



HAL
open science

Is there an ethical operational research practice? And what this implies for our research?

Odile Bellenguez, Nadia Brauner, Alexis Tsoukias

► To cite this version:

Odile Bellenguez, Nadia Brauner, Alexis Tsoukias. Is there an ethical operational research practice? And what this implies for our research?. *EURO journal on decision processes*, 2023, 11, pp.100029. 10.1016/j.ejdp.2023.100029 . hal-04239877v2

HAL Id: hal-04239877

<https://hal.science/hal-04239877v2>

Submitted on 16 Oct 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0 International License



ELSEVIER

Contents lists available at ScienceDirect

EURO Journal on Decision Processes

journal homepage: www.elsevier.com/locate/ejdp

Is there an ethical operational research practice? And what this implies for our research?

O. Bellenguez^a, N. Brauner^b, A. Tsoukiàs^{c,*}^a IMT Atlantique, LS2N, La Chantrerie, 4 rue Alfred Kastler, Nantes 44307, France^b Univ. Grenoble Alpes, CNRS, Grenoble INP, G-SCOP, Grenoble F-38000, France^c CNRS-LAMSADE, PSL, Université Paris Dauphine, France

ARTICLE INFO

Keywords:

Ethical operational research
Awareness
Autonomous artefacts

ABSTRACT

The ethical dimension of Operational Research and Decision Aiding, although not a new subject, has become more of a concern, both for the large public and the OR community, because of the wide spread of autonomous artefacts endowed with decision capacity thanks to the use of models, methods and tools developed within our field. The paper addresses the question of whether there exists an “Ethical Operational Research practice”, identifies the ethical questions which are specific to our professional community and suggests research topics which, although independently developed, are relevant for handling such questions.

1. Introduction

There is an increasing interest and discussion about “Ethical Operational Research” and more generally about “Ethical” or “Responsible” Decision Support (see Tsoukiàs, 2021). The topic is not really a new one: there is a EURO Working Group on Ethics¹ since 2002 and there is a “Prometheus Oath” written by J.P. Brans, founder of this Working Group (see Brans, 2002).² Interested readers can see two excellent surveys in Brans and Gallo (2007) and Ormerod and Ulrich (2013) of the literature on this topic.

Under such a perspective this contribution just continues an ongoing discussion already started in the 60s and early 70s (see Ackoff, 1974; Churchman, 1968) and continued since then (see Gallo, 2004; Gass, 2009; Gass, 1994; Menestrel and Wassenhove, 2009; Wenstøp, 2010). The reason for which these topics return to be discussed is related to the increasing diffusion of “autonomous artefacts” with augmented decision capacity. Both the wide public, but also scientists and policy makers are concerned by the wide spread of devices and processes which decide or recommend decisions using “algorithms” or “methods” which are felt to be non-controllable, dangerous, biased, unfair, inexplicable with unknown long-term impacts (Casteluccia and Métayer, 2019).

We share such concerns with a near discipline, Artificial Intelligence³ and more precisely with Computational Social Choice.

There is a large literature about the ethical issues which arise due to the massive deployment of autonomous artefacts with enhanced decision autonomy incorporating tools developed within the area of Artificial Intelligence. Such autonomous artefacts range from devices which actually take decisions (although bounded in scope) to devices (the vast majority) who provide recommendations to human operators (most of the times exploiting some machine learning capability).

A first remark to make is that more often than not, such devices and artefacts incorporate both AI tools and Decision Analysis or Operational Research tools, not to talk about tools at the edge of these communities (such as Constraint Programming tools). Under such a perspective most of the concerns expressed in this paper about the necessary awareness and critical view about the use of such tools applies also to Artificial Intelligence based autonomous artefacts (see Tsoukiàs, 2021).

There are however, some differences, at least in terms of perspective, when we consider tools exploring artificial intelligence techniques, specially when these are exploiting masses of data and deep learning methods. A typical difference consists in deploying a “data-driven” approach, while mainstream decision analysts generally adopt a “model-driven” approach. Interesting enough very little attention is paid from

* Corresponding author.

E-mail address: alexis.tsoukias@dauphine.fr (A. Tsoukiàs).¹ See <https://www.euro-online.org/websites/ethicsandor/>.

² Several OR professional organisations suggest ethical principles: <https://www.theorsociety.com/about-us/board/ethical-principles/>, <https://www.informs.org/About-INFORMS/Governance/INFORMS-Ethics-Guidelines>, <https://www.certifiedanalytics.org/code-of-ethics> which set the benchmark of what is considered today ethical practice in our discipline.

³ See the topics discussed at the conference: <https://factconference.org/> or the Mechanism Design for Social Good Working Group: <https://www.md4sg.com/>. See also the High-Level Expert Group for Trustworthy Artificial Intelligence recommendation to the European Commission: <https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai>.

<https://doi.org/10.1016/j.ejdp.2023.100029>

Received 8 June 2022; Received in revised form 4 December 2022; Accepted 16 January 2023

2193-9438/© 2023 The Author(s). Published by Elsevier Ltd on behalf of Association of European Operational Research Societies (EURO). This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

both sides on developing a “problem-driven” approach of the type we consider important in this paper.

