Combining System Dynamics and Ethics: Towards More Science?

Erik Pruyt and Jan Kwakkel
Delft University of Technology, Policy Analysis Section
Faculty of Technology, Policy and Management
P.O. Box 5015, 2600 GA Delft, The Netherlands
Tel: +31/152787468
E-mail addresses: E.Pruyt@tudelft.nl, J.H.Kwakkel@tudelft.nl

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Abstract

In this paper, ethics is discussed in relation to system dynamics. The domain of ethics is very broad which is why we will first of all demarcate what is meant by ethics here. Then, we will discuss the importance of ethics for the domain of system dynamics and where it could come into play. Calls for, mentions of, and applications of ethics in the system dynamics literature will then be reviewed, followed by a discussion of possible contributions of the explicit consideration of ethics to the domain of system dynamics and of system dynamics to the domain of ethics. Two examples will be discussed: 'responsibility' and 'sustainable development'. Then, some advantages and disadvantages of combining ethics and system dynamics will be discussed. And finally, possible ways to deal with ethics in system dynamics will furthermore be proposed in the concluding section.

Keywords: System Dynamics and Ethics, Consequentialism, Value Systems, Responsibility, Sustainable Development, Codes of Conduct

1 Introduction

For quite some time, the Management Science, Operational Research and Systems Sciences (abbreviated to MS/OR/S) community has been debating ethics –although less visibly to the general public than in medicine, exact sciences and business– in relation to the theory and practice of MS/OR/S. Hence, there is already much material available in domains related to system dynamics, which is often not explicitly called 'ethics'[1].

In the MS/OR/S literature, ethics is discussed mostly in relation to MS/OR/S practice and the MS/OR/S profession, which is not surprising because of the fact that 'ethical considerations are confronted at every step in an [MS/OR/S] intervention' (Ormerod 1999, p548). Howard (2001) discusses for example many situations to which MS/OR(/S) professionals might be confronted in practice. Similarly does Kleijnen (2001) discuss ethical issues based on his personal experience as a modeller. And the book on *Ethics in Modeling* edited by Wallace (1994) discusses among else (i) whether the construction and interpretation of models affects decisions, (ii) how values become incorporated in models, and (iii) what the ethical responsibilities of model builders are.

But not only do many hard and soft systems scientists pay much attention to ethics on a personal basis, several societies and professional organisations also deal explicitly with ethics,

[1] See (Brans and Gallo 2004) for an overview of ethics in Operational Research.

mostly by adopting some sort of code of conduct or guidelines for good conduct[2] which may be defined as an explicit statement of what is considered necessary ethical behaviour in a professional setting. Codes of conduct are however often controversial. In the MS/OR/S domain for example, there has been much controversy about codes of ethics. Some deplore the lack of ethical codes by most MS/OR/S societies (see for example (Caywood, Berger, Engel, Miser, and Thrall 1971), (Gass 1994a), (Gass 1994b), (Gass 2003), (Shutler 2003) and (Cowton 2003)) and point at many other professional societies which have some sort of code of ethics. They argue that this lack is a pity because 'a well written ethical code, reliably and fairly enforced, can eliminate unethical practices, relieve ethical dilemmas and throughout the process demonstrate [...] commitment to ethical conduct' (Molander 1987). But many others are strongly opposed to any code of ethics, because they argue that such codes 'will never be suitable for all people at all times in all circumstances' (Bowen 1994, p965) and might therefore be constraining.

The System Dynamics Society does not have a code of conduct, which might be surprising. System dynamics is after all rather specific: it is more than 'just simulation' since it mostly deals with social, distributional, environmental, intergenerational,... aspects too. It is also surprising that only very few contemporary system dynamicists explicitly discuss ethics in relation to system dynamics. We will therefore try to (re-)open the discussion of ethics related to system dynamics in this paper.

1.1 What is Ethics?

But what is ethics? Ethics is first of all a broad and major branch of philosophy, and the word ethics means different things depending on the ethical subfield considered. Generally speaking, it could be said that ethics is the study of values and customs instantiated in the lives of particular groups. 'Ethics' can be used more specifically to refer to a subset of these values and customs. It also covers the analysis of notions such as good and evil, right and wrong, fair and unfair, guild and shame, and virtue. A third use of 'ethics' is to refer to specific moral principles in the context of morality (Crisp 1998). The study of ethics requires conscious and deliberate thinking, critical questioning and honest and open justification of acts, actions and systems.

