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Incorporating an ethical perspective into problem formulation: implications for decision support systems design

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Abstract

As organizations become ever larger and increasingly complex, they become more reliant on information systems and decision support systems (DSS), and their decisions and operations affect a growing number of stakeholders. This paper argues that DSS design and problem formulation in such a context raises ethical issues, as DSS development and use puts one party, the designers, in the position of imposing order on the behavior of others. Thus, decision support systems are more than technical artifacts and their implications for affected parties should be considered in their design and development. The paper integrates Jones' model [Acad. Manage. Rev. 16 (1991) 366] of moral intensity with Mitroff's five strategies for avoiding Type III errors [I.I. Mitroff, Smart Thinking for Crazy Times: The Art of Solving the Right Problems, Barrett-Koehler Publishers, San Francisco, 1997], solving the wrong problem [H. Raiffa, Decision Analysis, Addison-Wesley, Reading, 1968], and proposes a model for incorporating ethical issues into DSS design and problem formulation. A survey of managers is used to assess the current situation regarding use of elements of the integrated model. The results are somewhat encouraging in that 40% of the respondents felt that their organizations did follow the model reasonably well, yet 23% felt their organizations did not.
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1. Introduction

As organizations become ever larger and increasingly complex, they become more reliant on informa-

tion systems and decision support systems (DSS), and their decisions and operations affect a growing number of stakeholders. For example, it was reported [5,34,64] that, on October 27, 1992, the city of London installed a new computer system for dispatching ambulances. Within a few hours, the system was overwhelmed by call volume and, the next day, the media reported that many lives had been lost due to the failure of ambulances to report where needed. The software house that developed the system had little expertise in the field and the system was technically

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inadequate to handle even ordinary call volumes. Moreover, the system had been built in a hostile environment between management and dispatchers, and users were not involved in the design process. Dispatchers may have sabotaged the system by giving it false information. This is a dramatic illustration of how dependence on computer systems can affect our lives, and how unethical behavior in the development of a system on the part of many involved led to a tragic outcome.

Today, a new DSS called the Computer Assisted Passenger Prescreening System (CAPPS II) illustrates this point well. CAPPS II is a nationwide computer system based on neural-network-based predictive software. The U.S. Congress ordered the system after the September 11, 2000 attacks and it is in development now. The system is designed to check such things as credit reports, consumer transactions, travel history and demographic information, to monitor passenger profiles and to generate a threat index or score for every passenger. Passengers will be asked for names, addresses and their date of birth before being allowed to board the plane. The information that passengers give will be used to create credit reports on passengers and to compare their names with government watch lists. Critics see a potential for invasions of privacy, for the likelihood of incorrect or biased information in a person's profile, for mismanagement of database data, for misidentifications by neural-network profiling, for mass surveillance and other problems (e.g., Refs. [3,39]).

Leveraging data and information to such a great extent and in such a timely manner would be impos-sible without the use of modern DSS. However, the technology that makes these manipulations possible also divorces the person represented by the data from the decision-making perspective of the DSS user. Introna [25] notes that DSS in these situations impart a hyperreality for decision-makers and makes "ethical sensibility nebulous" to the point that DSS users no longer imagine the faces of those affected by deci-sions made using the system. Thus, the DSS users never come face-to-face with important stakeholders that may be affected by decisions based on the system's outputs.

Building on work by Mitroff and Linstone [37] and observing that decision-making processes focus on increasingly complex contexts, Courtney [13] argues that a new paradigm for decision-making is needed within decision support systems. Rather than going directly into analysis (a technical perspective) in a decision-making situation, he recommends a process that develops multiple perspectives (see Fig. 1). The various perspectives provide much greater insight into the nature of the problem and its possible solutions, than the heavy reliance on the technical perspective that DSS has advocated in the past. He argues that the missing piece in the existing DSS paradigm is con-sideration for broad organizational and personal per-spectives, as well as ethical and aesthetic issues. What is missing in Courtney's work is some explanation of how the non-technical perspectives, in particular the components intended to incorporate ethical and aes-thetical decision-making concerns, actually would be implemented. This paper focuses on support for incorporating an ethical perspective in decision sup-
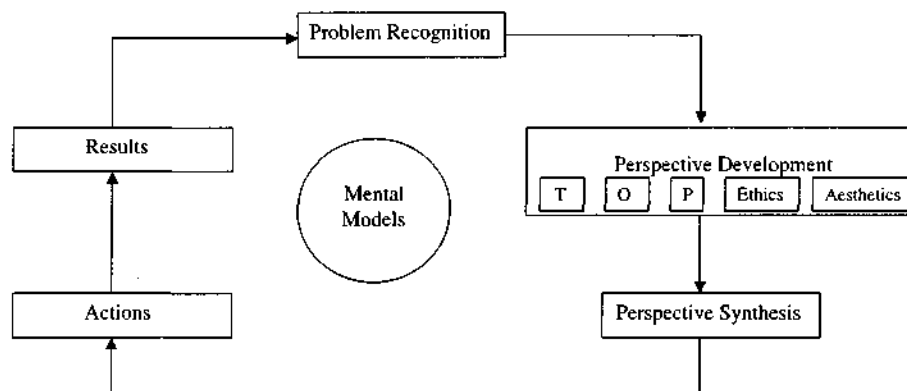

Fig. 1. A new decision-making paradigm for DSS (from Courtney [13]).

port processes. The aesthetic perspective is addressed in Paradice [41].

