

A THEORY OF STRATEGIC PROBLEM FORMULATION

MARKUS BAER
Olin Business School
Washington University in St. Louis
One Brookings Drive
St. Louis, MO 63130
e-mail: baer@wustl.edu

KURT T. DIRKS
Olin Business School
Washington University in St. Louis
One Brookings Drive
St. Louis, MO 63130
e-mail: dirks@wustl.edu

JACKSON A. NICKERSON
Olin Business School
Washington University in St. Louis
One Brookings Drive
St. Louis, MO 63130
e-mail: nickerson@wustl.edu

Author Note. Order of authorship is alphabetical. The authors wish to thank Nick Argyres, Nicolai Foss, the members of Organizational Behavior research group at Washington University in St. Louis for their constructive comments on earlier drafts of this manuscript.

A THEORY OF STRATEGIC PROBLEM FORMULATION

ABSTRACT

We develop a theory of strategic problem formulation for complex, ill-structured problems. Based on a limited number of assumptions, we theoretically identify a core set of impediments that limit the comprehensiveness of the formulation activity. We then use these impediments to derive design goals, which, if satisfied by an appropriately designed mechanism, can expand problem formulation comprehensiveness. We design a structured process that indeed satisfies the goals and discuss its use in several real-world applications.

Designing new business strategies, producing innovations to grow profit, and developing novel supply chain configurations to achieve a cost advantage are some of the complex, ill-structured strategic challenges organizations must grapple with in creating sources of competitive advantage (e.g., Camillus, 2008, Nickerson, Silverman, & Zenger, 2007).¹ Tackling these strategic challenges is often the domain of groups or teams, particularly those that bring together actors from heterogeneous backgrounds and disciplines, such as top management or cross-functional/interdisciplinary teams (e.g., Amason, 1996; Bantel & Jackson, 1989; Nickerson & Zenger 2004; Schweiger, Sandberg, & Ragan, 1986; Wanous & Youtz, 1986). To create valuable solutions to such wicked problems, however, these groups first must know *what* problem they should be addressing. Indeed, as many scientists recognize, “the formulation of a problem is often more essential than its solution...” (Einstein & Infeld, 1938: 92).

Research has shown that the initial formulation of a problem is not only one of the most significant determinants of its solutions, both in terms of quantity and quality, but also profoundly determines *what* problem is solved (e.g., Ackoff & Emery, 1972; Boland & Greenberg, 1988; Churchman, 1971; Csikszentmihalyi & Getzels, 1971; Dewey, 1938; Duncker, 1945; Lipshitz & Bar-Ilan, 1996; Loasby, 1976; Nutt, 1992; Simon, 1973; Simon & Hayes, 1976; Volkema, 1983). Indeed, according to Mitroff and Featheringham (1974), one of the most important challenges of problem solving, especially with respect to designing business strategies, is solving the “wrong” problem by adopting a formulation that is either too narrow or inappropriate (see also Yadav & Korukonda, 1985). Consequently, problem formulation—often under the guise of different terminologies such as problem finding, defining, or diagnosing (e.g., Drucker, 1954; Getzels, 1975; Kilmann & Mitroff, 1979; Mason & Mitroff, 1981; Mintzberg,

¹ Challenges include both problems and opportunities. Throughout the remaining paper we use the more conventional term, problem, but do so with the intent of referring to problems and opportunities.

Raisinghani, & Theoret, 1976; Simon, 1989)—is an important topic in business strategy, organizational behavior, psychology, and sociology as well as across many other academic disciplines (e.g., Getzels & Csikszentmihalyi, 1976; Hewitt & Hall, 1973; Heiman, Nickerson, & Zenger, 2008; Mitroff, Emshoff, & Kilmann, 1979; Nickerson et al., 2007; Pounds, 1969; Redmond, Mumford, & Teach, 1993).

Despite its long-recognized importance, problem formulation has attracted only limited attention from management and strategy scholars over the past quarter century. In fact, the observation by Lyles and Mitroff (1980) that most efforts have been directed toward identifying and describing optimal methods for solving already well-defined problems and that little is known about how problems are formulated in the first place appears to be as true today as it was almost three decades ago. Mirroring this lack of scholarly attention, Mintzberg et al. (1976) and Nutt (1984) portrayed managers as being equally oblivious to the importance of systematically formulating problems, frequently skipping or abbreviating formulation activities. In fact, analyzing 33 case histories of strategic problem formulation processes in large U.S. companies, Lyles (1981) found that 75 percent of problems that went through the problem-solving process had to be recycled back to problem formulation suggesting that many managers were either initially defining the problem inappropriately or avoiding this stage altogether (Niederman & DeSanctis, 1995).

In addition, practically all theories and approaches to strategic decision making and problem solving assume that a problem formulation is given. Take, for example, two of the most prominent techniques for structuring strategic decision making groups, dialectic inquiry and devil's advocacy (e.g., Cosier, 1978; Cosier & Rechner, 1985; Mason, 1969; Mason & Mitroff, 1981; Schweiger et al., 1986). Both approaches focus primarily on examining the validity of a set

of solutions and their underlying assumptions rather than on the mechanisms that produce a systematic and thorough understanding of the problem at hand. A similar point can be made with respect to most theories of organization. For instance, Cyert and March (1963) base a substantial part of their behavioral theory of the firm on problemistic search, yet the existence of a well-formulated problem is assumed rather than directly addressed. Other major theories of the firm suffer from similar shortcomings (e.g., Barney, 1991, Grant, 1996; Williamson, 1975).