Most of the discussion about the ethical questions which arise from deploying such autonomous artefacts (independently from the adopted technology) concerns issues such as the explicability of their outcomes, the accountability of the decision process implemented within such devices, and the social impact of their use when this implies amplifying discrimination, disparate impact and unfairness (see [Abu-Elyounes, 2020](#); [Brkan and Bonnet, 2020](#); [Casteluccia and Métayer, 2019](#); [Kroll et al., 2017](#); [Lepri et al., 2018](#)). Our claim is that such concerns are essentially the same with the ones discussed in this paper and that most ethical questions we introduce in this paper apply also for the case where algorithms and problem solving methods are embedded in autonomous artefacts.

The paper is organised as follows: in [Section 2](#) we introduce a general framework for the paper discussion. In [Section 3](#) we identify the type of “ethical questions” that could be of interest for this paper. In [Section 4](#) we discuss the questions which can be raised within our professional practice as decision analysts (or designers of decision support devices). In [Section 5](#) we briefly detail some research topics which although stand alone are at the same time useful in order to improve how we handle the topics discussed in [Section 4](#). We summarise the discussion in [section 6](#) where we ultimately provide a reply to the question in the title.

2. Motivations and setting

As already mentioned in the Introduction, there exist codes of ethical conduct for our profession. However, on the one hand most of the recommendations are based upon ethical principles of appropriate professional conduct which are independent from the type of profession OR practitioners do (do not consider the specific responsibilities deriving from the fact to help, using formal tools, other people to take decisions), and on the other hand such codes do not consider that part of our profession consists in embedding decision support methods and tools within autonomous artefacts with enhanced decision autonomy. This is the first reason for which we need to update the discussion about ethics in OR practice.

At the same time the existing surveys about “ethical OR” adopt a relatively broader and different point of view which we may summarise under the question: “can OR as a discipline adopt an ethical perspective including questions about the type of society we expect to establish using OR?” (see [Ormerod and Ulrich, 2013](#)). On the one hand our point of view is more limited: we question what an ethical OR practice should be (if it exists), considering that the question about an “ethical OR discipline” are more related to individual values. On the other hand, we explicitly introduce the dimension of our professional responsibility (potentially extendable to liability issues, see [Hacker, 2022](#)) when we (as OR professionals) contribute to create autonomous artefacts with a potentially high impact for the users, the involved stakeholders and the society as a whole. And this is the second reason for which we need to expand our discussion about ethics in OR practice.

Last, but not least, there is a question very little addressed in the “ethical OR” literature and concerns the demand: “which research topics of our discipline are more relevant to the ethical questionings for OR practice?” To this purpose we dedicate the discussion in [Section 5](#).

In order to frame our discussion we are going to use a precise setting introduced and discussed in [Meinard and Tsoukiàs \(2019\)](#), [Meinard and Tsoukiàs \(2022\)](#) and [Tsoukiàs \(2007\)](#).

We consider a situation where a “client” (an entity implied in a decision process), asks an advice to a “decision analyst” about how to improve his/her conduct with respect to that decision process. We also consider situations in which the “client” does not seek an advice for a precise decision process, but for a class of decision processes, the advice

coming under the form of a device/system/software which is supposed to elaborate recommendations; the decision analyst in such cases being the designer of such systems. Under such a perspective, the decision support activities can be seen as:

- either the direct interactions between client and analyst in order to elaborate a recommendation;
- or the design of an appropriate system which on its turn will compute or help to compute a recommendation.

Clearly many combinations between these two extreme cases are possible in the real world.

As already partially mentioned in [Tsoukiàs \(2008\)](#), the use of a formal decision aiding methodology implies considering three different dimensions.

1. An axiomatic dimension, establishing the conditions under which it is possible to use protocols/algorithms/models in a meaningful and useful way.
2. An algorithmic dimension, considering the size of the solution space, the necessary data (availability, accessibility, storage, quality) as well as the necessary computing resources.
3. A pragmatic dimension related to the conditions under which a decision aiding process is valid and legitimate (see [Landry et al., 1996](#); [Landry et al., 1983](#); [Meinard and Tsoukiàs, 2022](#)).

3. Ethics for whom?

First of all we need to identify different categories of concerned individuals. To be more precise: as Operational Researchers or Decision Analysts we may raise ethical questions for different purposes and under different perspectives. Not all of them are necessarily of interest for a scientific investigation.

We may raise ethical questions just because we are conscious citizens. These are the typical questions which all of us some day need to consider, but generally are related to our own individual values. These cannot be matter of study, analysis or guidelines and principles of conduct within our discipline if not respecting the very general values our societies consider relevant. But there is nothing specific to the fact that we are decision analysts.

Just to be more precise: accepting to provide support and models for military operations can raise ethical and/or moral questions to any among us, but the positive or negative reply is a matter of personal choices. Some of us will be happy to do it, others not and others might be indifferent. We cannot establish any ethical guideline on how to handle such issues.

Some among us, besides being citizens are also teachers or researchers (in OR). Independently from our specific discipline and research field, there exist ethical questions related to our precise role of scientists. Such ethical questions concern our conduct as teachers (with respect to our students and colleagues) and researchers (with respect to our near scientific communities and the science in large).

Such issues are generally handled through deontology charts (how to behave appropriately with the students, how to conduct experiments, how to write papers, how to quote the existing literature etc.), or specific debates in philosophy of sciences (see e.g. [Coutellec, 2019](#)), but are not specific to our discipline and research areas (see e.g. the Practical guide “Integrity and responsibility in research practises” from the CNRS ethics committee ([CNRS ethical committee COMETS, 2017](#)), the Singapore Statement on Research Integrity ([WCRIF, 2010](#)), the OECD Best Practices for Ensuring Scientific Integrity and Preventing Misconduct ([OECD, 2007](#)), The European Code of Conduct for Research Integrity by the European Academies [AllEuropeanAcademies, 2017](#)).