2. Ethical issues in business decision-making

Few would argue that, as corporations expand in scope and their operations become increasingly dependent on, and integrated with, information systems, these systems begin to affect the lives of an ever larger number of people in many and varied ways. Today, a growing number of researchers are concerned that organizations need to consider the larger picture of the organizational environment and take a long-term view when making decisions amidst this complexity [2,7,13,17]. Many view ethical issues as the key source of an organization's long-term success (e.g., Refs. [2,35,36,54]). Some claim that ethical behavior is the heart and soul of business and that long-term profits and ethics are intrinsically related [46].

Many researchers contend that the spiritual or ethical dimension has been missing from the prevailing decision-making paradigm in the academic and business communities (e.g., Ref. [37]), and that the development of an ethical perspective should be part of decision-making and DSS design in "inquiring organizations" [13,15,49]. Mitroff and Denton [36] argue that today's organizations are impoverished spiritually and that many problems come from this impoverishment. A recent empirical study of spirituality (ethics) in the workplace reports that senior executives and managers associated with organizations they perceive as more spiritual (ethical) also see their organizations as "more profitable" and they are able to deploy more of their full creativity, emotions and intelligence in spiritually based organizations [36]. The authors claim that profits follow directly from being ethical.

Schaef and Fassel [52] believe that many organizations are addicted to control, fear, suppressed feelings, sabotage, disrespect, distrust and dishonesty. They argue that organizations are functioning addictively, both in terms of individual personnel and as a whole system. This behavior diverts attention away from the impact of organizational decision-making on employees, the community, society and the environment.

Business philosopher Charles Handy [24] asks, "What is a business for?" He insists that the purpose of an organization is not simply to make a profit. Rather, it is to make a profit in order to continue to do things or make things. Profit is a means to other ends and not an end in itself. Handy states, "A requirement is not a purpose" (p. 159). According to Peter Senge [54], Russell Ackoff [2] at the Wharton School of Economics says, "Profit is like oxygen. If you do not have enough, you will not be around long; but if you think life is breathing, you are missing something" (p. 18).

Verschoor [59] studied the 500 largest U.S. public corporations, focusing on the link between a corporation's overall financial performance and its commitment to ethics. The empirical study shows that there is a statistically significant linkage between a management commitment to strong controls that emphasize ethical and socially responsible behavior on one hand, and favorable corporate financial performance on the other.

Schminke and Ambrose [53], in another of the few empirical studies in this area, found that the stage of moral development of organizational leaders permeates the ethical climate and affects employee attitudes throughout the organization. In a survey of 53 U.S. firms, statistically significant linkages were found between the score of organizational leaders on the Defining Issues Test [48] and the ethical climate of organizations that exhibited either socially oriented or independently oriented ethical climates. Also, firms exhibiting instrumental climates (where self-interest and profit making predominate) were related to more negative employee attitudes than were firms with social climates.

Organizations increasingly rely on information technology and decision support systems to process the massive (and ever-increasing) amount of data relevant to complex organizational decisions. However, these technologies rarely, if ever, incorporate anything other than a technical perspective (i.e., a quantitative model building perspective) for interpreting data. The systems may contain very complex models for manipulating the quantitative aspects of a problem, but they rarely contain any features designed to incorporate qualitative aspects such as those related to ethical concerns.

There is no such thing as an "ethically neutral" DSS [8]. The values held by the DSS designers are implicit in the way the system functions and the capabilities it employs. Boland [6] notes that any information system inevitably contains ethical suppositions of the designer, and designing an information system is a moral problem because it puts one party (the system designer) in the position of imposing an order on the world of another. An ethical issue always arises whenever one party's behavior in pursuit of its goals materially affects the ability of another party to pursue its goals [32,33]. Thus, although DSS do not currently contain an ethical decision model per se, the decision models included are based on ethical suppositions.

DSS manipulate information. Mason et al. [33] have described how intrinsic ethical considerations must be in decision-making situations in an information-oriented society. Information provides a source of power to those who give, take, or orchestrate its transfer (from the information givers to the information takers). There is, however, a power paradox associated with information. While information may give decision-makers great power to accomplish their goals, it may simultaneously make those same decision-makers more dependent on that information for continued survival. This moral problem may be even more significant in designing DSS used in business. Complex decision situations, for example, those involving ecosystems management [16] or urban infrastructure [13], affect far more parties than those typically involved directly in the decision-making process. Everyone involved in, or affected by, a decision-making situation has a vested interest in information being manipulated in a wise manner. Thus, DSS designers should not only consider technical factors, but also ethical and moral concerns in their designs. In this sense they need to play a role as a "moral agent" [63] rather than simply a "designer of technical artifacts".