Thus, not only has the topic of strategic problem formulation received surprisingly little attention in the management literature but there are also few theoretical frameworks to help guide research and practice. In the present paper, we attempt to advance the science and practice of strategic problem formulation by (1) providing a conceptualization of problem formulation in groups and identifying a core set of impediments potentially constraining this activity, (2) using this theoretical analysis to derive a set of criteria—call them design goals—for structuring the problem formulation process to mitigate these impediments, and (3) describing a specific process designed to satisfy our design goals, demonstrably enabling superior problem formulation.

Our focus is on problem formulation in groups or teams because tackling multifaceted and difficult-to-define strategic issues typically require the formation of groups, particularly those that bring together individuals from heterogeneous backgrounds and disciplines, to assemble broadly dispersed information and knowledge sets (e.g., Mason & Mitroff, 1981; Mitroff & Emshoff, 1979). We define *group problem formulation* as a collective activity aimed at translating an initial problem symptom or web of symptoms into a set of questions or alternative formulations of the problem that are sufficiently well-defined in terms of the causes of the symptoms to enable the subsequent search for or generation of solutions (Lyles & Mitroff, 1980; Mason & Mitroff, 1981). In evaluating the relative success of the group problem

formulation activity we employ the notion of *comprehensiveness*. We define comprehensiveness as the extent to which alternative and relevant problem formulations are identified with respect to an initial symptom or web of symptoms.

Although bringing together individuals from heterogeneous backgrounds and disciplines to address real-world, strategic problems may hold the promise of increasing problem formulation comprehensiveness, individuals in such groups not only come equipped with distinct information and knowledge sets but also commonly pursue different interests and objectives, all of which, especially in combination, can impede the problem formulation process by promoting, for example, conflict and distrust. Thus, the same heterogeneity required to comprehensively formulate complex, ill-structured problems is likely to cause the emergence of impediments that can ultimately reduce comprehensiveness of problem formulation and the likelihood of finding valuable solutions. The challenge for scholars and managers alike is to derive criteria to guide the structuring of the formulation activity so that impediments to comprehensiveness are remedied without sacrificing benefits of group heterogeneity.

Unfortunately, the extant literature provides only limited guidance as to how groups can improve their strategic problem formulation capabilities. Although existing work has provided descriptive accounts of how organizations formulate problems (e.g., Lyles, 1981; Lyles & Mitroff, 1981) and has begun to explore the strategies and approaches that promote successful problem formulation (e.g., Mason & Mitroff, 1981; Volkema, 1986), most efforts have been ad-hoc and lack theoretical grounding. Existing work on decision making in diverse groups has identified, in isolation, a variety of impediments that may undermine group decision making in general and thus offers insights into the specific issue of problem formulation. The present paper, however, takes the unique step of theoretically deriving the set of impediments that are most

likely to undermine problem formulation comprehensiveness in groups and describing the potential interactions among these impediments. Furthermore, we describe how the impediments generate a set of theoretically-derived design goals that inform our understanding of how the problem formulation activity may be structured so as to overcome these impediments. This effort represents one of the first attempts to theoretically motivate process design for group problem formulation. Our approach to problem formulation is not only theoretically grounded, however, but also practically applicable in that it articulates the underlying principles on which managers can draw upon to design processes that fit their specific circumstances. In essence, we attempt to offer a new paradigm for process-design in the context of complex, ill-structured problems.

We proceed by describing in more detail the nature of the problems we are focusing on and by reviewing previous research pertaining to the formulation of such problems. We then introduce several assumptions about our model of human behavior and use these assumptions to theoretically derive a set of core impediments that arise when heterogeneous groups attempt to formulate and solve complex and ill-structured problems. Based on these impediments, we develop a set of design goals, which, if satisfied, should increase formulation comprehensiveness. Next, we illustrate how these goals can be put into practice by describing a structured process that has been designed to satisfy our specifications and that has been successfully applied in several organizational settings. Last, we explore avenues of future research suggested by our theory.

BACKGROUND

Complex, Ill-Structured Problems

We focus our theoretical development explicitly on the formulation of *complex and ill-structured*, that is, strategic problems. We define a problem context (we will use problem and

problem context interchangeable for ease of exposition) as a deviation from a desired set of specific or a range of acceptable conditions resulting in a symptom or a web of symptoms recognized as needing to be addressed (e.g., Cowan, 1986; Newell & Simon, 1972; Watson, 1976). A problem is *complex* when it involves (1) a large number of different variables, many of which may not be directly observable, such that only knowledge about symptoms is available from which the underlying state then has to be inferred; (2) a high degree of connectivity among the elements of the problem such that change in any one variable will affect the status of many other variables making it difficult to anticipate the potential consequences of a given situation, especially, because the effects of these interactions are generally not immediately observable; and (3) a dynamic component resulting in the pattern of interactions changing over time. Due to a general lack of understanding of the variables involved and the interdependencies among them, few formalized and agreed-upon approaches are in place for formulating and solving such problems making them not only complex but also *ill-structured* (e.g., Fernandes & Simon, 1999; Funke, 1991; Mason & Mitroff, 1981).