Since the rise of ethics as a subfield of philosophy, it has also been concerned with advocating a specific way of acting or living. The three main accounts of applied ethics are consequentialist ethics, deontological ethics, and virtue ethics.

Consequentialist ethics refers to ethical theories that hold that the consequences of actions form the basis for valid moral judgments about those actions. Thus, from the point of view of consequentialist ethics, the morally right action is an action which produces the most good. The best known ethical account of consequentialism is utilitarianism as developed and advocated by Jeremy Bentham (1789) and John Stuart Mill (1861). According to utilitarianism the only good is welfare and all actions should be aimed at maximizing total welfare. Utilitarianism should be distinguished from the utility theory in economics, which limits welfare to the abstract notion of utility, whereas utilitarianism can have a broader, multi-dimensional conception of welfare.

Deontological ethics refers to ethical theories that put the emphasis on the character of the action itself, independently of its effects in a particular case. This means that 'if you accept any circumstances as reasons in one case, you must also accept them as reasons in other cases' (Rachels 1999, p130). The goodness or badness of actions is not determined by the consequences of the actions, but is an inherent property of the action itself. This type of ethics is concerned with duties and the consistent application of rights, obligations and principles, as its name already suggests (the Greek deon means 'one must' or 'duty'). The most famous account of deontological ethics is the account of Immanuel Kant who grounds the duties in his categorical imperative of which he gives different formulations. The best known are 'Act only on that maxim through which you

[2] See for example www.acm.org/constitution/code.html for the Association for Computing Machinery (ACM) Code of Ethics and Professional Conduct, or www.amstat.org/profession/ethicalstatistics.html for ethical guidelines of the American Statistical Association (ASA), or www.scs.org/ethics/ for the Code of Conduct of the Society for Modeling and Simulation.

can at the same time will that it become a universal law' and 'treat humanity... never simply as a means, but always at the same time as an end' (Kant 1785), (Kant 1788).

Virtue ethics focuses neither on the consequences of actions nor on the actions itself, instead, goodness and badness are attributes of an agent. In order to act good, agents should strive to become virtuous. Virtue ethics can trace its roots to Plato and Aristotle. What unites modern virtue ethics is its criticism of both consequentialism and deontological ethics, how both have been primarily occupied with ethical rules to resolve dilemmas and in doing so, have overlooked the importance of the moral character of the agent (see for example (Anscombe 1958) and (MacIntyre 1958)).

1.2 Review of Ethics in the System Dynamics Literature

Although ethics seems to be important for the field of system dynamics and seems to play a rather important (implicit) role in practice, it is not so often explicitly dealt with, mentioned or called for by system dynamicist. There are of course some notable exceptions: several well-known system dynamicists have indeed called for the explicit consideration of ethics in system dynamics modelling, interventions and practice.

In session I of the Forrester Seminar Series on System Dynamics[3], Forrester deals with *ethics in modelling* questions such as: What are ethical considerations for modelers? Should the field of system dynamics have a certification test? What is good research? Will the client use the model properly? Are system dynamics models useful for forecasting? Does every model involve an ethical compromise? And what are the ethics of larger models versus smaller models? These questions basically deal with *professional ethics*.

Meadows, Richardson, and Bruckmann (1982) call for the explicit consideration of moral consequences of strategies, and hence for *consequentialistic ethics*. Meadows and Robinson (1985, p433) also shine an ethical light on the role of modelers who 'can see themselves as responsible not to parochial, short-term interests, but to all humankind [and who] can be comfortable with the fact that they have glands, hearts, values, beliefs, moral stands, and blind spots.' Dana Meadows has always been extremely preoccupied with ethics and urged modelers to be clear about their ethical a-priori and to behave ethically, and even to *be* ethical. The latter could be seen as a call for *virtue ethics* of the part of System Dynamics modellers. Dennis Meadows (2007) also called in silence for virtue ethics in the 'Proverbs for Teaching' part of his presentation at the 2007 Conference of the System Dynamics Society: 'A person who is wise and learned, but without virtue, will be despised'.

Some system dynamicists have also dealt with seemingly technical choices that are in fact ethical choices. Perelman (1980, p83) for example deals with ethical questions when discussing the issue of choosing a time horizon in system dynamics. He notes that '[t]he choice of the future temporal boundary of any nonmechanical [and irreversible] system is inevitably an ethical decision[:] there is no way to define a time horizon for nonmechanical systems without raising questions about origin, destiny, purpose, and value. As soon as we take the question of defining the time horizon of a system seriously, we are plunged into ethics and metaphysics'. Moreover, he points out that '[c]arving out an interval of interest is also defining a zone of responsibility' (Perelman 1980, p86). In that context, he suggests that 'a minimal approach for the purposes of system dynamics would be to establish a set of ethical criteria for defining 'reasonable' time constants in model construction [and that] modelers should [at least] make their personal values and judgment of long-term responsibility explicit' (Perelman 1980, p86).