We argue that ethical issues should be incorporated early in the decision-making process, during problem formulation. Problem formulation is the most crucial step in decision-making because it feeds forward, affecting the direction of all the succeeding problem solving stages, including model building, DSS design, alternative generation, data collection, data analysis, the decision itself and implementation of that decision

[1,9,18,22,28,29,35,36,38,62,66]. Failure to give ethical issues just concern during problem formulation leads to a type of Type III error [28]: solving the wrong problem, and in the case of the London Ambulance Service, the deaths of innocent people.

There are many ways to solve the wrong problem. Although we describe Type III errors in more detail in the next section, let us briefly reflect on what variation of Type III error we are addressing. Carrier and Wallace [9] provide a detailed examination of how improper modeling approaches may be applied to problem situations. They consider three types of modeling environments: descriptive (using statistics), prescriptive (using OR techniques) and "rescriptive" (using expert systems and AI techniques to "rescribe" a process). As an example of an error that can occur, regression techniques may be used when the underlying assumptions for applying regression do not hold. Their work focuses on the problems that occur when the underlying epistemology of the decision aid is not well understood. Theirs is a focus on the question, "How do you know what you know?" Our focus is related, but different. We focus on incorporating problem stakeholders properly during the problem formulation process. We assume that decision-makers will choose the proper modeling tool once a thorough understanding of a problem is obtained.

We believe that consideration of an expanded set of factors during problem formulation, appropriately supported in DSS design and in decision-making in general, may lead to better organizational performance in the long run. In Section 3 of the paper, we discuss how values influence what we consider to be problems in the first place. Next, we present Jones' [26] moral intensity paradigm followed by Mitroff's strategies for more holistic decision-making [35]. Then, Jones' model and Mitroff's strategies are integrated to develop a means for incorporating ethical issues in DSS design, particularly the problem formulation phase of design. Finally, the results of a survey designed to assess the relevance of the model to practice are discussed.

3. Problems, values and Type III errors

"A problem well-stated is half solved", observed John Dewey [19]. Einstein was once asked if he had 1

h to save the world, how would he spend the hour? He said, "I would spend 55 minutes *defining* the problem and then only 5 minutes solving it" [4]. In spite of its significant importance in decision-making,

> The ability to spot the right problems and then formulate them correctly is the critical skill that all workers, managers and top executives must possess if they are to compete successfully in the 21st century. Organizations that know how to think critically will dominate. Individuals who know how to think critically will make better and wiser decisions in their lives [35] (p. xi).

But what exactly is it that we consider a "problem" and what is the essence of problem formulation? Pounds [44] notes that a problem occurs when a difference exists between an existing situation and a desired (or in some cases, expected) situation. Organizations recognize that something is a problem when things are not as they *ought* to be. Mitroff and Linstone [37] note:

> What we call a "problem" is not only a reflection of our values but of our ethical commitments, of what we believe ought to be. Especially in the social realm, something is a problem because things are not as they ought to be. Thus, the gaps between what we desire and what we can accomplish are not merely measured by a few perspectives. Instead, they constitute ethical and aesthetic gaps as well. Consideration of aesthetics and ethics thus play a fundamental role in our selection of problems and in the means we use to address them [37] (p. 171).

In the social realm, problems may be especially complex. Rittel and Webber [50] describe problems that are ill-defined, lacking a clear set of permissible operations for attack, and lacking a clear solution as "wicked problems". Such problems are always unique, have no definitive formulation or stopping rule, and are essentially symptoms of other wicked problems. Solutions to wicked problems are "one-shot" operations; no opportunity exists for trial and error approaches. In fact, the problem solver has no right to be wrong.

Pracht and Courtney [45], Mitroff [35], Ackoff [2], Volkema [61,62] and many others pointed out that problem formulation and its activities are poorly understood by managers during organizational decision-making. Problem formulation for wicked problems is a talent that is particularly difficult to master. To every problematic situation, there is a simple problem formulation—typically arrived at too quickly and with too little discourse—and it almost invariably leads to solving the wrong problem. An early closure to any inconsistencies is also likely to result in solving the wrong problem, which may only make matters worse. The "solutions" to wicked problems cannot be described as true or false [50]. Instead, they are described as good or bad: a morality issue. Vickers [60] uses the term "appreciation" (in the sense of "appreciating a situation" (p. 54)) to describe a two "segment" process used by executives in dealing with policy problems. He notes that an appreciation involves making judgments of fact (reality judgments) about the state of the system and judgments about the significance of these facts (value judgments) to the appreciator. He observes that reality judgments and value judgments are inseparable.