The reason for our focus on complex, ill-structured problems is two-fold. First, there is widespread and longstanding agreement among scholars and practitioners that most strategic problems exhibit at least some degree of complexity and ill-structuredness (Kilmann & Mitroff, 1979; Watson, 1976). In fact, Lyles and Mitroff (1980) found that 90 percent of strategic problems reported by managers of large U.S. companies could be classified as ill-structured, meaning that there was generally more than one way to formulate and solve a given problem. Second, because complex, ill-structured problems invite the development of multiple, often competing views of the problem and typically defy the use of formulaic, agreed-upon approaches for describing and solving them, problem formulation activities have been suggested to be of

particular importance in such circumstances (Lyles, 1981; Lyles & Mitroff, 1980; Mason & Mitroff, 1981).

To illustrate the nature of complex, ill-structured problems, we discuss three examples drawn from actual situations (we also draw on these illustrations throughout the paper to illuminate the concept of problem formulation and the impediments associated with it). The first example involves a large and successful consumer products company under pressure to achieve higher levels of profitable growth. The company performed well at renewing existing products, but grew increasingly concerned about the fact that few new product and service ideas were developed and ultimately marketed. In response, senior management engaged an executive education program that formed multiple teams to recommend solutions. Teams were composed of individuals drawn from different parts of the organization. Initial discussions with many managers indicated no agreement on either the causes of the problem or a course of action to accelerate growth from innovation.

Next, consider a North American business school faced with slipping placement rankings and complaints from interviewers regarding an apparent lack of “communication skills” in the graduating student body. A standing curriculum committee was charged by the dean to develop a strategy outlining how communication skills could be improved. The committee was comprised of faculty from different disciplines as well as administrators. Entering the situation, neither the dean nor any of the committee members agreed on the causes underlying the various concerns or on the solutions that were suggested.

Finally, consider a large health-care system with a mission statement centered on delivering high-quality care. The mission statement was designed with the intent to differentiate the hospital system from other systems. However, the system’s overall quality metric was similar

to competitors' metrics, yet did not clearly reflect the system's mission statement. In addition, there was a great amount of variance across hospitals within the system with respect to the patient satisfaction care metrics used. Senior management assembled and charged an interdisciplinary team to better define the mission statement and to develop an implementation plan to achieve the objectives of the mission statement. Initial discussions with team members indicated very different conceptualizations of the problem along with a list of competing potential solutions. Apparently, across the health-care system there was no consensus on what high-quality care constitutes or how such care could be defined or delivered.

Problems such as the ones described above are complex and ill-structured. They involve numerous elements, the direct measurement of which is often difficult or impossible (e.g., factors that drive innovation in a long-established company, quality healthcare, etc.). There is recognition that the elements comprising each problem situation are interconnected, yet few of these interdependencies are well-understood initially. Finally, the context as well as the interconnections among the elements are likely to change over time (e.g., past and future organizational changes impact innovation; new and different students arrive each year; the health care system has been in flux for the past 30 years and is likely to remain so in the future). In addition, given the multifaceted nature of each problem, there is little consensus regarding the underlying causes of the problem, let alone its solution, among the group members appointed to address the problem.

Recognizing the importance of thoroughly understanding the nature of the problem when confronted with such multifaceted and difficult-to-define issues, scholars have discussed the notion of problem formulation across a range of disciplines. We now turn to a brief overview of this literature.

Formulation of Complex, Ill-Structured Problems in Groups

Although the value of an appropriate problem formation to the success of the problem solving activity is well-documented (e.g., Getzels, 1973; Pounds, 1969; Volkema, 1983), problem formulation, compared to other stages of the problem solving process such as solution generation and implementation, has received surprisingly little systematic attention (Lyles & Mitroff, 1981; Simon, 1989). Nevertheless, some important insights have emerged from this work. For example, research suggests that the problem formulation activity may be impacted by a number of different factors, including the complexity and ill-structuredness of the problem, the bounded rationality of the actors involved in the problem formulation effort, and the processes used by organizations to formulate a given problem (Volkema, 1983; Simon, 1989). It is this latter aspect, the processes that organizations employ to formulate problems, however, that seems to have attracted the bulk of the attention among scholars in the fields of business policy, operations research, and management. In fact, over the past 50 years, there have been a number of attempts to systematize the problem solving process, from the initial formulation of the problem to the ultimate implementation of a solution (e.g., Ackhoff, 1978; Kepner & Tregoe, 1965; Pounds, 1969; Sagasti & Mitroff, 1973; Rittel & Webber, 1973; Schein, 1969). For example, studying 25 strategic decision making processes in organizations, Mintzberg et al. (1976) uncovered that there was a basic structure underlying these rather unstructured strategic processes. With respect to problem formulation, although not explicitly addressed, this research suggests that there is culmination of stimuli and that once this culmination reaches a certain threshold level, managers will recognize a given situation as problematic and, subsequently, initiate a decision process (see also Cowan, 1986).