Heffron (2004) also calls for the inclusion of *deontological ethics*. The combination of deontological ethics and system dynamics is less obvious than the combination with consequentialist ethics, but it is possible in at least three ways. Deontological ethics could first of all be used in a code of ethics for system dynamics practitioners. Deontological ethics could also be used to eliminate actions/strategies/systems that would involve deontologically unacceptable actions (e.g. for their implementation). And system dynamics could be used to model and simulate the

[3]See http://www.systemdynamics.org/JWFSeminars.htm

influence of deontological value systems on overall systems behaviour.

This could also be done for other value systems. System dynamics could in that respect be used as a tool for moral imagination (Werhane 2002). Several others suggest using system dynamics models for teaching and exploring ethical dilemmas (e.g. (Bardoel and Haslett 2006) and (Kunsch and Theys 2006)) and sustainable development (e.g. (Heinbokel and Potash 2001)). Many system dynamics contributions do not explicitly mention ethics but deal with sustainable development –which could be seen as a specific ethical framework– or responsibility –which could be seen as deontological or virtue ethics.

Other interesting publications also touch upon ethics. Snabe and Grossler (2006) discuss for example the risk of manipulative modelling in strategy implementation. Based on a single case study they mention three issues. First, what are the consequences of accepting a scope set by the problem owner? Second, in their case there was a debate about whether or not to include a relationship about motivation in the model. The problem owner did not want to include this, because he considered the relationship to be unethical and hence did not want to legitimise the behaviour by including it in the model. A third issue was that the problem owner wanted a group model building session, but wanted to have a preliminary model that showed the expected behaviour *before* the session...

1.3 Locus and Importance of Ethics in System Dynamics Practice

But the need for ethics in system dynamics is –apart from the aforementioned calls– almost never voiced in practice. This is rather strange, because ethics is omnipresent in system dynamics – both explicitly and implicitly: in system dynamics theory and methodology, in system dynamics models, in system dynamics processes and interventions, in the professional conduct of system dynamics practitioners and in system dynamics institutions.

The initial choice/accceptance of the type of research to be conducted and the type of methodology to be used are ethical choices that depend on the world-view of the researcher/practitioner. Four major questions to be posed and answered, at the start of any system dynamics research, are actually ethical questions. These questions are: Who matters? What matters? What time horizon matters? What are the boundaries of the system/model to be considered? For many system dynamicist, the criterion determining whether an element or a structure is modelled or not –and hence where the boundary lies–, is whether the inclusion/exclusion changes the behaviour of the model, which is a technical criterion. But these questions are essentially ethical questions because boundary choices involve values (Midgley, Munro, and Brown 1998) (Ormerod 1999) and lead to different systems, models and outcomes –which is important in terms of consequentialist ethics.

A basic system dynamics assumption is on the other hand that all side effects should be treated as effects (Sterman and Booth Sweeney 2002, p505), or stated differently, that there are no externalities, only products to all (Meadows and Robinson 1985). This means that the boundary is assumed to be rather broad, which means that all (substantial) impacts on all important dimensions over time matter. Thus, if ethics is defined as taking into account acts and consequences impacting others, then it could be concluded that system dynamics models always implicitly contain ethical choices. This broad boundary assumption implies that ethics is generally implicitly and explicitly present in system dynamics models. Even more so because many system dynamicists explicitly add subjective elements and relationships, value choices and soft variables in models.

Depending on the issue, these questions could be further split out into relevant questions such as: Whose world-view, value system, perspective and interests are taken into consideration? The client's? The final decision-maker's only? Those of the stakeholders and impacted parties? Our whole world society? Nature? Future generations? Should all their views and values be represented? And who participates? And who decides from what perspective? What is the role of the analyst? How far reaching is the responsibility of researchers? What dimensions are considered important? Do the participants determine the dimensions to be considered? Are intrinsic dimensions also considered? What about intrinsic nature? What about intrinsic culture? What about equity? What is the time frame considered? Is the very long term taken into account

or not? A system dynamics practitioner faces these and more ethical questions, but how can he find an answer to these? How can knowledge and awareness of ethics help the field of system dynamics?

