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Operations research/management science contributions to peace studies

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Abstract

The discourse on ethics in operations research/management science (OR/MS) has many aspects. Among them there is the ethical responsibility the OR/MS community faces in a world in which the widespread presence of structural violence makes the construction of a peaceful and sustainable social order a very challenging task, and puts at risk the very survival of human kind. In this paper we want to emphasize the role of the systemic approach, which is proper of OR/MS, with respect to the issue of peace, and in particular within the Peace Studies area.

Keywords: ethics in OR; Peace Studies; system thinking

1. Introduction

The discourse on ethics in operations research/management science (OR/MS) has many aspects. We can say that it develops around three main questions: "How?", "Who?", and "What?".

The first question has to do with the way operations researchers perform their research or professional activity: "How should we behave in our work?" and "How should we build our models?" The seminal book edited by Wallace (1994), *Ethics in Modeling*, was largely centered on these questions. The answer often takes the form of a set of ethical rules each researcher or practitioner is expected to follow. Typical rules of this type are, for instance, *to be honest and realistic in stating claims or estimates based on available data*, or *to reject bribery in all its forms*. Professional codes of ethics usually provide such sets of rules. A "Code of Professional Standards" and "Guidelines for Professional Standards in Operations Research and Management Science" were proposed by the *ORSA Ethics Committee* in 1983, although they have never been officially adopted by the Society.

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Models are not objective, nor are they value neutral, and a relationship between the model builder and the model user is essential in order to determine the "subjective" weights needed to achieve a solution "acceptable" or "appropriate for the parties" rather than "objectively optimal" (Le Menestrel and Van Wassenhove, 2004). And that leads us to the second question: "Who are our clients? For whom do we work?" This was the question asked in the OR/MS community by those whom Rosenhead and Mingers (2001) call "revolutionaries" who "did not seek just a change in the subject's method, but also in its clientele and establishment stance." The answer given by Rosenhead (1994) is that the OR/MS people "have worked almost exclusively for one type of client: the management of large, hierarchically structured work organizations in which employees are constrained to pursue interests external to their own." Those are not the only possible clients: other types of organizations exist, operating by consensus rather than chain-of-command, and representing various interests in a society (health, education, shelter, employment, environment). But such organizations usually have few resources at their disposal, although the problems they face are no less challenging for the OR/MS profession. Community-based Operations Research was created in the United Kingdom in the 1980s to provide OR expertise to these organizations.

The second question is strictly linked to the third: "What kinds of problems should we tackle?" This question is at the center of a discussion within the OR/MS community, which has found space in two issues of *OR/MS Today* published in 2008.

While the first two questions have to do with the way OR/MS researchers/practitioners work, with their relation with the client, and with their attention to the broader effects of the proposed solutions, this third question has to do with the ethical responsibility the OR/MS community faces in a world of growing inequalities and in which the ever greater stress that human activities impose on the environment puts at risk the very survival of human kind (Brans and Gallo, 2007). The awareness of the role the OR/MS community may play with reference to these problems is growing. Evidence of this awareness is the institution of the "Doing Good with Good OR" Committee of INFORMS, with the "goal of showing how operations research can (and does) provide important insights that can be used to inform and shape public policy on important societal topics." In the 2008 INFORMS annual meeting, at Washington, DC, a special stream on "Doing Good with Good OR" was programmed with a focus on three daunting societal challenges: energy and the environment, public health, and air congestion. In one of her editorials in *ORMS Today*, Cinthia Barnhart, INFORMS President, discusses the grand challenges humanity faces today and how and which of them can be tackled through our OR/MS expertise (Barnhart, 2008). Among the topics she mentions are providing access to clean water, developing a self-sufficient sustainable energy program, improving healthcare in developing countries and in the United States, and developing effective counter-terrorism strategies. An example of how OR analysts can make a contribution in sectors quite far away from the usual ones is provided by Samuelson (2008) in an article on the "little-known role of O.R., statistics and data analysis in uncovering human rights abuse around the world."

