a 'moral' behaviour. All the adjectives between quotes may actually have different meanings in space and time as will be further explained in Section 2.2 (see references in [6]). The discovery process of moral principles is most of the time quite tedious and difficult. The main reason is that moral principles in a given context are too general in character to deduce right courses of action in particular real life situations. Knowing what is 'right' and 'wrong' at a general level is not that useful in solving concrete ethical dilemmas. Even if we knew what the morally right principles actually are, it would not be enough to guide our decisions. Moreover, stable conditions are necessary for the construction of functioning moral principles, even at a general level. This is not the case in the world today, given the high pace of change.

Under such conditions, individual decision-makers, as well as groups and organisations, must acquire high ethical competence and confidence in handling significant moral problems that may arise in professional activities. That is necessary in order to solve moral problems, and to make moral decisions in accordance with relevant values, principles and interests. Spontaneous subjective reactions to moral