There are instead two areas of ethical concerns which are specific to our domain and role of Decision Analysts. These are related to our profession (providing advice to decision makers or designing tools to be used by decision makers) and to our research in the broad area of Operational Research and Decision Analysis.

4. Professional ethics

It is interesting to note that large part of the debate and the literature about the ethical dimension of our discipline and the practice related to it, originate from discussions about professionalism and deontology in our profession started at the late 60s (ORSA, 1971). At that time the idea of creating a professional body of “chartered” operational researchers or decision analysts (later on called “OR Fellows” by the ORS in UK) ignited a debate which lasted several decades before reaching any practical conclusion. This discussion moved beyond the UK and USA professional bodies and was characterised by connecting the question of what a “chartered OR professional” should be, with the question of what an ethical OR conduct and what appropriate professional deontology prescriptions should be. Most of the debate (see Ackoff, 1979a; Ackoff, 1979b; Churchman, 1970; Kirby, 2006; Rauschmayer et al., 2009; Rosenhead and Mitchell, 1986) criticised the initiative of the ORS and the ORSA⁴ as being partial and ineffective, focusing on professionalism without defining what the OR profession is (some claiming this definition as impossible) and without clarifying what an appropriate ethical standing of this profession should be.

We can try to summarise our point of view under a specific perspective (the one of conducting rationally decision aiding processes).

As decision analysts we provide support to clients. We are not the only professionals who provide decision support: lawyers, accountants, physicians, psychotherapists, engineers, just to give some examples, help their clients to handle their problems and they do so using some scientific knowledge and approach, thus distinguishing their profession from just informal intuitive advice to friends and relatives. There are two topics we need to consider here:

- What does make our decision support different from other equally scientifically based decision support activities? In other terms why decision analysts are not psychotherapists?

- Since we nevertheless share some features with other professions, who already considered the problem of deontology, compliance, unsatisfied clients, young professional training etc., why our profession should not establish similar protocols, practices, training modules etc.?

We are not going to answer the above two questions here because it is out of the scope of this paper. These two topics instead help us identifying the ethical problems to handle within our profession: under which conditions we can claim that our professional advice to a client satisfies appropriate ethical standards and who establishes such standards?

We need to separate two distinct cases raising potentially different types of “ethical questions”. The first one is the case where analysts directly provide at a client some advice on how to handle a problem within a decision process, a typical case being organising the shifts of the personnel at the emergency department of a hospital or managing a large call for tenders for software COTS for an IT industry.

The second case consists in designing generic methods, protocols or software aimed at being used for a precise class of decision problems, possibly customising such products for and with specific clients. Typical examples here include, supply management packages, flow-shop scheduling procedures, generic recommender systems etc.

There are certainly mixed cases as well as cases where specific applications become generic ones (a well known example being the yield management procedures originally designed for a specific client and then developed as stand alone customisable methods; see Smith et al., 1992).

Despite the apparent differences between these two cases, we will develop a unique argumentation based on two aspects:

- the use of a decision aiding methodology;
- the unveiling of hidden or implicit assumptions within our models and/or methods.

⁴ the Operations Research Society of America, from which INFORMS arose after merging with TIMS.

4.1. Decision aiding methodology

We start considering our profession as being characterised by the use of a formal language, the pretention of using/introducing a rationality model within the client’s decision process and the use of algorithms (see Tsoukiàs, 2008). As introduced in Tsoukiàs (2007), a decision aiding process can be defined as the interactions between a “client” (asking for advice, including the case where a generic tool is requested) and an “analyst” (providing the advice) and can be represented through a set of “deliverables” such as:

- a description of the problem situation;
- a problem formulation;
- an evaluation model;
- a final recommendation.

In constructing such deliverables we make choices (as analysts).⁵ For instance:

- in order to represent the likelihood of an event we may adopt a probability measure (while other measures are possible);
- in order to compute a majority for a voting procedure we may adopt the “Borda” rule (but others are possible);
- in order to model the impact of the combined realisation of some decision variables we assume this impact being linearly defined with respect to the variables (but other choices are possible).

Such “technical” choices are most of the time uncontrollable by the client and we (the analysts) are the only able to measure the consequences and to guarantee the meaningfulness and usefulness of their use.

We also do further hypotheses which are less technical, but nonetheless important. For instance:

- in calculating the economic impact of a given infrastructure we consider a “territory”, but how this territory is chosen/defined?
- in designing a supply chain we consider the client’s costs and time constraints, but are these the only constraints we should take into account?
- in order to set up a vendor rating procedure should we compare the suppliers between them or only with respect to quality standards?

Despite such choices being agreed with the client(s), it is unlikely the client(s) really realise the extension to which modifying any of these hypotheses can modify the outcome of the decision aiding process. In other terms, beyond any generic deontological constraint due to the fact that we have a professional relationship, we need to consider the specific constraints our condition sets. We can try to summarise these through the following points.