One structured process that has enjoyed great popularity and widespread acceptance among theorists and practitioners alike is the Nominal Group problem solving technique (NGT). Delbecq and Van de Ven (1971) developed this process specifically for the purposes of engaging community groups to describe problems and determine which problems to address. Although the technique is still considered “to be one of the best (if not the best) process for reaching effective and efficient decisions” (Bartunek & Murningham, 1984: 418), researchers have pointed out its limited usefulness in addressing challenging strategic issues, as the rigid structure of the technique neither accommodates complex, ill-structured problems nor allows for the reformulation of a problem once the process has been set in motion (Bartunek & Murningham, 1984). In addition, like many of the studies mentioned above, individuals participating in the NGT are often removed from their normal work environment and placed in workshops or seminar settings for the duration of the training. Although these efforts encourage managers to explicitly focus their attention on the benefits and implications of problem formulation, little is known about how the process of problem formulation unfolds and, more importantly, should unfold in real organizational settings—environments in which political and other social forces are operating on a continuous basis. Indeed, considering political and other social forces, especially in the context of complex, ill-structured problems is imperative. As noted by Lyles (1981: 74), “The more ill-defined the nature of the problem, the more political will be the problem formulation process.”

Addressing this inadequate characterization of the real-world process by which problems in organizations are typically formulated, Lyles (1981) developed a model of the problem formulation process specifically acknowledging the often political nature of this process. Although this model found partial support in the studies of Lyles (1981) and Lyles & Mitroff

(1981), provides important insights into how problem formulation occurs, and offers some ad hoc suggestions for how to improve it, missing is a theoretical account of which impediments are most likely to emerge during the formulation of complex, ill-structured problems, how these impediments interact, and the mechanism most likely to overcome these impediments. We next turn to an analysis of these impediments and the criterion by which to establish the success of the problem formulation activity.

THEORETICAL DEVELOPMENT

Evaluating the Success of the Problem Formulation Activity

What constitutes successful problem formulation? Although a number of investigations have examined the factors that impact problem formulation (e.g., Boland, 1978; Niederman & DeSanctis, 1995; Volkema & Gorman, 1998), a clear criterion by which to establish successful problem formulation has not yet emerged (Mason & Mitroff, 1981). In fact, in many instances problem formulation success appears to have been approximated by evaluating a distal outcome of this activity—the production of solutions addressing the identified symptoms (e.g., Nutt, 1977; Volkema, 1983). This approach is indirect and imprecise, however, as it assesses the outcome of the problem solving activity, which may or may not be effective irrespective of the quality of the problem formulation.

Alternatively, we offer the criterion of formulation *comprehensiveness* (e.g., Fredrickson, 1984). We define comprehensiveness as the extent to which *alternative* and *relevant* problem formulations are identified with respect to an initial symptom or web of symptoms. Given this definition, comprehensiveness increases as the *number of alternative problem formulations* grows. Research has suggested that the ultimate success of the problem formulation activity is intimately connected to the number of alternative formulations proposed regarding a symptom or

web of symptoms (Boland, 1978; Volkema, 1986; 1988). For example, Niederman and DeSanctis (1995) suggested that a necessary criterion for achieving accurate and complete problem formulation is for groups to engage in intensive search for information—a process that should allow for alternative problem perspectives to emerge, that is, for equivocality to surface, encouraging more successful problem solving in the future. In a similar vein, Volkema and Gorman (1998) considered problem formulation to flourish to the extent that groups extensively search for information allowing for the generation of alternative, competing problem understandings. Lyles and Mitroff (1980) also suggested that improved formulation entails the generation and selection of alternative views of the problem.²

It is important to note, however, that, in contrast to some previous accounts, we do not equate comprehensiveness with completeness (i.e., number of formulations divided by total number of possible formulations). The total number of possible formulations for a given problem, especially when it is complex and ill-structured and, as a result, multiple, competing, yet equally valid views of the problem are plausible—often remains unknown and may even be unknowable. As stated by Rittel and Weber, “the formulation of a [complex] problem *is* the problem” (1973: 161). This impossibility implies that any optimality criterion, such as completeness, is not appropriate for evaluating the success of the problem formulation activity (Mitroff, Emshoff, & Kilmann, 1979; Rittel & Webber, 1973).

Relevance, the second necessary component of our conceptualization, implies that each alternative formulation must illustrate at least one mechanism that causes at least one of the identified symptoms (Mitroff et al., 1979). Thus, comprehensiveness increases to the extent that

² Previous research on problem formulation, notably Lyles (1981), DeSanctis and Niederman (1995), and Volkema and Gorman (1998), argued that successful problem formulation entails both the production of alternative problem views as well as the reduction of this equivocality via consensus building. Although reduction of equivocality is not part of problem formulation as conceptualized in this research, we recognize that this activity may occur post-formulation in the form of hypothesis testing. Thus, for the purpose of this research we consider the reduction of equivocality as part of the solution derivation stage (see also Mason & Mitroff, 1981).

an additional formulation (1) adds to the overall number of symptoms that can be explained or (2) provides an alternative explanation for at least one of the identified symptoms. A set of formulations that addresses only a subset of symptoms is hence considered to be less relevant and, as a result, less comprehensive than a set that addresses the entire web of symptoms. There is a caveat, however, to this conceptualization. Formulations that suggest mechanisms that produce symptoms outside the symptom web, even when explaining a number of identified symptoms, is not considered relevant.

By focusing on formulation comprehensiveness we assume a probabilistic relation between the comprehensiveness of a problem's formulation and the likelihood with which the root cause of a particular situation will be discovered. Identifying the root cause, in turn, will not only decrease the need for groups to cycle back to the formulation stage later on in the problem solving process thereby reducing inefficiencies (see Lyles, 1981) but may also have implications for the effectiveness of solution generation and/or implementation.