Thus, ethics and problem formulation are inseparable. Just as in the design of solutions, defining problems requires both moral judgment and expertise, and the boundary is never easy to draw [58]. When problem formulation occurs without considering ethical aspects of the problem, the decision-maker and organization are likely to be solving the wrong problem, or committing a "Type III" error [47]. Type III errors relate to the process of formulating the problem, while the more widely known Types I and II errors come into play after the problem has been formulated.

For example, a Type I error occurs when a hypothesis (traditionally the null hypothesis in statistical hypothesis testing) is true yet we reject it based on our analysis. In a DSS, the analogous setting is having a model of a problem that is accurate, yet we reject the model's recommendation. A Type II error occurs when the (null) hypothesis is false yet we fail to reject it. The analogous DSS situation is that our underlying model is false, yet we fail to detect that and consequently fail to reject the system's recommendation. Both errors can be costly. Failure to accept correct output or recommendations can lead to missed opportunities, as when one fails to invest in a market

because one doesn't believe the investment model's predictions are accurate. On the other hand, failure to detect underlying model inadequacies could lead to investment losses, as when one believes an investment model's rosy prediction is correct when, in fact, they are not. If the user of the DSS is an investment manager responsible for the investment of a major retirement fund, these errors can be catastrophic to a large number of people.

In the context of complex problems, we can consider these types of errors as they apply to the American justice system, a good example of a Hegelian inquiring system [11]. A Type I error occurs when an innocent person is sent to jail, that is, we have rejected the hypothesis (i.e., the ever-present presumption in the American justice system) that the person is innocent. A Type II error, on the other hand, occurs when a guilty person is not convicted, that is, the presumption of innocence has not been appropriately rejected. In most cases, if a Type I or II error is recognized by asking "do we have the right solution?" the problem can be "re-solved" [9]. Clearly, Type I and Type II errors can be serious errors (especially in our example: innocent people may go to jail and guilty people cannot be re-tried once acquitted), but they are not the focus of this work.

An approximate solution to the right problem is far better than an exact solution to the wrong problem [35]. Unlike Type I or II errors, a Type III error requires the problem to be either "dis-solved" or "un-solved" [9]. Thus, solving the wrong problem is costly [14,62] because it consumes important organizational resources. Further, it may result in unexpected consequences in the long term and in the larger system and often in a manner far worse than what we think. The solution for a problem that is incorrectly formulated can be much worse than no solution to that problem. Thus, the danger lies not only in picking the wrong problems on which to spend limited energies but far worse, in creating more serious problems as a result [35]. To Churchman [11], solving the *right* problem makes an *ethical difference* in human affairs rather than simply making a *significant difference*. It leads to the betterment of the human condition [35]. While Churchman might agree with Dewey that a problem well-stated is half-solved, he has also observed that solving "only part of a wicked problem, but not the whole, is morally wrong" [10].

4. Moral intensity and interconnectedness

4.1. Jones' moral intensity model[3]

Jones [26] has developed a concept he calls "moral intensity". Moral intensity is "a construct that captures the extent of issue-related moral imperative in a situation" (p. 372). Moral imperative is the requirement to act in a manner consistent with one's moral beliefs. The component parts of Jones' model include the magnitude of consequences, social consensus, probability of effect, temporal immediacy, proximity and concentration of effect (see Table 1).

Magnitude of consequences indicates the significance of the impact of the problem formulation on different stakeholders and allows them to recognize the seriousness of the situation and the importance of their participation. A situation that affects 10,000 people is of greater magnitude of consequence than a situation that affects 10 people. Also a situation that causes one person's death is of greater magnitude of consequence than a situation that causes a temporary inconvenience to hundreds of people. The inclusion of magnitude of consequences into problem formulation is based on "common-sense understanding and observation of human behavior and empirically derived evidence" [26] (p. 374). Many information systems in operation today have a high degree of magnitude of consequence and thus result in significant impacts on many organization stakeholders. For example, information systems controlling air travel safety, medical operations, criminal justice and banking, to name a few, impact millions of people daily.

Social consensus is the degree of agreement among stakeholders that a given problem formulation is correct. Different stakeholders belong to their individual communities of practice [27] or social worlds [20]. Thus, their capability to perceive a certain problem issue may be very limited and their understanding is often biased by worldviews that are embedded in their

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[3] An anonymous reviewer observed that Jones' approach is largely consequentialist (or teleological). Indeed, a full ethical impact approach would need an interactive tripartite approach including deontology, teleology (or consequentialist) and virtue theory. For a related discussion, please see Whetstone [67], Macdonald and Beck-Dudley [30] and Weaver and Trevino [65]. We appreciate this observation.

as mutual understanding and concession into problem formulation in addition to the terms of conflict and dispute.