- *Are we sufficiently critical?* The fact we work for a client does not mean we cannot or we should not have a personal and independent perspective about what the client claims to be the problem to consider. We need to be able to show to the client aspects of the problem or other problems she does not see. At the same time we should be ready to modify our perspective and learn from the client’s claims, values and beliefs.
- *Where does rationality come from?* This topic is extensively discussed in Meinard and Tsoukiàs (2019). The point to raise in this discussion is that there are several sources of “rationality”, from external norms and standards to subjective behaviours and argued beliefs. What we need is understanding which among such different sources we use with that precise client for that precise decision process we are involved to. The pretention of introducing one or more dimensions of rationality to the client’s reasoning for her problem, is what, most of the times, legitimates our action as analysts. Having a clear idea about where such dimensions of rationality come from is essential in establishing an appropriate professional relationship with the client.
- *Can we explain, justify and easily revise or update?* Most of the times we deliver both a model and the results of applying a set of methods

⁵ In this section “we” will indicate the “decision analysts” and not the authors.

to the constructed model. This implies choosing among what our technical knowledge and skills provide, following what the client claims being her problem. However, we do many technical choices which not always are “obvious”, at least for the client and/or the other involved stakeholders. It might not be always necessary, but we need to ask ourselves: should I be asked, am I able to explain why we did such a technical choice, to completely justify such a choice against an appeal to a court and to defend the choice against an “adversary” analyst? Moreover, since modelling for decision support purposes is always a learning process, we also need to ask ourselves: how easy is it to revise and update the model and the methods in case the data change, the values and the opinions change, the problem setting (and formulation) can change.

- *Is the result convincing for us, for the clients and for the involved stakeholders?* Providing decision support means constructing convincing arguments for some potential action to undertake. Such convictions concern three different categories of stakeholders. We first need to convince ourselves that our advice is sound with respect to our technical knowledge and our methodology. We then need to convince the client that our advice is appropriate with respect to the problem the client has, the decision process for which the advice has been asked: the client needs to feel owner of the advice received. Finally we need to convince the rest of the stakeholders that the advice to the client was legitimately designed, that we have been critical and that the impacts of our advice being adopted have been understood.

4.2. Hidden assumptions

Although in a professional setting analysts deploy a formal decision aiding methodology, they are always induced in considering some assumptions as granted or given. Some of these can become explicit through an appropriate use of our methodological knowledge. The fact that using a linear (additive, separable) utility function in order to aggregate the impacts of decisions along different attributes implies assuming that such impacts are commensurable and can be traded among them, is part of their methodological knowledge which will consistently impede them from using such a method in case this assumption does not hold (i.e. the client does not accept it). However, there are potential misuses and errors which can occur under certain implicit assumptions, for which they are not really trained and prepared to handle. Such implicit assumptions (often ignored exactly because implicit) need to be explicitly identified and handled if analysts want to build a trusted relationship with their clients or in case they want a trustworthy use of any autonomous artefact using OR and other formal models and methods.

- *Cognitive biases.* Decision Analysts are subject to the same cognitive limitations as other humans. They have personal values, personal cognitive limits, personal habits, culture and feelings. How much these influence the way through which the client’s problem and the information provided are modelled? Other professional bodies impose specific training in order to handle such questions or establish specific protocols and external assessors to be used by those clients who may doubt about the analysts’ biases. It is certainly true that our profession does not consider any specific training or appealing procedure, although these problems exist and should at least be discussed with our clients.
- *Exceptional circumstances.* Consider a classic risk management model and a situation characterised by extreme risks (extremely unlikely to occur events, but with extremely high impacts in case they actually occur; see [Nott, 2006](#)). Would our model still work appropriately? Consider a model of extreme risk theory: would this still apply for emerging risks management (see [Bier, 2016](#))? Consider a supply chain model. Would this work and be robust under any possible circumstances? And would that model still apply if the supply chain problem concerns humanitarian logistics (see [Tomasini and van Wassenhove, 2009](#))?

The above examples are just cases where mainstream methods and models have been proven to be inappropriate when exceptional circumstances occur. This leads to a general question: given any method or model analysts suggest using for advising a client, will this advice still hold if such exceptional circumstances occur and if not what do they suggest the client to do? Which raises the question of whether analysts (and our discipline in general) know the application limits of generalisation of whatever is suggested as recommendation to clients.

- *Data.* All methods and algorithms require data. Not only the ones provided by the client, but also data about the “territory”, the “landscape”, the “culture”, the “economical and social context”, the “organisation” where the decision process for which our help is requested is going to be used. Data are collected, stored, transferred, transformed, manipulated, along “pipelines” which are far from being with no impact upon the final outcome. Moreover, data, although they belong to nobody, can be protected by “rights”, private or collective, social, economic or cultural. In designing methods and models analysts need to consider both the data pipeline quality as well as the rights protection issue (see [Christophides et al., 2021](#)).
- *Algorithms.* Most of the times formal methods require efficient algorithms. Most of the times it is necessary to trade-off between efficiency and accuracy or even optimality. Most of the times it is necessary to take into account other features of the algorithms such as manipulability, strategic proofness, security, robustness to adversarial attacks, black-box effect etc. Most of the times clients are not aware of what is the impact of choosing an algorithm instead of another. Clients are also usually unaware of the software differences when algorithms are coded and of the computing resources necessary to run them. It is unlikely clients will ever be tempted to learn all such topics, but is the analysts’ “ethical” obligation to know them and let the client understand which are the stakes at play when choosing a precise algorithm and a precise software implementation.
- *Impossibilities.* Not all methods fit to any type of decision problem. Generally speaking it is known that most of the times, given a set of properties to be satisfied by the outcome of a potential algorithm, these are inconsistent. In other terms there is no algorithm able to satisfy at the same time all the desired properties (see [Arrow, 1951](#); [Brandt et al., 2016](#); [Vincke, 1992](#)). This is not really a problem in terms of computing solutions, but we need to know which properties are satisfied by which algorithms and we need to be able to explain that to our clients. In other terms it is important to be able to explain to clients what an impossibility theorem means for her problem and which are the different partial solutions that can be adopted (and at which “price” in terms of satisfied properties).
- *Long term consequences.* When American Airlines started studying yield management methods in order to manage the ticket pricing (see [Smith et al., 1992](#)), nobody (within the company and in the broad Operational Research community) could ever imagine the impact these methods will have on the travelling industry and the travelling habits within our societies. Today potentially any operator running a travelling business (including trains and buses) uses a yield management method in order to price dynamically tickets. The whole industry in this field changed its business model and each single consumer modified its willingness to pay for a travelling ticket (independently from business or leisure travelling). We are not going to discuss here whether this had a long term positive or negative impact, although some may discuss the consequences on the tourism industry, the house renting industry, the environmental impact etc. The “ethical” question is that all such impacts have never been discussed neither within the company nor within the society. Nobody anticipated, discussed or even questioned the new business model underestimating the impact of a simple optimal pricing method. Practically speaking, it might have been impossible to do that when yield management has been designed, and it might be almost impossible to set up such