Heterogeneous Groups as Vehicles for Comprehensive Problem Formulation

Comprehensively formulating complex, ill-structured problems is not an individual activity (Mitroff & Emshoff, 1979). Given that complex, ill-structured problems typically constitute complicated mixtures of a range of different, yet highly interdependent issues that cannot be addressed in isolation from each other, comprehensively formulating these problems poses extraordinary demands on the breadth and depth of information and knowledge required. Such demands naturally confront *bounded rationality*, that is, the limitations of both knowledge and cognitive capacity (i.e., attention, memory) characterizing human rationality (Simon, 1955; 1957). Due to bounded rationality, actors experience limits in the extent to which they can acquire, accumulate, and apply information and knowledge. These limits in conjunction with the

notion that information and knowledge acquisition, accumulation, and application are costly activities—for example, new communication channels and codes may have to be established cutting into limited resources, such as time and attention, necessary for other activities—restrict the ability of any one actor to tackle complex, ill-structured problems (Arrow, 1974; Simon, 1955). Indeed, research suggests that when confronted with such problems, individuals often only identify the most obvious symptoms, or those to which they are most sensitive, resulting in the problem being described inappropriately (Mitroff & Featheringham, 1974; Watson, 1976) or in overly simple terms (March & Simon, 1958). As noted by Volkema (1997: 31), “Problems have a way of growing during discussions, often beyond the limitations of the human mind. When this occurs, there is a temptation to oversimplify the problematic situation to fit human capacity, rather than to find ways to extend memory.”

The challenges associated with comprehensively formulating complex, ill-structured problems in conjunction with the limitations resulting from bounded rationality then suggest that no single actor is likely to possess or to be able to accumulate quickly enough the range of information and the breadth of knowledge needed to span the entire problem space (Newell & Simon, 1972). We therefore assume that the relevant information and cognitive structures (i.e. mental models, knowledge sets, etc.) needed to comprehensively formulate complex, ill-structured problems is likely to be dispersed across multiple individuals. As Mason and Mitroff noted, “the raw material for forging solutions to [complex, ill-structured] problems is not concentrated in a single head, but rather is widely dispersed among the various parties at stake” (1981: 13-14). As a consequence, groups comprised of individuals who are heterogeneous with respect to both the information and knowledge sets they possess must be engaged if comprehensive problem formulation is to be achieved.

Along with information and knowledge sets, members of heterogeneous groups are also likely to possess different motivations (Cyert & March, 1963). A key assumption of the political perspective of organizations, we subscribe to the view that organizations consist of coalitions of actors with at least partially competing interests and objectives (e.g., Allison, 1971; Pettigrew, 1973; Pfeffer, 1981). Although we acknowledge that individuals may pursue some objectives that are shared among all actors, such as the overall welfare of the consumer products company, business school, or health care system in our earlier examples, some goals may be at odds with each other due to differences among individuals in self-interests resulting from occupying different positions, belonging to different departments, or pursuing different career goals (Eisenhardt & Zbaracki, 1992). It is therefore inevitable that groups composed of members from different functional, hierarchical, and professional backgrounds—the springboard for comprehensive problem formulation—also experience divergence in interests and objectives (Dean & Sharfman, 1996). This heterogeneity can be functional for problem formulation in that it ensures that no single interest controls the lens through which the problem is viewed. Following a common behavioral assumption in strategy, however, individuals have the potential to pursue this self-interest with guile (e.g., Williamson, 1975) which, as we discuss below, has the potential to severely undermine the problem formulation activity, for example, by restricting and distorting the flow of information (Cyert & March, 1963; Nickerson & Zenger, 2004; Pettigrew, 1973).

With our definition of formulation comprehensiveness and assumptions about human nature (i.e., bounded rationality with the potential to pursue self-interest with guile) as well as the relevant contextual conditions (i.e., need for groups composed of individuals with heterogeneous

information and knowledge sets, existence of heterogeneous motivations), we now turn to a theoretical analysis of the relevant impediments.

Impediments to Comprehensive Problem Formulation in Heterogeneous Groups

By combining different sets of information and cognitive structures, in the abstract, a heterogeneous group is more likely to find formulations that encompass the root causes of a problem and engender discovery of more valuable solutions than either an individual alone or a homogenous group. This ideal, however, is rarely achieved in practice. In a recent review, van Knippenberg and Schippers (2007) concluded that there is little evidence that heterogeneous groups outperform homogeneous groups on a variety of tasks, including decision making and problem solving. Similarly, a meta-analysis by Webber and Donahue (2001) found a non-significant correlation between team heterogeneity and team performance. Although this research has not specifically examined the effects of group heterogeneity on problem formulation comprehensiveness, these results nevertheless suggest that the formulation activity in heterogeneous teams may be plagued by similar problems as group performance in general.

We argue that the very group heterogeneity promising superior comprehensiveness generates a set of impediments that narrow and limit comprehensiveness. Drawing on our assumptions and definitions, we theoretically derive a core set of impediments following from the three types of heterogeneity—information, cognitive structures, and objectives. Although this list may not necessarily reflect all possible impediments, it nonetheless derives from only a few assumptions and identifies a set of group biases that have been reported to be common and important. Confirming the importance of these impediments, we draw on existing group research. Our theory development differs from that found in the group decision making literature in several ways, however. First, instead of focusing on those impediments that are likely to

undermine group decision making in general, we identify the impediments most likely to impact formulation comprehensiveness specifically. In addition, rather than focusing on certain impediments individually, we theoretically derive a core set of impediments that is likely to jointly limit formulation comprehensiveness and describe the potential interactions between these impediments.