There are indeed many ethical aspects related to (system dynamics) theory, methodology, tools and models, such as:

- (Unrevealed) basic assumptions, paradigms and world-views (see also subsection 2.2). If the basic assumptions do not hold, then the model is not applicable, and using its results without revealing the assumptions would be selling results that do not hold.
- Limits: Closely related to the underlying paradigms and assumptions, but also to technical details, are the limits of theories, methodologies, methods, techniques, tools and models. These determine what issues could be dealt with and what interpretations are justified.

  The mainstream system dynamics basic assumptions are for example not compatible with accurate short term predictions, especially on a non-aggregated level (for example person X will do Y at time t): system dynamics is appropriate for issues characterised by feedback effects, not for dealing with issues characterised by detail complexity, or (highly detailed) geographically dispersed problems.

  Often however, theories, methodologies, methods and models are used to do things they are not really appropriate for (an alternative theory, methodology, method or model is not known or opted for). In many such cases, the limits of the theory, methodology, method, technique, tool or model are transgressed. In such cases, clear indication and corrections to the results are required in the process.
- Unrevealed Value Choices: Many theories, methodologies, methods, techniques, tools and models also (implicitly) contain specific value choices, such as anthropocentric value choices and one-sided/egoistic/uni-dimensional points of view (in time and place) and are therefore not only descriptive, but often also (consciously or unconsciously) prescriptive/normative.
- Hidden Technical Choices with Ethical Consequences: Many theories, methodologies, methods, techniques, and tools contain (at first sight) small and often hidden methodological or technical choices, which could however have major (ethical) implications and consequences.

2 Possible Contribution of Ethics to System Dynamics, and System Dynamics to Ethics

2.1 Ethics to System Dynamics

A way in which ethics can contribute to system dynamics is that, ethical perspectives and frameworks could be used explicitly to guide such ethical questions as: Who matters? What matters? What time horizon matters? What are the boundaries? With an ethical framework we mean a framework that guides us in making choices (e.g. a sustainability perspective).

Later in the process, we could search explicitly for strategies to solve issues consisting of right acts without unacceptable future consequences to all those impacted on all dimensions on all time scales. Most of the time, this is not possible, otherwise there would not have been an issue in the first place. System dynamics as a methodology is not fit for evaluation and choice in complex situations where there is not an unambiguous best alternative on all dimensions over time and for all stakeholders. When ethical dilemmas rise and tough decisions need to be made, then ethical perspectives and frameworks could also be used explicitly for system dynamics –for example by means of consequentialistic (and other) ethical filters– to eliminate alternative strategies or systems. In other words, it could be used to answer the question of what alternatives/policies/systems are ethically acceptable.

Due to the many factors that remain excluded from the system dynamics models, the many (inherent) uncertainties, the need to include many views of many stakeholders, the combination of

objective and subjective elements, and on the other hand the limited resources (time, money,...) and the resulting impossibility to consider them all, there is anyhow also a clear need for ethics in the system dynamics *process* so that these '[f]actors excluded from an actual model are [...] addressed in the modelling process taken as a whole' (Lane 2000, p16) (also stressed by (Forrester 1961) and (Forrester 1971)). Hence, many ethical questions need to be dealt with in the process, even if an ethical framework has already been used. All the more, the underdetermination of theory by fact, combined with modelling for future behaviour, could lead –in case of bad will, ignorance or insufficient experience– to modelling results that could practically be interpreted to mean anything. Hence, the ethics of the system dynamics professional –and system dynamics practice in general– becomes of overriding importance in system dynamics modelling. The system dynamics professional called upon should pay attention to all these and many more (ethics-related) aspects, such as adequate group dynamics, or philosophical, methodological and technical consistency. From this, it could be concluded that professional ethics is tremendously important for the credibility of the system dynamics field as a whole. This requires at the very least high personal ethical standards of all system dynamics practitioners, and maybe a minimal code of ethics.

However, there are a number of problems surrounding professional ethics. First of all, it could become a constraining burden if it is codified in the form of a detailed code of conduct –even up to a point where it can become an excuse for not doing the right thing. A second problem is that a code of conduct often describes what the duty of the professional is. As such it has deontological roots. A problem with this is that professional duties and generic human duties can clash. How to resolve these clashes is an open question. Furthermore, deontological ethics describes the generic rules and duties one has to follow. How to apply these rules in concrete situations, however, is left to the professional. Professional ethics, codified in a code of conduct are therefore not sufficient to deal with the ethical problems encountered in practice. As such there is a need in professional ethics to move beyond a deontological perspective and start discussing what it means to be a virtuous modeller.