Moral intensity is generally expected to increase if there is an increase in any one (or more) of its components, assuming the remaining components remain constant [26]. A number of empirical studies (e.g., Refs. [51,55]) suggest that moral intensity positively influences ethical decision-making.

Moral intensity is closely related to awareness of what Mitroff and Denton [36] refer to as "interconnectedness". That is, if stakeholders or groups have "a basic feeling of being connected with one's complete self, others and the entire universe" [41] (p. 83), the chance of ethical problem formulation occurring will greatly increase. We believe the key to incorporating moral intensity into DSS is by facilitating and encouraging interconnectedness among problem stakeholders.

4.2. Mitroff's strategies for avoiding Type III errors

Mitroff [35] identifies five sources of Type III errors occurring repeatedly in all contexts (see Table 2). Each source is distinct in the sense that it identifies a particular instance of flawed or muddled thinking, but there are strong overlaps between them. For each,

Mitroff suggests a broad strategy for helping to assure the avoidance of Type III errors.

These five strategies are closely related to one another. For example, picking the right stakeholders is expected to increase the chances to expand options and the problem's boundaries; expanding the problem's boundaries enhances the ability to phrase the problem correctly; and so on. Even though none of these five strategies should be overlooked, the first strategy ("picking the right stakeholders") is particularly important because the other strategies are clearly facilitated by having the right people involved in the problem formulation process. It is difficult to expect the "right" problem formulation from the "wrong" stakeholders or when critical stakeholders are not involved.

5. A model for ethical problem formulation

Mitroff's five strategies for mitigating Type III errors are derived from Churchman's [11] description of a Singerian inquiring system. Churchman focuses on holistic decision-making and suggests a sweeping-in process, that is, sweeping in ever more features of problem context. Through this expansion of the problem context, Churchman argues that a more systemic

Table 2
Sources of Type III errors and strategies for prevention (from Mitroff [35])

Problem	Characteristic(s)	Strategy
Picking the wrong stakeholders	Involving only a small set of stakeholders in the formulation of a problem; ignoring other stakeholders and especially their reactions.	Never make an important decision or take an important action without challenging at least one assumption about a critical stakeholder; consider at least two stakeholders who can and will oppose the decisions or actions.
Selecting too narrow a set of options	Relying on past ways of solving a problem; failing to consider other views of a problem.	Never accept a single formulation of an important problem; it is vital to produce at least two very different formulations of any problem deemed important.
Phrasing a problem incorrectly	Using a narrow set of disciplines, business functions, or variables to express the nature of a problem.	Never produce or examine formulations of important problems phrased solely in technical or human variables; always strive to produce at least one formulation phrased in technical variables and at least one phrased in human variables.
Setting the boundaries/scope of a problem too narrowly	Drawing the boundaries or scope of a problem too narrowly; not being inclusive enough.	Always broaden the scope of every important problem just beyond your comfort zone.
Failing to think systemically	Focusing on a part of a problem instead of the whole system; focusing on the wrong part; ignoring the connection between parts and wholes.	Never attempt to solve an important problem by fragmenting it into isolated and tiny parts; always locate and examine the broader system in which every important problem is situated.

approach to decision-making occurs. Mitroff's five strategies define a sweeping-in process for problem formulation in practical terms. We now consider those strategies in more detail.

5.1. Expanding the number of stakeholders involved

Including at least one stakeholder or group who will challenge the decisions or recommended actions helps expand options and problem boundaries and helps avoid fragmenting a problem into isolated and tiny parts. Decision-makers need to ask themselves the following potentially uncomfortable questions: "Whom do we typically exclude in our discussions and formulations of important problems?" "Who is absolutely unthinkable to include?" These stakeholders should be included in the problem formulation process.

Integrating moral intensity requires that decision-makers challenge the old ways of selecting stakeholders and makes them rethink who should be sitting at the table. Assessing magnitude of consequences, temporal immediacy and concentration of effects requires having the beneficiaries (or harder still, the victims) to provide inputs to the process. Increasing social consensus requires reaching some level of agreement between stakeholders. Proximity necessarily increases when previously excluded stakeholders are now included in the problem formulation process. Clearly, assuring the systematic representation of all the right stakeholders and encouraging them to *participate* in the discussion is as important as identifying them.

The point in expanding the level of stakeholder involvement is "not just democratic participation but rather a deepened understanding of "objective" evaluation as critically normative, *pluralistic evaluation*" [57] (p. 425). Similarly, the goal is not to get everyone thinking in exactly the same terms (i.e., "group think" is not a goal). Complex problems benefit from rich problem formulations that provide many perspectives. In fact, the sweeping in of different perspectives is more likely to lead to conflict among participants than "group think". Integrating the various components of moral intensity into the problem formulation process may lead otherwise ambivalent people to be aware of the seriousness of the situation and encourage their participation.