If we consider "peace" not just the absence of war or of direct physical violence, but a situation in which the root causes of war, violence, and injustice have been eliminated, then all the tasks we have just mentioned are part of the construction of peace. Indeed, to get to such a situation, we need to establish social equality and justice, economic equity and ecological balance, meeting the basic human needs of all the citizens. In the next section we will elaborate on the concept of

positive peace and of its implications. Then in Section 3 we will review the main application areas connected to conflict prevention and peace construction where the different OR/MS techniques do find application. Finally in Section 4 we will move toward a more methodological and epistemic level, elaborating on the role of system thinking and interdisciplinarity in peace construction. Some concluding remarks end the paper.

2. Peace and freedom

Today, within the Peace Studies community, the distinction between negative peace and positive peace is quite common (Galtung, 1969, 1996). It is, more than a distinction between two concepts, a distinction between two perspectives: the same concept peace is seen from two different points of view.

Negative peace means focussing on the need of ending a conflict or of curbing an ongoing violent confrontation. A negotiated process that leads to the interruption of a confrontation, a peace treaty ending a war between two countries, the intervention of a peacekeeping force, or of an interposition force are different types of negative peace interventions. *Positive peace* means, on the other hand, focussing on the conditions that make a lasting and sustainable peace possible.

As in negative peace, positive peace also has to do with violence, but here we need to enlarge substantially the concept of violence. This is what is usually done with the introduction of the idea of *structural violence* (Galtung, 1996). We shall first try to provide a general definition of violence and then we will distinguish among different types of violence. Borrowing from Sen (2001), we define violence as any action or any condition that "prevents people [from leading] the kind of life they have reason to value." Using this definition we have linked the concept of violence to the concept of freedom. We may distinguish between positive or "substantial" freedom and negative freedom. Substantial freedom has to do with that set of freedoms which not only makes our life "richer and more unfettered, but also allows us to be fuller social persons, exercising our own volitions and interacting with and influencing the world in which we live" (Sen, 2001, p. 15). Among these freedoms we can list: (i) *political and civil freedom*, which implies not only free vote and free speech, but also the capability of leading one's own life and of having the opportunity to take part in crucial decisions regarding public affairs; (ii) *social and economic freedom*, that is the freedom to access those basic goods and services such as food, shelter, education, healthcare, without which we are denied the capability of fully living our lives; and also the freedom to participate in the work market, to exchange goods and to make transactions; (iii) *cultural and religious freedom*, that is the freedom of developing one's system of religious, philosophical and cultural beliefs and of ethical norms, to express them and to live according to them. These are not necessarily individual freedoms. They may also be collective ones, that is their subject may be a community or a population.

All these freedoms are "freedoms of," while on the contrary negative freedoms are "freedoms from," such as, for instance, the freedom from need, from poverty or from starvation, the freedom from suffering, from illness or from premature death, and the freedom from the many dimensions of insecurity. Sen uses the term unfreedom to denote those situations in which someone has lost some specific freedom. An extreme poverty is an example of unfreedom, so is the case of slave

labor still present in some countries, or the impossibility of finding a job in absence of social safety nets.

Another important concept that is necessary to make our definition of positive peace as freedom complete is that of equality. In principle everybody must be granted an equal right to the different forms of freedom. That does not mean that in a certain situation all have to share the same quantity of freedom, but that as far as quality everybody should have right to the same types of freedom. And in fact inequality is possibly the biggest obstacle to peace in today's world: "What is happening in individual countries of the South, and much more harshly across the world, is an increasing rich–poor divide. All the indications are that this will continue over the next 30 years, and may even accelerate, with the development of a trans-state global elite surging ahead of the rest. This elite, of rather more than a billion people, a sixth of the world's population, lives mainly in the countries of the North Atlantic community, Australasia and part of East Asia" (Rogers, 2002, p. 86).

The overcoming of inequalities is a fundamental task in peace construction, and the main claim of this paper, on which we will elaborate in the following sections, is that OR/MS has a relevant role to play in that.

The role that MS/OR may have in peace construction is twofold. On the one hand it has to do with the specific problems that are dealt with, and with their technical solution. On the other hand it regards the epistemic contribution of OR/MS to the Peace Studies/Research area. These two aspects will be the subject of the next two sections.