2.2 Different System Dynamics Approaches, Different Ethics

Apart from the aforementioned generic problems with professional ethics, there is a problem that is more specific to system dynamics. The system dynamics field shows a rich diversity of practices. A professional code or a very limited understanding of professional ethics can endanger this diversity by confirming system dynamics modellers to mainstream practice. At first sight, the domain of system dynamics seems to lack an undisputed or unambiguous normative basis –apart from the consequentialist predispositions– in that it does not directly answer questions as to who, what and what time perspectives matter. System dynamicists and ethical specialists would most probably answer that this depends on the issue, the context, and those involved ... but it also depends on the specific system dynamics approach used (see (Lane 2001a), (Lane 2001b), (Pruyt 2006b) and (Pruyt 2007) for system dynamics approaches with different paradigmatic bases). It could be argued that:

- mainstream system dynamics seems to assume that values, emotions and subjectivity are important for increasing the understanding of underlying structures and choosing appropriate strategies. Mainstream system dynamics is in se also 'transformational'. And it could benefit from the application of explicit ethical frameworks to answer several important questions that need to be answered.
- the marginal strand of (post-)positivist system dynamics practice (for example austere system dynamics, policy engineering and hard system dynamics), is concerned with controlling the value-ladenness as much as possible and requires the research to be as 'scientific' as possible, and the results to be as close to the 'real world' as possible. It tries to escape these ethical questions (called 'ethics outside MS/OR/S' by Le Menestrel and Van Wassenhove (2004)) which at the same time reduces their applicability to issues that involve decisions as to whom and what matters. Ethical frameworks could however also contribute to this

kind of practice as externalised frameworks that help externalise and answer 'scientifically' unanswerable questions which are otherwise out of reach of this kind of practice.

- pragmatist system dynamicists (see for example (Barton and Haslett 2006), (Barton 2002)) would most likely accept –but are *not* concerned by– value- and emotion-ladenness, hence, ethical perspectives could be used, but are not thought *necessary* unless they are desired by and/or close to the value systems of those directly involved, or if they specifically help to reach pragmatist goals.
- more constructivist or interpretivist system dynamics approaches are based on the realisation that (fundamentally) different sets of values (and thus ethics) and emotions are important, omnipresent and unavoidable, and that they should be explicitly dealt with in the process by involving/representing the different actors, their different views, values and emotions.
- other (currently marginal) strands of practice might also be fully interwoven with a specific ethical perspective, such as for example emancipatory or radical system dynamics variants.

Hence, the system dynamics normative basis differs depending on the paradigmatic approach taken which is therefore already an implicit normative choice. This implies that a single strict code of ethics is both undesirable and nearly impossible to formulate, let alone implement, because such a code of ethics can not do justice to the inherent diversity of system dynamics practice and could hinder innovation. In addition, the realisation that there are in fact different paradigmatic approaches in the field of system dynamics implies that, from a consequentialist perspective, a system dynamics practitioner should become aware of his or her own conceptual biases, or absolute presuppositions (Collingwood 1940). For the (unconscious) conceptual biases of a practitioner will affect the many and diverse choices that one needs to make in a system dynamics study, which in turn effect the outcomes of the study.

2.3 System Dynamics to Ethics

Until now, the contribution of ethics to system dynamics has been discussed. But system dynamics could also positively contribute to ethics in several ways:

- System dynamics models can be used to deduct consequences on different time scales and dimensions of the structures thought to be important and could therefore be used to explore consequentialist ethics.
- System dynamics models and simulations are often able to generate the insight that the apparent ethical dilemmas between different dimensions or time scales are in fact not really dilemmas, because their dynamics are inseparably linked.
- System dynamics throws a different light on the issue of responsibility (see section 3).
- System dynamics allows to simulate the dynamics of the modelled system in a virtual 'laboratory' before implementation in the real-world when it would be unethical to experiment directly with the real world systems ((Meadows and Robinson 1985) and (Lane 1999, p188)).
- System dynamics could be used to explore what the system ought to be or what it needs to be (systems critique) –which is seldom done in system dynamics– which goes beyond a mere analysis of the current system (systems analysis) and of the desired system (systems redesign) (Nelson 2003, p467). System dynamics could be used to model, simulate, and evaluate what *ought* to be done in case of important complex issues.
- System dynamics could also contribute positively to ethics in that it might be used to take different perspectives (also different ethical perspectives) and their consequences on different dimensions over time into account, without aggregating immediately to a single artificial dimension such as 'happiness', or –worse– to a single monetary dimension if not all dimensions are naturally of the monetary type.