We do not wish to imply that these impediments are unique to the formulation stage of the problem solving process. Even if some impediments may arise during subsequent stages of this process, problem formulation typically, at least in successful groups, precedes these other stages (Lipshitz & Bar-Ilan, 1996) and, thus, it is imperative to identify and address the impediments as early as possible, that is, during problem formulation (if impediments are addressed in the problem formulation stage then these particular impediments may be less prevalent or absent in subsequent stages). Our argument does not, however, assume that groups proceed through these stages a linear fashion, but instead that problem formulation is an activity that must be effectively addressed.

Impediments resulting from heterogeneous information sets. We begin our theory development assuming homogeneity of objectives. We relax this assumption in a later section to explore the unique effects of heterogeneous objectives, as well as how heterogeneity of objectives interacts with heterogeneous information sets and cognitive structures to impact comprehensiveness. We propose that groups composed of members with homogeneous goals but heterogeneous information sets will discuss and consider only a small subset of the total amount of information available to the group. Specifically there is a tendency to discuss information which is commonly held at the expense of unique and uncommon information when resources are limited. This tendency, which will necessarily narrow and limit formulation

comprehensiveness, ultimately arises from the bounded rationality of group members who possess heterogeneous information sets.

Heterogeneity in information sets implies that although there may be some problem-relevant information that is held in common by group members (known to most or all members), each member also holds unique information (known only to a single member). Given the limitations associated with bounded rationality, individuals will find it difficult to initially judge which elements of the information they hold are most likely to be relevant to a particular problem. Group members therefore will begin communicating by sending such cues they believe are most likely to be understood. Generally, understanding signals requires recipients to recognize cues and then engage in a conversation to transfer and verify the information sent and received. Individuals are more likely to respond to cues that they recognize, which is far more likely to be information that they hold in common. Sharing unique information incurs additional costs for an individual as new communication channels and codes may have to be established before unique information can be understood and appropriately interpreted. With limited resources of attention, memory, and time, group members are more likely to discuss and consider information that incurs lower communicating and decoding costs, such as information that is held in common, leaving unique, individually-held information less likely to be communicated.

Research on the effectiveness of collective information-sharing processes in decision making groups provides evidence supporting these arguments. Hearing other group members reveal information makes similar and commonly held information appear more important or relevant (Wittenbaum, Hollingshead, & Botero, 2004). Moreover, research shows that groups often make suboptimal decisions because they tend to discuss and incorporate information that is shared at the expense of information that is unshared (e.g., Larson, Christensen, Abbott, & Franz,

1996; Stasser & Titus, 1985). For example, Stasser, Taylor, and Hanna (1989) asked university students to read descriptions of candidates for student body president. These descriptions were constructed such that some information was read by one member before discussion (i.e., unshared), whereas other information was read by all members (i.e., shared). Groups were then instructed to discuss the candidates and decide which was best suited for the position. Results revealed that, on average, discussions contained 46% of the shared but only 18% of the unshared information. In addition, research supports the notion that common information has a sampling advantage over unshared information because it is often considered to be more important, relevant, and accurate than unique information (Postmes, Spears, & Cihangir, 2001; Wittenbaum, Hubbell, & Zuckerman, 1999).

Sharing and discussing information that is commonly held by many members rather than revealing unique information is likely to undermine comprehensive problem formulation. Specifically, failure to discuss or share information that is unique undermines the ability of groups to generate not only different or alternative but also relevant problem formulations as groups are likely to prematurely, that is, before the entire problem space is explored, converge on the least common denominator—a problem understanding that everyone can easily agree upon but that not necessarily reflects the intricate nature of the underlying problem.

Impediments resulting from heterogeneous cognitive structures. Groups composed of members with homogeneous objectives but heterogeneous cognitive structures—i.e., the mental models that serve to govern the interpretation, organization, and use of information and knowledge—will suffer from the emergence of representational gaps. A representational gap is a group-level phenomenon capturing differences in representations—understandings of a problem situation constructed on the basis of an individual’s domain-related knowledge (Chi, Feltovitch,

& Glaser, 1981)—among the members of a group (Cronin & Weingart, 2007). Due to the limits associated with bounded rationality, individuals faced with a complex, ill-structured problem are likely to formulate problems in a way that capitalizes on the knowledge that they possess. In other words, existing knowledge and its organization determines how people come to see and formulate a given problem context resulting in what Mason and Mitroff (1981) have termed, “tunnel vision” (this phenomenon can also occur when there is homogeneity in information sets).³

Conceptualizing a given problem in accordance with one’s cognitive structures, while functional from the perspective of the focal individual in that it focuses attention and capitalizes on scarce cognitive resources, can have devastating consequences for comprehensive problem formulation once considered in the context of a heterogeneous group. Specifically, as members of such groups, because of differences in knowledge sets, are likely to produce problem understandings that are, at least partially, incompatible with one another, representational gaps are bound to emerge. These gaps, in turn, are likely to jeopardize problem formulation comprehensiveness in at least two ways.