3. MS/OR methods and tools in peace construction

Humanitarian interventions is a typical case in which classical OR/MS methods can find a new, relevant and challenging area of application. Extreme natural events, such as earthquakes, floods or droughts, and human generated events, such as interethnic violence or internal conflicts, require large coordinated interventions to bring relief to the populations affected. This is particularly true in situations characterized by a scarcity of internal resources. Typical examples are the 2004 Tsunami which hit hard Indonesia, Sri Lanka, India, and Thailand, the interethnic conflicts in the Balkans, and the huge number of internally displaced people (about 26 million, according to the UNHCR, the UN Refugee Agency) who need assistance all around the world. All these cases call for the use of sophisticated logistics and management tools, and that has led to the development of a new sector within MS/OR, that of Humanitarian Logistics and Management (Van Wassenhove, 2006; Tomasini and Van Wassenhove, 2009), a sector concerned with the study of supply chain strategies, processes, and technologies that can make humanitarian operations more effective.

Emergencies due to pandemics, either naturally occurring or as a consequence of calamities, conflicts or even bioterrorist attacks, demand fast, efficient, large-scale dispensing of critical medical countermeasures (Lee, 2008). OR/MS tools can be used to help expand access to HIV care and treatment in developing countries, where resources for treatment are usually very limited.

Another area in which there are plenty of competences and experience within the OR/MS community is that of planning, location and management of services. Providing access to health

and school services, to clean water, and to energy are essential tasks for which the contribution of OR techniques is essential.

A relatively new area in which OR/MS may provide interesting contributions is that of conflict analysis and prevention. The use of OR/MS techniques in this area is still at an early stage. Simulation can be used to analyze the dynamics which may lead to violent clashes between states or within a given state. An example is the system dynamics model of Wils et al. (1998), where the conflict is related to factors affecting the possibility of sustainable development such as population growth, resources and technology. Considering the types of variable used, which change rather slowly over time, this model can hardly be used to anticipate the outbreak of a violent conflict, but can provide evidence of situations of possible instability. It can be used to analyze both inter-state and intra-state conflicts. Ellis (2004) has used a system dynamics methodology, in a more qualitative way, to examine the geopolitical significance of narcoterrorism dynamics in Colombia and the Andean Ridge region. Through influence diagrams, a systemic analysis of the phenomenon is presented, and the interactions between drug production and insurgency are discussed. The analysis of the model suggests that the extensive quantity of positive feedback relations in the system could make the violence and social chaos spread across the region, and overwhelm the capability of governments to respond more rapidly than a traditional analysis of narcoterrorism and other regional phenomena suggests.

Clustering techniques, either single or multicriteria, can be used for analyzing and forecasting the phases through which a conflict may develop. Here daily or weekly data representing the events occurring in a given geographical area can be used, hence allowing for more accurate analyses. Single criterion clustering has been used by Schrodt and Gerner (1996). As test bed they have used the Middle East conflict, making use of the Reuters headlines as source of their data. The use of multicriteria clustering, with an application to the conflict in Nepal, has been proposed by Gallo et al. (2006).

A different approach to the problem of detection of situations of instability and of risk of the outbreak of violent conflicts is one based on classification and pattern recognition techniques. The use of neural networks to try to detect the situations in which there is a high risk of violent conflict has been proposed by Marwala and Lagazio (2005). A different approach, making use of logic functions and Boolean optimization techniques, has been proposed and tested with good results by Felici and Sodini (2006).

4. OR/MS epistemic contribution to Peace Studies

The emergence of Peace Studies and Research has required a sort of paradigm shift within the social sciences. The main question is how to include the *values* in the research without losing the characteristic of science it should have.

The answer of Galtung (1996, pp. 11–12), in accord with constructivism, can be synthesized in the triangle "Data–Theories–Values." *Data* means the reality in a rather wide sense: the reality we observe and the reality we would like but we do not observe. So "data divide the world into *observed and unobserved*." Theory is what makes the data intelligible. Theories divide the world "into *foreseen* (meaning 'accounted for by the theory', which may or may not imply an element of prediction) and *unforeseen*." *Values* correspond to our judgment, and "divide the world into

accepted and *rejected*.'' It is our values that make us decide whether a state of the reality around us should be considered as acceptable or not, and to decide whether a change goes in a desirable direction or in an undesirable one. ''If the observed is foreseen and desired, and the unobserved is unforeseen and rejected, then we live in the best of all worlds. The second-best is a world where the desired is unobserved but foreseen through an evolutionary process.'' Unfortunately this is rarely the case. So we might imagine any intervention in the reality as a spiraling process, which, starting, at least in principle, from any of the three points, is iterated again and again:

1. From the data/reality we build models/theories.
2. What we can foresee from the models appears to contradict the values.
3. We devise actions that – hopefully – make the reality to change toward a more desirable state.