However, system dynamics does not allow to evaluate the multi-dimensional outcomes on these different dimension and over time, and to choose a most appropriate solution if there is not a single unambiguous best solution on all dimensions over time. The combination of system dynamics, multiple criteria decision analysis and ethics could then be used to define the system of interest (ethics and system dynamics), to deduct consequences of possible systems and policies (system dynamics), and to determine the most appropriate policies (ethics to remove unethical strategies and multiple criteria decision analysis) starting from non-aggregated dimensions. Their combination does not only allow dealing with anthropocentric consequentialistic ethics, but also with intrinsic dimensions, deontological ethics, and so on (see also (Pruyt 2006a)).

3 System Dynamics, Ethics, Responsibility and Sustainable Development

Until now, we have broadly highlighted a number of issues were ethical considerations might be important. In this section, we want to deal more specifically with issues of responsibility and sustainable development.

3.1 System Dynamics and Responsibility

Systems thinking and system dynamics throw a very particular light on the issue of responsibility by suggesting that 'everyone shares responsibility for problems generated by a system [which however] does not necessarily imply that everyone involved can exert equal leverage in changing the system' (Senge 1990). Thus, each shares responsibility for the *whole* system. But if not everyone takes up the full responsibility for the whole system, the fragmented chain of decisions and actions and their limited, fragmented responsibility will totally diffuse all responsibility. Even worse, since decisions result in actions, and actions in reactions, we are in the end confronted with chain reactions of an action impacting other lives, nature, et cetera. So everyone in the system and everyone who could change the system is responsible and should take action ... *if they can*: the ones who have the *leverage* or *power to act* therefore are –from the systems point of view– the ones who ought to act, which is mostly not the same as the ones who are traditionally or legally considered to be responsible. Different roles could indeed be distinguished such as the *owners* who have legally the *right to demand to act*, the *managers* who have the *duty to execute the demand to act* by the owner, the ones *responsible* who have the *moral duty to act*, the ones *liable* who have the *legal duty to act*, the ones *financially accountable* who have the *financial duty to act*, the ones who have the *leverage* or *power to act*, the *legislators* who have the *power to change the rules or legislative structure*, the *enforcers or regulators* who have the *power to enforce, check, demand account and punish*.

In most complex issues these roles are not that clear cut. Mostly, it is extremely difficult to see who should take action, and who could demand action or compensation from whom. Even more interesting questions are whether those who are (potentially) negatively impacted by the consequences of actions could demand action or compensation? And those (potentially) negatively impacted by consequences of *inaction*? And their defenders? And other stakeholders? In most complex issues it is not clear who could and should legally take action because of diffusion of responsibility and the existence of boundaries to hide behind. In system dynamics terms, the issue of responsibility is clearer: all those who could actually do something –anything– are jointly responsible. This requires however a fundamental understanding of the system, which could be researched by means of system dynamics.

Then, those with leverage are responsible, not only for actively pursued strategies, but also for passive inaction: since method(ologie)s to explore consequences on multiple dimensions and from multiple views exist (e.g. system dynamics and multiple criteria decision analysis), there is simply no excuse not to do this in the case of important complex issues.

Another implication of this conception of responsibility is that a system dynamics practitioner bears an important responsibility. As the person with the most knowledge of and insight into

the system and its behaviour, he or she is the key person to identify courses of action that could significantly improve system performance. In addition he or she has the specific responsibility to share this knowledge with others, which is rather difficult in the case of very complex issues. So, in light of the rule that the ones who have the leverage or power to act, ought to act, system dynamicists need to be aware of their leverage and heavy responsibilities.

3.2 System Dynamics and Sustainable Development

If ethical decision-making or sustainable decision-making is defined as decision-making taking local and global, short-term and long-term economic and environmental and social and cultural dimensions into account, then system dynamics would remarkably well suit –from a technical point of view– the support of such ethical decision-making or sustainable decision-making. System dynamics assumes that no complex issue is purely economic, environmental, social-cultural or technical. System dynamics allows the simulation of the evolution of *whole* modelled systems, consisting of the causal links between these aspects and dimensions, and hence of the consequences of strategies.

Systems thinking and system dynamics have actually been sustainable development *avant la lettre*: '[a] central principle of system dynamics is to examine issues from multiple perspectives; to expand the boundaries of our mental models, to consider the most important long-term consequences [...] including their [economic,] environmental, [social,] cultural and moral implications (Meadows, Richardson, and Bruckmann 1982) (Sterman and Booth Sweeney 2002, p32).