a long term foresight exercise. But this should not prevent from raising questions about long term impacts.

Providing models, methods, tools, aiding to improve decision making has impacts which can go far beyond the client and the other involved stakeholders. Most of the ethical questions we rose in the previous paragraphs are related to a precise decision aiding process, the actors involved and the immediate impacts. But we need to also consider impacts which will occur on a long, very long term and for stakeholders, citizens, territories and biomes who never ever thought that changing the optimal production policy of a company could change their lives half a century later.

5. Ethics in OR research

We have seen that most of the “ethical questions” about our discipline concern its use in the real life and the way through which we handle the relations with our clients, the relevant stakeholders and the use of our decision aiding methodology. The reader may note that many of such questions are related to topics addressed in our research (mostly indirectly) already since the 70s such as the axiomatic analysis of voting procedures, the analysis of behavioural biases or the development of problem structuring methods. The question we raise at this point is: “are there specific research topics in Operational Research which, although not directly addressing ethical questions, are relevant for these”? Being more precise: probably any research topic in our discipline could be relevant for our ethical questions, but are there some new or more relevant ones?

1. **Are we aware?** The first class of research questions concerns awareness. In Section 4 we raised several ethical questions concerning the use of models, methods, algorithms, protocols, etc. The fundamental remark is that none among such tools (which are used in order to advise clients in their decision processes) are “neutral”. Using one instead of another can have short or long term consequences which are independent from what the client asks or the situation requires. The question is: are OR practitioners and OR analysts aware of such consequences? And the consequent research question is: do OR as a discipline knows how to select appropriately our tools? In other terms, is there a methodology explaining what each tool can do, cannot do, the conditions under which they can be used and provide meaningful results?

Axiomatic characterisations and representation theorems are certainly research fields in our discipline which provide results usable in order to reply to the above demands. A first recommendation (in terms of research directions) should be to further pursue research in order to extend the number of methods which are axiomatically characterised. On the other hand numerical simulations and experimental settings (testing protocols, behavioural biases and modelling hypotheses) result in very useful tools helping to undercover hidden behaviours and tacit assumptions which could be concealed during the use of any among our tools. A second research recommendation should thus be to increase testing (experimentally) our methods.

We may also emphasise that the more OR researchers and academics use the “open science” paradigm, sharing data, software codes, results and findings, the more it improves our capacity to increase awareness about what, when and how works (or does not work).

2. **Do we help others becoming aware?** Being ourselves (as analysts) aware of what our tools and our methodology can (and cannot) do is necessary, but not sufficient. Both our clients and the involved stakeholders (possibly the society as a whole?) need to develop awareness of what our tools can (and cannot) do.

This of course raises a far larger topic about how scientists can and should communicate their findings to a “non-scientific” audience in a way that increases and strengthens awareness and autonomy (see Bauer et al., 2007 or Bucchi and Trench, 2014), but remains relevant for our discipline. Large part of the general public gets used in misusing statistics and other quantitative information, in using

inappropriately averages, indexes, protocols and codes, producing totally meaningless results and conclusions (see Gigerenzer, 2002 or for more fun Barker, 2020). Even large and prestigious institutions, not to talk about public agencies and governments misuse such information in order to justify regulations and policies (for a famous example see the incredible diffusion of a meaningless index such as the Shanghai ranking of the Universities: Billaut et al., 2010). Under such a perspective it pays learning to use simple heuristics facilitating communicating quantitative information in a meaningful way (see Gigerenzer and Todd, 1999).

Developing general frameworks which allow to unify a field of models and provide a unique frame within which interpret, explain and justify methods and protocols helps increasing awareness for any stakeholder (and the general public) involved in a decision process. The reader can see the impact of measurement theory, Roberts (1979), in establishing a rigorous notion of meaningfulness: Narens and Luce (1990) Roberts (1980), or the impact of conjoint measurement theory in unifying the field of multiple criteria decision analysis, Bouyssou and Pirlot (2009). Under such a perspective, research efforts allowing to create general frameworks help in establishing a methodology within which handling a decision problem should be viewed as the result of methodological choices and not as the use of a (unjustified?) method. As such the use of any OR tool is easier to explain and understand (and therefore easier to be accepted).

Moreover, assuming a problem driven decision support attitude, instead of a method driven one, generally allows to improve communication with the client and enhance awareness about why certain methods will not fit in that precise problem situation, while others might be more appropriate. The result is adopting an “horizontal” or “methodological” view of our discipline and not seeing Operational Research as just a collection of methods (see Tsoukiàs, 2008).