We can easily recognize that there is a strong correspondence between Galtung's approach and the System Thinking approach widely used within the OR/MS community. Such a correspondence is summarized in Table 1.

The correspondence is strong although not entirely complete. Data in Galtung's view is the reality from which we start in our analysis, and which we would like to change through our intervention, although the use of the term ''data'' instead of ''reality'' suggests that all the problems connected with the way we know the reality are somehow underestimated. These problems involve two points, distinct but overlapping. The first is essentially philosophical, and concerns the fact that ''we cannot know the exact relationship between human knowledge, the language we use to frame this knowledge, and reality. This is because, whatever we know about reality is just that – knowledge, not reality itself'' (Midgley, 2000, p. 2). The second is more practical and can be expressed by the well-known metaphor of ''Clouds and Clocks'' (Popper, 1972): the reality is more similar to irregular, disorderly and unpredictable ''clouds,'' rather than to regular, orderly and predictable ''clocks.'' In the system thinking paradigm the awareness of these problems has always been present. We know that the reality ''is fundamentally elusive, and that the attempt to clarify its meaning and to identify a solution distorts [it] and destroys its real significance'' (Churchman, 1970). Ackoff calls such a reality mess: we ''are not confronted with problems that are independent of each other, but with dynamic situations that consist of complex systems of changing problems that interact with each other. [We] call such situations messes. Problems are abstractions extracted from messes by analysis'' (Ackoff, 1979).

A conflict, either explicit or latent, either characterized by direct violence or only by structural violence, is a ''mess.'' Within such ''mess'' we can single out some relevant components. But we know that analyzing these components per se is not enough to understand the conflict: we have to understand how they interact and, no less important, how these interactions make them change

Table 1
Galtung's constructivism vs System Thinking

Galtung's triangle	System thinking
Data	Reality (''Mess''), current state
Theories	System as a modeling paradigm, models
Values	Goals, desirable state

over time, that is the dynamics of that particular system that is a conflict. To analyze a "mess" means mainly to build a model of a system that represents it or, better, makes it intelligible. A related important problem, therefore, is that of the definition of the boundaries of our system. Which elements/variables shall we include in the system and which will be left out? In a conflict there are multiple actors, those who are affected by the conflict's outcome (also if they do not have any decision capability), and those whose actions have an (possibly unwanted) effect on the conflict. Of all these actors/stakeholders some are openly and directly involved, some are only marginally involved, and some are even hidden. The decision on whom to include explicitly in the system is crucial (and not an easy one). At the same time there are multiple issues at stake. Some are more tangible, such as resources or physical boundaries, others are at symbolic level, such as the right for a minority group to speak its own language, or the control over a holy place. Again, the decision about their inclusion or exclusion from our analysis of the conflict may prove to be crucial. These are the crucial problems of defining the boundaries of the system. All this requires the interaction and intertwining of different competencies and disciplines, together with system thinking capabilities.

Take for instance the Israeli–Palestinian conflict. Where shall we put the boundaries of this conflict? We can limit ourselves to consider the main actors and the land issue, but only to discover soon that there is the question of the water, and that the two societies are quite fragmented inside. Shall we consider the political dynamics that develop inside the two camps? And to which level of detail? Consider that it may happen, and in fact it happens, that the action of a splinter group may derail a peace process. But boundaries do not involve only social groups or physical entities like land, they have to do also with time. In analyzing the conflict, not as historians but as political actors, when should we consider the conflict as starting from? From 1967 as most Israeli leaders would want, or from at least 20 years before as most Palestinians would insist? That has crucial consequences on one of the more controversial issues in the conflict, the refugee issue.