5.2. Expanding options, phrasing the problem and expanding problem scope

These three strategies are so inter-related that we take them together. We take them in this order only to suggest that one should consider multiple options for formulating the problem definition before attempting to phrase the problem, and that the scope definition will follow from the way the problem is phrased. If sufficient options (i.e., formulations) are adequately defined on the first examination of the problem, then the scope will not need to be expanded. In reality, these activities are typically iterative. A decision-maker confronting a problem likely moves back and forth among these strategies perhaps many times before settling on a specific problem formulation.

Ulrich states, "for almost any problem situation, there exists an indeterminate number of conceivable definitions of "the problem", and each may imply different groups of problem owners and stakeholders" [58] (p. 417). Essential to expanding the options considered is recognizing which disciplines (for example, engineering, economics, law, political science and so on) exert a dominant influence over the current definition of the problem. The strategy, of course, is then to incorporate *other* disciplines. The disciplines dictate which variables must be considered in the problem definition.

In order to define a problem correctly ("ethically"), there is a need for introducing new languages and disciplines. The components of moral intensity are useful for phrasing a problem ethically. Magnitude of consequences introduces the variables "harm" and "benefit". Social consensus introduces a notion of agreement measurement. Probability of effect explicitly calls for an estimate of the likelihood of the actions and consequences involved. Temporal immediacy introduces a planning and impact horizon. Proximity requires some measure of empathy for those most affected by the problem resolution. Concentration of effect requires some definition of who will be most severely affected.

Expanding scope can be a goal of both individual and group thinking. Every stakeholder needs to engage in critical self-reflection to avoid falling prey to his or her own cognitive biases. At the same time, each stakeholder should challenge every other stakeholder's assumptions about the problem. In an ideal

situation, stakeholders should welcome challenges to their own assumptions and be prepared for rational discourse about them.

5.3. Thinking systemically

If one has been successful at the prior strategies, the decision-makers involved should be aware of the broader system in which a problem is situated and even to see the interactions between important problems. Mitroff notes that managing the interactions between complex problems (i.e., managing at the boundaries of the problems) may be more important than managing any particular complex problem. He refers to this as a paradox, since one best manages a complex problem situation by managing its interaction with other complex problems, not by managing the problem itself.

For example, some argue the plight of homeless people stems from problems in their ability to obtain adequate job training. Others argue that the heart of most problems for homeless people is their medical condition. In reality, any "solution" to the plight of homelessness will likely involve a combination of these and other factors, and the issue of how to get homeless people healthy enough to obtain adequate job training will be a key point. The medical community and the educational community will need to work together. In other words, someone managing this solution will need to manage this medical/educational

community interaction—something that occurs at the boundary of the homelessness issue.

Fig. 2 brings together the concepts described thus far into a model for ethical problem formulation. The model suggests that stakeholders (S) confronting a problem situation engage in initial problem formulation. This process exploits development of the traditional technical, organizational and personal (T, O and P perspectives) identified by Mitroff and Linstone [37]. However, the strategy of including stakeholder expansion brings more concerned parties into the process. The approach begins to consider not only the decision-makers involved directly in the situation but also stakeholders that may be affected indirectly by actions resulting from the decision taken. Once all of the stakeholders involved in a situation have been included (more accurately, the systematic representation of all stakeholders has been assured), problem formulation can proceed as diagrammed in the larger box.

"Typical" problem formulation may begin with identification of a current state of affairs versus a desired state of affairs. This process usually involves detailed quantitative analysis in an attempt to produce a model of the current situation (i.e., heavy reliance on the T perspective). At this stage, we suggest expanding the "typical" problem formulation process by integrating the components of moral intensity into the process. These components will add some quantitative aspects to the problem
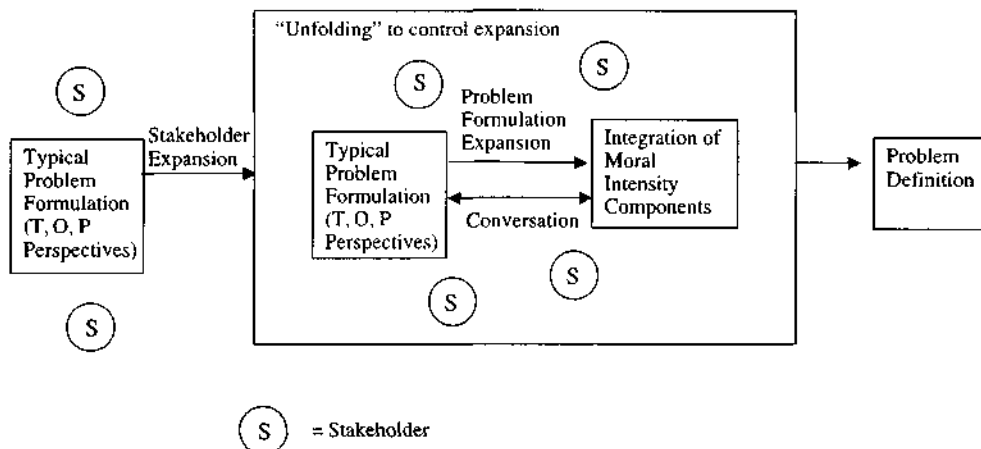