3. **Are we critical?** A decision aiding process is certainly a set of activities involving the client (who asks for advice) and the analyst (who provides the advice). However, we already observed that the choices we do, while conducting the decision aiding process, have impacts far beyond these two stakeholders. Moreover, remaining confined within the client’s demand and/or the analyst’s perception can result in missing other opportunities the decision aiding process offers. Most problem structuring methods (see Keeney, 1992; Rosenhead, 1989) emphasise that decision problems are constructed (and not identified) and that solutions critically depend on how problems are formulated. More recently the problem of constructing the set of alternatives (which is at the centre of the decision model) has turned to be a research topic (see Colorni and Tsoukiàs, 2020; Ferretti et al., 2019).

Under such a perspective, research in the following three areas is extremely important in order to improve and expand our capacity to interact with the clients and the other stakeholders developing our critical view of the decision aiding process:

- **Problem structuring methods** in general, since they provide a general framework for supporting the whole decision aiding process (Rosenhead, 2006). More precisely we need to develop the conjunction of PSM with most mainstream OR methods. Most of the existing literature in PSM see them as an “alternative” to “hard OR” (a reason for which they are often called “soft OR” methods), while at the same time most mainstream OR methods underestimate the importance of an accurate problem structuring before using any method.

- **Design theory** as a formal tool for developing “out-of-the-box” alternatives beyond the dominant designs usually suggested as solutions (Alexander, 1982; Masson et al., 2013). More precisely we need to investigate how design theory can help OR and Decision Analysis to construct alternative for the decision process, overcoming the traditional approach for which alternatives are “given”.

- **Preference learning** because whatever we use in order to elaborate an advice is learned through interaction with the clients and/or

accessing data and information (Fürnkranz and Hüllermeier, 2010). More precisely we need to further investigate how learning protocols and methods impact the ways through which values and preferences are structured within the decision process: values and preferences rarely “exist” (having to be discovered), they are constructed through the client/analyst interaction.

4. **Do we help others becoming critical?** Keeping a critical perspective with respect to the problem situation as it appears to be (or as the client makes it appearing) is certainly important for our ethical questions. However, it is not sufficient. The client and the involved stakeholders also need to develop a critical perspective about what happens both within the decision process they are involved in and the decision aiding process.

Such a process is very much a matter of “convincing”: first of all ourselves (we remain within standards of meaningfulness), then our clients (they get something they feel helpful) and then the rest of the world (the whole process was legitimate; see Meinard and Tsoukiàs, 2019; Meinard and Tsoukiàs, 2022).

Under such a perspective our clients and the other stakeholders need to be able to reply positively to the question: is this advice going to resist to any arguing against it, arguing grounded on data, procedures, protocols, and authority? A formal framework where such problems are discussed is formal argumentation theory (see Amgoud and Prade, 2009; Dung, 1995; Ouerdane et al., 2010; Trevor and Bench-Capon, 2003).

6. Conclusions

Let us summarise the discussion and the claims we introduced. Ethical questions arise in our everyday life as well as in our professional life independently from what our profession is. The questions we are interested in this paper derive from our specific profession as decision analysts. As a side effect we need to consider which research topics, while independently developed, can help us in handling such ethical questions.

Under such a perspective we need to remember that decisions (what we are supposed to help making) are value driven and not data driven: data are necessary, but not sufficient for making decisions. It is part of our profession to make understand these values, for us, our clients and the involved stakeholders. At the same time we need to remember that aiding to decide is problem driven and not method driven, which means we first need to understand the problem and then we need to think about solving it.

As we show in the paper, ethical questions have been introduced in our discipline since the very beginning. Our discussion emphasises two parallel issues we need to consider when we try to handle such questions. The first concerns awareness of what methods are, can do, cannot do and how choosing any among them is not neutral with respect to the solution computed and the recommendation provided. The second is the development of a critical attitude about the consequences of our modelling choices which goes beyond the usual relation analyst/client.

A first point to make is that there are no universal procedures, protocols, algorithms or methods. Any of them will unfit for some reason and for some kind of problem situation and for some type of client and we need to know how to handle this. Keeping a critical attitude with respect to the clients’ demand and to our profession helps on a long run both our clients and our profession. There are many hidden hypotheses and implicit choices in modelling and solving a decision problem and these need to be clear to us (as analysts), to our clients and to the stakeholders who might be involved in the problem situation.

Is there an ethical Operational Research? If ethics consists in applying to our profession standards of morality (in whatever way these have been established) then our reply is negative. But if ethics consists in assuming our responsibility for what we offer to our clients then yes. Although we may not be liable for what our clients decide using our advice and/or our tools, we are responsible for many (avoidable) conse-

quences which can occur. We have a power and we need to use it with responsibility.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The paper reflects discussions held within the Special Interest Group on Ethics in Operational Research of the CNRS funded National Research Network on Operational Research (GDR-RO, <http://gdrro.lip6.fr/>). We specially thank the participants to the workshop held at the LAMSADE, Université Paris Dauphine the 26/11/2021, <http://gdrro.lip6.fr/?q=node/254> for the discussion. Christine Solnon read an early version of this document and her comments greatly improved it. Two anonymous referees did very useful comments which further clarified our standing and our claims. We definitely remain responsible for the content of this essay.