The fundamental role of the boundaries has a far reaching consequence: the waning of the idea and role of "the expert." The pertinent knowledge in any system depends on where we set the boundaries. The setting of the boundaries decides also the people who produce that knowledge, whether or not they are included in the system. In general more different expertises are required in the analysis of the system, and this depends on the boundaries we have chosen for the system. Further, this means that there is not a single person or a group of people who owns the knowledge. That should make us cautious about the possibility of the idea of the "conflict expert" and of the pretense that the goal of peace studies curricula is to form such experts. It might well be the case that the only true "conflict expert" is one who is capable of critical thinking, of analyzing the reality via system thinking, and of organizing and utilizing the knowledge coming from those "experts" who are more appropriate to the particular situation in which he/she is operating. This is the typical role of the OR/MS researcher/practictioner, who happens to work in many diverse application areas, and who has the need to access different types of specific expertise.

Other important components of a peace worker's activity have to do with making choices, taking decisions and implementing them. This again requires interdisciplinarity and a systemic approach. Most of the problems in today's world arise from a mechanistic/reductionistic way of thinking, based on linear cause–effect reasoning: "I have a problem, I perform an action (the cause) and get the wanted effect." This is something we have seen many times in recent years, sometimes with deadly results. Complexity defies this simplistic linear reasoning. A host of

different examples can be brought to illustrate this point. We will just mention one. In 1982 the Israeli government wanted to get rid of the Palestinian Liberation Organization (PLO), whose headquarters were in Lebanon at that time, and launched the operation Peace in Galilee, which took the form of a full-scale invasion of Lebanon (Sharon was the mastermind behind the plan). Losses were heavy on both sides; and while the PLO was dislodged, it did not take too much effort for it to reorganize in Tunis, and it was only a matter of a few years for the PLO to become powerful again with the start of the Intifada. Most importantly, a completely unforeseen effect materialized: the birth of a new nationalistic, fundamentalist Islamic movement, Hezbollah, who engaged Israel first in a long war of attrition and, more recently, in a full-scale one. Contrary to mechanistic/reductionistic thinking, system thinking starts from a full appreciation of the complexity and nonlinearity of the real world. It goes through three steps. "First, a thing to be understood is conceptualized as a part of one or more larger wholes, not as a whole to be taken apart. Then understanding of the larger containing system is sought. Finally, the system to be understood is explained in terms of its role or function in the containing system. Analysis of a system reveals its structure and how it works; it yields know-how, knowledge, not understanding. It does not explain why a system works the way it does. Systems thinking is required for this" (Ackoff, 1979). It is barely necessary to stress that this approach is somehow recursive, each system being not only part of a larger one, but containing smaller systems (its subsystems or components) whose interaction is essential in explaining the way it works. It should never be forgotten that a system usually exhibits behaviors or properties that none of its components individually may exhibit. Crucial to the understanding of a system is also the concept of feedback. Feedback leads to causal loops, which may be either self-reinforcing or self-correcting. A typical case of a self-reinforcing loop is that involving repression and resistance in asymmetric conflicts. Fear and insecurity within the population holding the power leads to a reinforcement of repressive measures. Repression increases the hate of the oppressed minority, strengthening its group identity and its determination to resist oppression. That produces new violent resistance, possibly terrorist actions, which in their turn reinforce fear and insecurity, leading to renewed repression. The final effect of the loop is to justify the idea that each part holds firmly true, that no compromise with the adversary is possible.

5. Conclusions

The discourse on ethics within the OR/MS profession has many aspects. One of them has to do with the role OR/MS may play in contributing to peace construction. In this paper we have first analyzed the concept of peace, enlarging its scope and linking it to the idea of freedom. Then, based on this wider idea of peace, we have discussed the many contributions the OR/MS techniques and methodologies can make to the construction of a better and more peaceful world. In particular we have reviewed the many areas in which some OR/MS techniques have already found applications; among them "Humanitarian Logistics," design and management of basic services (health, schooling, water, etc.), planning of emergency interventions, analyzing the development of conflicts, anticipating the outbreak of violence in crisis situations, etc. In the last section we have shown how system thinking, which is at the basis of the way OR/MS professionals analyze complex problematic situations, may complement and enrich the methodological approach developed within the peace research area for the analysis and the intervention in conflict situations.

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