First, the emergence of representational gaps makes it difficult and costly for individuals to share knowledge and recombine representations to explore additional problem formulations. As different representations or problem understanding are built upon and involve different concepts and terminologies, communication across these divides will be difficult. For example, a concept that exists in one domain may not exist or may carry a different meaning in another

³ The tendency of tunnel vision has been well-supported by previous research (e.g., Boland & Greenberg, 1988; Walsh, 1988). For example, Dearborn and Simon (1958) investigated departmental affiliation as a contributing factor to executives’ problem formulation activities. Their results suggested that problem formulation is selectively directed towards the department to which the executive belonged. Looking at the exact same data, for example, 83 percent of sales executives identified sales as the most important problem compared with 29 percent of executives from other areas. As Dearborn and Simon noted (1958: 140), “Presented with a complex stimulus, the subject perceives in it what he is ready to perceive; the more complex or ambiguous the stimulus, the more the perception is determined by what is already in the subject and the less by what is in the stimulus.”

domain. In the health care case described earlier, for example, the concept of “high-quality care” was understood by physicians to encompass the use of high-quality medical procedures, whereas from a chaplain’s perspective such care encompassed reverence and quality of life concerns. Or, from our business school illustration, individuals with an economic versus behavioral background used the term of “rigor” to refer to research and teaching but this term carried substantively different meanings in these two groups (e.g., rigor as mathematical models versus structured qualitative analysis). Naturally, these differences make the communication of such concepts and terms not only difficult but also costly as significant time and energy would have to be invested in order for group members to be able to bridge these gaps.

Different cognitive structures, however, may not only involve different concepts and terminologies but also differences in the assumptions about the way those concepts are interrelated. As an example from the consumer products firm, individuals with a marketing perspective, assumed that innovation would generate positive externalities with respect to revenue and brand image. In contrast, individuals from a production background assumed that innovation would generate negative externalities in production costs because of the process disruptions created by introducing a new product. Such assumptions, which are often unarticulated, provide the foundations on which representations are not only constructed but also transferred from one individual to another. Discovering differences in concepts, assumptions, and definitions, then codifying and transmitting them, however, is costly for boundedly rational actors and, as a result, likely to impede the sharing and recombination of such representations. As both the communication and integration of different problem understandings are essential to formulating problems, differences in assumptions are likely to undermine the comprehensiveness of this activity.

Second, differing cognitive structures and the resulting inability of individuals to understand each other can promote conflict and distrust, which further impedes the sharing and recombination of representations, let alone the recognition of each other's formulations. In general, task conflict consumes scarce cognitive resources, which not only can negatively impact overall group performance (De Dreu & Weingart, 2003) but problem formulation in particular. For instance, Carnevale and Probst (1998) suggested that conflict limits problem solving abilities because it makes individuals more rigid in their thinking processes—that is, less able to see or integrate alternative ideas or perspectives and, as a result, less creative. As complex, ill-structured problems require that different problem understandings are generated and integrated, such rigidity will necessarily undermine the production of alternative and relevant problem formulations, that is, formulation comprehensiveness. Furthermore, in the absence of trust, task conflict can turn into other potentially more harmful conflict types, such as relationship conflict, thereby diverting even more resources away from problem formulation toward, in this case, the management of relationships (Simons & Peterson, 2000). As a result, formulation comprehensiveness is even less likely to be achieved.

Impediments resulting from heterogeneous objectives. We propose that heterogeneity in motivation results in group members engaging in political maneuverings that consume scarce resources—attention, memory capacity, and time—and contaminate and constrain the exchange of information and cognitive structures thereby limiting and narrowing problem formulation comprehensiveness. Consistent with previous research, we define political maneuvering as “intentional acts of influence to enhance or protect the self-interest of individuals or groups” (Allen, Madison, Porter, Renwick, & Mayes, 1979: 77). The notion that problem formulation in the context of complex, ill-structured problems is a political process has been acknowledged by a

number of scholars (e.g., Mason & Mitroff, 1980). For example, in their study of 33 managers, many of whom from Fortune 500 companies, Lyles and Mitroff (1980) showed that social and political influences, such as power acquisition and political maneuvering, were among the primary forces impacting the problem formulation process in organizations. Similarly, Lyles (1981) highlighted the importance of identifying the interest and stakes various members have in the problem formulation process as a critical determinant of its success.

Political activity yields impediments resulting directly from the assumption that members of heterogeneous groups have different objectives and are motivated by self-interest to enhance or protect these objectives. Specifically, political maneuvering undermines problem formulation comprehensiveness by predisposing group members to (1) engage in dominance activities, (2) jump to solutions, and (3) transfer information and cognitive representations strategically. We describe each in turn.

First, those individuals who have high stakes are more likely to advocate strongly for solutions from which they benefit. Those individuals who have few stakes are likely to acquiesce because otherwise the cost incurred from consuming time to advocate a position exceeds the benefit of succeeding. Such dominance, which arises from heterogeneity of motivations, likely leads to the narrowing of formulation comprehensiveness by focusing attention on formulations and solutions that are consistent with those group members who have the most at stake.