Appendix A

Recommended Research and Training Topics

- Increase research efforts in axiomatic characterisation of methods, tools, procedures, protocols etc.
- Increase methods testing, using numerical simulations and experimental settings.
- Increase efforts for creating methodological frameworks for a problem-driven approach to decision support.
- Establish conjunctions between problem structuring methods and mainstream OR methods.
- Create formal methods for generating decision alternatives.
- Develop constructive preference learning methods.
- Develop the conjunction before formal argumentation theory and decision support.
- Establish training material based on a problem-driven methodological view of decision support (replacing the view of OR as a collection of methods).
- Promote the use of open science, data sharing and open source coding.

References

- Abu-Elyounes, D., 2020. Contextual fairness: a legal and policy analysis of algorithmic fairness. *J. Law Technol. Policy* 2020, 1–54.
- Ackoff, R.L., 1974. The social responsibility of operational research. *Oper. Res. Q.* 25, 361–371.
- Ackoff, R.L., 1979. The future of operational research is past. *J. Oper. Res. Soc.* 30, 93–104.
- Ackoff, R.L., 1979. Resurrecting the future of operational research. *J. Oper. Res. Soc.* 30, 189–199.
- Alexander, E.R., 1982. Design in the decision making process. *Policy Sci.* 14, 279–292.
- All European Academies, 2017. The European code of conduct for research integrity. <https://allea.org/wp-content/uploads/2017/05/ALLEA-European-Code-of-Conduct-for-Research-Integrity-2017.pdf>.
- Amgoud, L., Prade, H., 2009. Using arguments for making and explaining decisions. *Artif. Intell.* 173, 413–436.
- Arrow, K.J., 1951. *Social Choice and Individual Values*, 2nd ed., 1963 J. Wiley, New York.
- Barker, H., 2020. *Lying Numbers: How Maths and Statistics Are Twisted and Abused*. Little, Brown Book Group, London.
- Bauer, M., Allum, N., Miller, S., 2007. What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda. *Public Understanding Sci.* 16, 79–95.
- Bier, V.M., 2016. *The Gower Handbook of Extreme Risk: Assessment, Perception and Management of Extreme Events*. Routledge, London.
- Billaut, J.-C., Bouyssou, D., Vincke, P., 2010. Should you believe in the Shanghai ranking? *Scientometrics* 84, 237–263.
- Bouyssou, D., Pirlot, M., 2009. Conjoint measurement models for preference relations. In: Bouyssou, D., Dubois, D., Pirlot, M., Prade, H. (Eds.), *Decision Making Process*. J. Wiley, Chichester, pp. 617–672.
- Brandt, F., Conitzer, V., Endriss, U., Lang, J., Procaccia, A.D., 2016. *Handbook of Computational Social Choice*. Cambridge University Press, Cambridge.