Randers (2000, p214) argues that 'the evolution of the societal debate on sustainable development illustrates the tremendous strength of the system dynamics paradigm and the tools of our profession'. He also points out that system dynamics has also been crucial in putting sustainable development on the agenda: '[w]ith 30 years of hindsight, it is now clear that a few months of system dynamics analysis in early 1970 was sufficient to get to the core of the then non-existent concept of 'sustainable development'. The World Dynamics book (Forrester 1971) defined the issue of unsustainable growth, pointed to its likely consequences, and provided the elements of a fundamental solution' (Randers 2000, p214).

System dynamicists plead to look at the whole system. Then it becomes clear that actions good on one dimension, but harmful on another dimension, might actually in the long run be harmful on the first dimension as well: suppose that a decision leads to rapid economic growth but degrades the environment, which reduces public health in the longer term, which decreases productivity, which harms the economy, et cetera. System dynamics can also be used to find acceptable decisions to dissolve problematic (as it were) dimensions which are also acceptable on other dimensions. System dynamics can furthermore be a very powerful tool to improve public participation in decisions on the environment and sustainable development 'by showing that our choices can affect the direction the future takes' (Stave 2002, p165), which is mostly important in case of sustainability issues which can very often only be combatted effectively with efforts of the entire population.

4 Some Advantages and Disadvantages of Combining Ethics and System Dynamics

In this section, some advantages and disadvantages of *ethics and system dynamics* will be briefly discussed. These advantages could be seen as arguments to convince theorists and practitioners of the value of ethics in the system dynamics domain, the disadvantages as potential pitfalls to which attention needs to be paid.

4.1 Some Advantages Related to Ethics and System Dynamics

'Problem definition, choice of method, boundary, and selective omission of facts about the system being modeled are the most essential assumptions of any model. These assumptions are

almost never documented, not because modelers wish to hide them, but because they are largely unconscious of them' (Meadows and Robinson 1985, p367). Now, all assumptions cannot possibly be comprehensively dealt with, but at least an attempt to reveal, reflect on, make conscious choices and justify part of them would already be of great help. There seem to be several advantages from revealing implicit ethics and explicitly integrating ethics in system dynamics theory, method(ologie)s, models and processes. First of all, it could be argued that better decisions could be reached because:

- it focusses the analysis on what really matters, and emphasises the omissions;
- more or better information is used, since different perspectives, other actors and their possible reactions are taken into account, which leads to more robust recommendations and decisions;
- so-called 'objective' theories or models dealing with 'subjective' human, multidimensional and complex real-world issues which *always* contain ethical dimensions, are per definition omitting an important part of reality, which could sometimes be added through ethics, bringing the research closer to the (perceived) real-world by integrating subjective and ethical constructs;
- the large set of appropriate strategies/systems could be further reduced by eliminating 'unethical' ones;
- more insight in an issue and its uncertainties and risks could be gained, for example by simulating the same model but with different ethical or cultural perspectives;
- increased commitment (proud to do good and act right) and reduced resistance (no shame) will lead to stronger commitment and more effective implementation;
- less compensation will have to be paid by the decision-makers in case of really unanticipated consequences –not the ones system dynamics could surface–, since it can be proved that deliberate thinking and critical questioning could not have foreseen the unanticipated consequences, which makes that there is no foul play.

Second, it could be argued that the quality of the system dynamics process could benefit from or be guaranteed by:

- making sure through theory, methodology and guidelines that the steps a good analyst would certainly take in the system dynamics process are not overlooked, ignored or neglected by (inexperienced) analysts[4];
- clearly explaining the theory and the ethical framework and/or aspects so that decision-makers and stakeholders understand more clearly what happens, and find the tools less black-box-like and more human.

Third, existing theories, methodologies, methods and models can be improved, or better new ones can be created. Using ethics could for example significantly improve the problem definition and system evaluation phases of system dynamics interventions.

Finally, revealing the (implicit and explicit) ethics might show that the world-view, basic assumptions or ethical perspectives of the theory, methodology, method, model or process are consistent with or conflict with those of the decision-makers and analysts, or with those of other theories, methodologies, methods, or models it is combined with, or with the issue at hand, et cetera. This might reduce the meta-decision problem:

> 'knowledge of the philosophical underpinning of a decision aid can provide a context for selecting appropriate tools: matching the tool to the problem. This can be thought of as a meta-decision process similar to specifying procedures and rules before the modelling process is undertaken' (Carrier and Wallace 1994, p40).