Fig. 2. A model of ethical problem formulation (an expansion of the ethics perspective in Courtney [13]).

formulation, but they may add even more qualitative aspects as well. It is expected that moral intensity will give rise to factors such as caring, love, responsibility and empathy in addition to efficiency, costs and benefits. In addition to economics, engineering and law, new disciplines (e.g., psychology, theology, ethics) and new human-side variables will be included in problem formulation. We expect the process to move iteratively back and forth between "typical" problem formulation processes and those that consider moral intensity.

In our model, we readily admit that the creation of a final problem definition may be more difficult for two reasons. First, a common criticism of the sweeping-in process (or expansionism) described here is that its application enlarges the scope of the problem under study to unmanageable size and thus is impractical. Churchman himself recognized this problem in the book, *Thought and Wisdom* [12]. Singer felt too much agreement required "unfolding" or decomposition to find the "right" level for problem solving. (Too little agreement required "folding" or reaching a higher level of generalization to reach the right lead.) Ulrich [57] recommends an "unfolding" process of bounding the problem by overcoming "inconsistencies" (i.e., differences in views) and defending the status quo. Therefore, the unfolding process becomes the critical counterpart to the sweeping-in process and its endless quest for comprehensiveness. It is drawn as a box around the expanded problem formulation process to illustrate that it constrains the process.

Two components of moral intensity—social consensus and concentration of effect—may be useful for implementing the process of unfolding. In a situation where there are too many "inconsistencies" among stakeholders, they may ask, "Is there any social consensus on this issue?" Different techniques or information sources such as Internet forums, public opinion polls and expert knowledge could be employed to gather data or supply information. These sources can offer stakeholders a general understanding of the issue and may lead them to follow social norms, interests and values rather than self-interest and biases. Concentration of effect shows whose interests would be most affected by problem formulation and helps identify people whose interests ought to be served first.

The second reason that problem definition will likely be more difficult in our model is that we expect this approach to make many complex problems *even more complex* through our approach. The strategies for expanding options and problem boundaries and for sweeping in other reference disciplines are unlikely to reduce problem complexity. We are, in effect, advocating a paradoxical notion: we propose that the key to formulating a complex problem situation is to make it even more complex. As noted above, some decision-makers will come to realize that their best strategy is to manage the problem's interaction with other problems rather than managing the problem at hand directly. These decision-makers are beginning to manage the paradox. When people are prepared to manage paradox, the possibility of unintended and/or unacknowledged consequences caused by their decisions or actions may dramatically decrease.

Churchman [11] (pp. 166–168) illustrates this point with the example of the inventory problem. If one is designing a company's inventory policy, one must be concerned not only with the cost of acquiring stock—the problem itself—but also with the cost of holding that stock and *not* using the funds elsewhere—the problem's environment. When considered in these terms, designing the "simple" inventory policy entails understanding the company's marketing, production, personnel, financial and other policies [31].

5.4. Model investigation

A survey containing five open-ended questions was developed for collecting information regarding the applicability of the model in organizations today. The five questions were:

1. Do you think Mitroff's five strategies are followed in this organization?
2. Do you think Jones' concept of "moral intensity" is considered in this organization?
3. Do you think the organization could be persuaded to adopt a more holistic (ethical) approach to problem formulation somehow? Can you suggest how?
4. Does the leader of the organization encourage ethical behavior and behave ethically himself or herself?

5. Does this influence the behavior of other people in the organization? Note that you do not have to identify the organization.

The survey was administered to forty employees, from various firms, pursuing an MBA in a major metropolitan area who were asked to read a paper describing our model integrating Jones's work with Mitroff's and to evaluate their organizations with respect to each of the five questions. Obviously, the survey does not constitute a formal test of the model, but was simply a small convenience sample intended to assess the degree to which some employees believe that their organizations have already integrated these underlying principles into their daily operations.

Briefly, 40% of the respondents felt their organizations followed the model reasonably well, employing elements of both Jones' and Mitroff's approaches in problem formulation. For example, one respondent from a Fortune 500 company reported that problems identified with the production of gas turbines are first classified according to the magnitude of its consequences and the probability of its effect. The critical stakeholders are identified and included in the decision-making process to ensure that multiple departmental inputs are solicited. As a result of selecting the 'right' stakeholders, multiple formulations of important problems usually occur, and downstream conflicts seemed to be mitigated.

However, approximately 20% of the respondents felt that their companies failed to incorporate any aspect of the model into their problem formulations. In another example, a large telecommunications company, concern with ethical and moral issues seems to be completely stalled. From an internal perspective, the employee felt that the organization did not consider all of the stakeholders, specifically the employees, to be an important element in their decision-making processes.