- Brans, J.P., 2002. OR ethics and decision: the OATH of PROMETHEUS. *Eur. J. Oper. Res.* 140, 191–196.
- Brans, J.-P., Gallo, G., 2007. Ethics in OR/MS: past, present and future. *Ann. Oper. Res.* 153 (1), 165–178.
- Brkan, M., Bonnet, G., 2020. Legal and technical feasibility of the GDPR's quest for explanation of algorithmic decisions: of black boxes, white boxes and fata morgana. *Eur. J. Risk Regul.* 11, 18–50.
- Bucchi, M., Trench, B., 2014. *Handbook of Public Communication of Science and Technology*. Routledge, London. 2nd ed.
- Casteluccia, C., Métayer, D.L., 2019. Understanding Algorithmic Decision Making: Opportunities and Challenges. EPRS study, European Parliament, p. 104.
- Christophides, V., Efthymiou, V., Palpanas, T., Papadakis, G., Stefanidis, K., 2021. An overview of end-to-end entity resolution for big data. *ACM Comput. Surv.* 53, 1–42.
- Churchman, C.W., 1968. *Challenge to Reason*. McGraw-Hill, New York.
- Churchman, C.W., 1970. Operations research as a profession. *Manage. Sci.* 17, B37–B53.
- CNRS ethical committee COMETS, 2017. *Practical guide “integrity and responsibility in research practises”*. <https://comite-ethique.cnrs.fr/en/practical-guide/>.
- Colomi, A., Tsoukiàs, A., 2020. Designing alternatives for decision problems. *J. Multi-Criteria Decis. Anal.* 27, 150–158.
- Coutellec, L., 2019. Penser l'indissociabilité de l'éthique de la recherche, de l'intégrité scientifique et de la responsabilité sociale des sciences. *Revue d'anthropologie des connaissances* 13 (2), 381–398.
- Dung, P.M., 1995. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games. *Artif. Intell.* 77, 321–358.
- Ferretti, V., Pluchinotta, I., Tsoukiàs, A., 2019. Studying the generation of alternatives in public policy making processes. *Eur. J. Oper. Res.* 273, 353–363.
- Fürnkranz, J., Hüllermeier, E., 2010. *Preference Learning*. Springer Verlag, Berlin.
- Gallo, G., 2004. Operations research and ethics: responsibility, sharing and cooperation. *Eur. J. Oper. Res.* 153 (2), 468–476.
- Gass, S., 2009. Ethical guidelines and codes in operations research. *Omega* 37, 1044–1050.
- Gass, S.I., 1994. On ethics in operational research. *J. Oper. Res. Soc.* 45, 965–966.
- Gigerenzer, G., 2002. *Calculated Risks: How to Know when Numbers Deceive You*. Simon and Schuster, New York.
- Gigerenzer, G., Todd, P.M., 1999. *Simple Heuristics That Make Us Smart*. Oxford University Press, New York.
- Hacker, P., 2022. *The European AI Liability Directives. Critique of a Half-Hearted Approach and Lessons for the Future*. European University Viadrina. <https://ssrn.com/abstract=4279796>.
- Keeney, R.L., 1992. *Value-Focused Thinking. A Path to Creative Decision Making*. Harvard University Press, Cambridge.
- Kirby, M.W., 2006. A festering sore: the issue of professionalism in the history of the operational research society. *J. Oper. Res. Soc.* 57, 161–172.
- Kroll, J.A., Huey, J., Barocas, S., Felten, E.W., Reidenberg, J.R., Robinson, D.G., Yu, H., 2017. Accountable algorithms. *Univ. Pennsylvania Law Rev.* 165, 633–705.
- Landry, M., Banville, C., Oral, M., 1996. Model legitimisation in operational research. *Eur. J. Oper. Res.* 92, 443–457.
- Landry, M., Malouin, J.L., Oral, M., 1983. Model validation in operations research. *Eur. J. Oper. Res.* 14, 207–220.
- Lepri, B., Oliver, N., Letouzé, E., Pentland, A., Vinck, P., 2018. Fair, transparent, and accountable algorithmic decision-making processes. *Philos. Technol.* 31, 611–627.
- Masson, P.L., Dorst, K., Subrahmanian, E., 2013. Design theory: history, state of the art and advancements. *Res. Eng. Des.* 24, 97–103.
- Meinard, Y., Tsoukiàs, A., 2019. On the rationality of decision aiding processes. *Eur. J. Oper. Res.* 273, 1074–1084.
- Meinard, Y., Tsoukiàs, A., 2022. What is legitimate decision support? In: Greco, S., Mousseau, V., Stefanowski, J., Zopounidis, C. (Eds.) *Intelligent Decision Support Systems*. Springer, Berlin, pp. 207–224.
- Menestrel, M.L., Wassenhove, L.N.V., 2009. Ethics in operations research and management sciences: a never-ending effort to combine rigor and passion. *Int. J. Oper. Res.* 37, 1030–1043.
- Narens, L., Luce, R.D., 1990. Meaningfulness and invariance. In: Eatwell, J., Milgate, M., Newman, P. (Eds.), *Time Series and Statistics*. Palgrave Macmillan, London, pp. 140–148.
- Nott, J., 2006. *Extreme Events: A Physical Reconstruction and Risk Assessment*. Cambridge University Press, Cambridge.
- OECD, 2007. *Best practices for ensuring scientific integrity and preventing misconduct*. <https://www.oecd.org/science/inno/40188303.pdf>.
- Ormerod, R.J., Ulrich, W., 2013. Operational research and ethics: a literature review. *Eur. J. Oper. Res.* 228 (2), 291–307.
- ORSA, 1971. *Guidelines for the practice of operations research*. *Oper. Res.* 19, 1123–1148.
- Ouerdane, W., Maudet, N., Tsoukiàs, A., 2010. Argumentation theory and decision aiding. In: Figueira, J., Greco, S., Ehrgott, M. (Eds.), *Trends in Multiple Criteria Decision Analysis*. Springer Verlag, New York, pp. 177–208.
- Rauschmayer, F., Kavathatzopoulos, I., Kunsch, P.L., Menestrel, M.L., 2009. Why good practice is not enough - ethical challenges for the OR practitioner. *Omega* 37, 1089–1099.
- Roberts, F.S., 1979. *Measurement Theory, with Applications to Decision Making, Utility and the Social Sciences*. Addison-Wesley, Boston.
- Roberts, F.S., 1980. On Luce's theory of meaningfulness. *Philos. Sci.* 47 (3), 424–433.
- Rosenhead, J., 1989. *Rational Analysis of a Problematic World*, 2nd revised edition in 2001. Wiley, New York.
- Rosenhead, J., 2006. Past, present and future of problem structuring methods. *J. Oper. Res. Soc.* 57, 759–765.
- Rosenhead, J., Mitchell, G.H., 1986. Report of the commission on the future practice of operational research. *J. Oper. Res. Soc.* 37, 831–886.
- Smith, B.C., Leimkuhler, J.F., Darrow, R.M., 1992. Yield management at American airlines. *J. Appl. Anal.* 22, 8–31.
- Tomasini, R., van Wassenhove, L., 2009. *Humanitarian Logistics*. Palgrave, London.
- Trevor, J., Bench-Capon, M., 2003. Persuasion in practical argument using value-based argumentation frameworks. *J. Logic Comput.* 13, 429–448.
- Tsoukiàs, A., 2007. On the concept of decision aiding process. *Ann. Oper. Res.* 154, 3–27.
- Tsoukiàs, A., 2008. From decision theory to decision aiding methodology. *Eur. J. Oper. Res.* 187, 138–161.
- Tsoukiàs, A., 2021. Social responsibility of algorithms: an overview. In: Papanthanasios, J., Zaraté, P., de Sousa, J.F. (Eds.), *EURO Working Group on DSS*. Springer Nature, pp. 153–166.
- Vincke, P., 1992. Exploitation of a crisp relation in a ranking problem. *Theory Decis.* 32 (3), 221–240.
- WCRIF, 2010. *Singapore statement on research integrity*. <https://wcrif.org/guidance/singapore-statement>.
- Wenstøp, F., 2010. Operations research and ethics: development trends 1996–2009. *Int. Trans. Oper. Res.* 17, 413–426.