[4]More and more non-experts use system dynamics and other systems methods and tools without the guidance of experienced modellers (see for example (Mason 1994, p183)) among else because of user-friendly computer software which make them (too?) easily accessible.

4.2 Some Disadvantages Related to Ethics and System Dynamics

Disadvantages related to combining *ethics and system dynamics* could be:

- the fuzziness of the 'ethics' concept and its application domain;
- the fact that ethics is not *simply* applicable, it is an entire and rather complex discipline on its own;
- the additional difficulty of dealing with incompatible ethical theories;
- integrating ethics might lead to opacity resulting in either lack of confidence or too much confidence;
- the *perception* of subjectivity and manipulation might undermine an 'objective image' (desired by some);
- that the acceptance, integration or consideration of ethics in theories, methodologies, methods, models and process might render the system dynamics job and processes more difficult and methodologically demanding by requiring more attention to and elaborate explanations of all these aspects;
- and finally that clients –in spite of the advantages– may not want ethics to be integrated in their studies commissioned.

5 Concluding Remarks

It has been argued that it is important to elicit the basic assumptions underlying the system dynamics modelling paradigms and approaches, among else because they might actually greatly influence the conclusions and recommendations. The paradigmatic basis of the system dynamics approach also determines at least partially the possible room for ethics, which makes the choice of the paradigmatic approach also an ethical choice.

Apart from eliciting the hidden ethics, using explicit ethical frameworks could be of great help in order to consciously define the issues, to delimit the model boundaries (Who matters? What matters? What time horizon matters? And what are the boundaries of the system/model to be considered?), to select or omit facts and values, and finally to determine appropriate strategies and justify all of these choices.

Today, guiding frameworks are mostly not used to construct system dynamics models or to choose strategies and formulate policy recommendations, which makes system dynamics modelling and decision-making sometimes highly pragmatic (in the negative sense of the word), one-sided (often only one perspective modelled), and highly influenced by the unrevealed assumptions. And *if* multiple perspectives are modelled in mainstream system dynamics practice, then they are mostly merged in a single system dynamics model. This practice is directly linked to –or caused by– the very specific ontological-epistemological basic assumptions of mainstream system dynamics –namely that there is one external real world which is only accessible via subjective mental models. These specific basic assumptions incite to build a single model from different mental models instead of building several distinct models.

It has been argued that ethical aspects are found in system dynamics theory, methodology, models, processes, the profession, but not in its institutions. We think that there should be (i) a very short and general code of ethics to raise general awareness and force system dynamics practitioners to critically reflect on and justify ethical choices, supplemented most of all by (ii) guidelines and examples of good practice to help and guide in practice, (iii) a broad movement to inspire system dynamicists to embrace ethics, (iv) much education to raise critical awareness of ethics in the system dynamics profession, and above all, (v) the taking up by system dynamics practitioners of the responsibility for undertaking a process of critical self-reflection on ethical

issues at all stage of the system dynamics process (following the call of Taket (1994, p123, p131) in the OR community).

This requires honest, accurate, and comprehensible communication about the theories, methodologies, methods, models, processes, assumptions and results. The process should favour transparent communication and understanding and a decision should not be an automatic consequence of the model but of the enhanced understanding and entire process.

Now, this is all very difficult, also for parties concerned with serious interests at stake. Hence, it is no luxury to call upon critical analysts with ethical, procedural, group dynamics, methodological, technical and some content knowledge and feeling. This is even more important when many uncertain, subjective, and subjectivist aspects and different value systems seem to be involved, because 'the use of models with characteristics of subjectivity or of subjectivism, depends [...] on the ability and ethical behaviour of the researcher constructing the model' (Munda 1995, p89).

A related question is whether basics of ethics are enough for system dynamics specialists who would like to integrate ethics explicitly in system dynamics, or whether the co-operation with professional ethicists is required. Many professionals do not seem to have a sufficient (technical) understanding/knowledge of ethics. Personally, we think that all system dynamics theorists and practitioners should always take ethics implicitly and explicitly into account –even if they are not specialised in ethics–, but that they should call upon trained ethicists when the ethical issues become too complex for them while ensuring that the dialogue between the three groups involved (decision-makers/other parties, system dynamics professionals, and ethicists) remains open and clear and does not become *too* specialised (either concerning the ethics or the system dynamics or the content issues).

We really think that the field of system dynamics should embrace ethics, because without explicitly considering ethics, system dynamics modelling will remain at best *more of an art than a science* and at worst *blind*.

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