What we found encouraging about this small sample was that three fourths of the respondents indicated that they felt their organizations could be persuaded to adopt a more holistic approach to problem formulation. While we feel that these results seem to indicate that the model may have some merit in encouraging more concern for ethical and moral issues, we hasten to add that it is not possible to draw any definitive conclusions from a survey such as this and a more formal test of the model is needed.

Of course, formal tests of ethical models present an ethical dilemma. To truly test behavior in ethical dilemmas, one must place subjects in such a dilemma, and doing so violates most canons of research. One approach in information systems ethics research that has been used with good results is to have subjects examine vignettes of situations and evaluate the behavior of the actors in the vignettes (see, for example, Refs. [40,42,43]). This model contains factors that could be varied over a series of vignettes to allow for detection of changes in subject perceptions. For example, a series of vignettes could be developed with increasingly significant magnitudes of consequences. Changes in subject evaluations over the vignettes would provide insight into the impact of this factor on ethical problem formulation. The test could be repeated with increasingly diverse groups of subjects working together, to simulate the process of expanding the number of stakeholders involved. A formal test will be complex in design and require careful planning, but it is possible.

6. Implications for DSS design and problem formulation

Several implications for DSS design follow from the model in Fig. 2 and the comments gathered in the preliminary survey. At least three broad categories of functionality can be identified. One category focuses on stakeholder identification and support. As mentioned above, stakeholders not normally included in the problem formulation process need to be included. The DSS could initiate the inclusion of stakeholders by requiring participants to identify themselves and their objectives. Participants could self-identify themselves as protagonists or antagonists of other participants. In an extreme case, one could design the DSS so that the problem formulation process does not continue until each stakeholder is identified as an antagonist of at least one other stakeholder. Once the problem formulation process has begun, this component could monitor inputs to ensure that all stakeholders have at least an opportunity to participate and contribute to the

formulation. It could also work with the components that implement the support for the moral intensity components to ensure that all stakeholder views have been considered when assessing the six attributes of moral intensity.

A crucial aspect of supporting the incorporation of ethical issues into problem formulation is to alter the conception of DSS to include the notion of conversation support. Boland and Tenkasi [7] have observed that decision-makers are often involved in perspective making and perspective taking activities, and that information systems need to support users as conversation makers in order to provide an environment capable of supporting decision-making activities in complex and knowledge intensive environments.

A second component category includes capabilities to manage the iteration between "typical" problem formulation and our expanded notion that incorporates the components of moral intensity. Some mechanism is needed that will move the problem formulation process from strictly technical (i.e., non-ethical) concerns into the arena of social-orientation. That process must not be allowed to abandon the advantages that accompany focusing on specific technical aspects of a problem, however. In other words, the benefits of expanding the problem formulation process to integrate ethical concerns are not meant to replace the benefits that already exist in typical problem formulation. Ethical problem formulation should add to existing DSS benefits.

Where possible, the DSS should support integration of the quantitative aspects of moral intensity—magnitude of consequences, concentration of effect, probability of effect—into the quantified aspects of the non-ethical formulation. This ability will require support for dynamic model modification. The DSS will need some measure of "understanding", or meta-knowledge, about model types to achieve this goal. For example, if the problem formulation is in the form of a spreadsheet, then adding rows or columns to the spreadsheet may be needed. This is still not a trivial exercise, however, as the spreadsheet may be an implementation of some type of linear or integer programming model. Thus, adding a row (for example) to the spreadsheet may have serious implications for the form of the model or the constraints upon it.

A third category focuses on managing the unfolding process. Managing the expansion of the problem options and scope without (a) allowing the problem to become unwieldy and (b) prematurely stopping expansion into a potentially vital aspect of the problem situation will be a difficult balancing act to achieve. Again, meta-knowledge of model types may be a key to implementing this feature. The system may also need to incorporate a means to poll participants in the process to assess their perception of whether the process is headed in a fruitful direction. On the other hand, DSS designers might build into the DSS more knowledge of successful problem formulation techniques than the participants possess. If that is the case, it may be up to the system to lead the problem formulation process.

7. Summary

As organizations grow, their impact on society and the natural environment expands. It is increasingly important that organizations include a much broader range of factors in DSS design, and decision-making processes, especially ethical concerns. What have been lacking to date are some specific suggestions as how ethical concerns can be incorporated into the DSS design process. We have expanded Courtney's [13] new paradigm for decision-making processes by describing a model for ethical problem formulation based on Jones' [26] components of moral intensity and Mitroff's [35] rules for generating holistic problem formulations that avoid Type III errors. We have also offered suggestions on the type of capabilities DSS components will need to exhibit to implement this model. We hope this model will be adopted by DSS designers and decision-makers and that its use will lead to more ethical problem definition in organizations.

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