Second, numerous scholars have observed the tendency for group members to prematurely propose solutions at the expense of investing time and energy into comprehensively formulating problems (Maier & Hoffman, 1960; Van de Ven & Delbecq, 1971). Although this tendency may in part derive from bounded rationality itself (abbreviating or forgoing the problem formulation activity economizes on bounded rationality), heterogeneity of objectives

nevertheless creates incentives to jump to a solution. Specifically, as every solution implicitly suggests a certain problem formulation, actors who prematurely suggest a particular solution are in the unique position to limit problem formulation to such alternatives that support their objectives, as opposed to searching for and considering other relevant formulations. For instance, in our illustration of the curriculum committee, members representing accounting and finance quickly offered the solution of expanding accounting and finance courses as a means to improve student analytic skills. This proposal stimulated immediate reactions and “solutions” from other members of the committee. Similarly, several individuals in the consumer products firm recommended expanding the resources at their disposal as a solution to generate more innovation. And, several group members at the hospital system suggested that the organization use the model of palliative care, which represented a strong interest of theirs. In each of these instances, jumping to solutions quickly foreclosed the search and evaluation of alternative formulations, which ultimately limits problem formulation comprehensiveness.

Third, dominance and jumping to solutions not only directly impact the comprehensiveness of the formulation activity in the ways described above, but also indirectly by triggering political behavior in others. Indeed, the suggestion of a solution may trigger others in the group to offer their own solutions consistent with their self-interests. Thus, these behaviors triggered by heterogeneous objectives *interact* with the impediments of information sampling and representational gaps, which were developed assuming homogeneity of preferences, by causing team members to strategically disclose some information and share some problem understanding while withholding others in order to manipulate the formulation activity to disproportionately benefit themselves (Wittenbaum et al., 2004). In short, the introduction of

heterogeneity in objectives amplifies the impediments associated with heterogeneous information and cognitive structures by initiating strategic behaviors.

Ample research supports this tendency. For instance, Pettigrew (1973) analyzed the decision making process of a computer adoption. Different managers in the firm had conflicting preferences for outcomes. As a consequence of these preferences, managers would block and slant information in favor their own solution. Likewise, in an experimental study of problem solving, Ferrin and Dirks (2003) observed that when the team members faced competing incentives they perceived the other parties more negatively, trusted their partners less, and withheld and misrepresented important information. These results indicate that although group members may have insights on the problem or relevant data, they may withhold such information when it undermines their objectives, or may choose to emphasize particular elements when they support their positions. These actions further contribute to a narrowing as well as a biasing of the formulation activity as scarce resources are consumed on political posturing instead of comprehensively exploring the problem space. In addition, political maneuvering generates mistrust which dynamically and further undermines a team's willingness to expend scarce resources to create shared understandings because of the limited returns expected from doing so. As a result, unique information is even more unlikely to be shared and representational gaps are even less likely to be bridged further undermining problem formulation comprehensiveness.

Summary of impediments. Our theory suggests that although heterogeneous groups have the potential to achieve higher levels of problem formulation comprehensiveness, they also confront a particular set of serious impediments that undermine and limit problem formulation comprehensiveness. First, information sampling implies that groups have difficulty in pooling all of their relevant information. Second, representational gaps imply that groups have difficulty in

communicating their unique perspectives, which, when combined, could expand the number of alternative and relevant formulations. Third, heterogeneity in motivations implies that groups have a tendency to suffer from dominance, jumping to solutions, and the strategic revelation of information and cognitive structures. These impediments and their interactions collectively act to limit and distort the comprehensiveness of problem formulation.

A logical conclusion from our theoretical analysis is that if this core set of impediments narrow and limit problem formulation comprehensiveness then any mechanism or set of mechanisms that mitigate these impediments as a set expands comprehensiveness. We therefore establish the impediments as a set of design goals, which, if collectively satisfied, will mitigate the impediments of problem formulation comprehensiveness described above. In the next section, we consider the implication of the theory for practice.

IMPLICATIONS FOR PRACTICE

Numerous scholars recently have noted the critical importance of developing theory which not only advances fundamental understanding, but also practice (e.g., Rynes, Bartunek, & Daft, 2001; Van de Ven & Johnson, 2006). Accordingly, one might ask whether the theoretical arguments outlined in the prior section can serve as a “good theory” for improving problem formulation in practice.

The problem formulation impediments described above might be addressed via three general approaches—selection/group composition, use of incentives, and process design (i.e., input, output, and behavior controls; see Ouchi, 1977, Thompson, 1967). Selection involves purposely composing groups to capture the gains from heterogeneity while simultaneously attenuating impediments. However, this presupposes that managers not only are able to verify, a priori, what individuals’ interests and objectives are and how they differ in terms of their

cognitive structures and informational sets, but also that they have enough control over the composition of work groups to select ideal members for inclusion—both assumptions that are typically not met in organizations (Wanous & Youtz, 1986).

Incentives offer another alternative mechanism, however, their use requires the ability to measure effort or outcomes (DeMatteo, Eby, & Sundstrom, 1998) and to selectively intervene in an organization by offering targeted incentive structures (Williamson, 1985). Unfortunately, the difficulty in actually measuring and verifying cognitive efforts (e.g., related to sharing unique information and overcoming representational gaps) and the costs associated with targeted interventions within organizations (Nickerson & Zenger, 2008; Williamson, 1985) make their application in most instances infeasible. Selection and incentives therefore are of limited value in attenuating the impediments associated with group problem formulation.

Given the limitations of these two options, we turn our attention to the use of a third category of mechanisms for shaping human behavior, structured processes. As observed by Van de Ven (1992), the term “process” has been used in a variety of ways in the management literature. In this paper, we refer to a *structured process* defined as a specified set of rules or guidelines that direct group interaction to arrive at a desired outcome (e.g., comprehensiveness). Thus, instead of focusing on selection or incentives to arrive at the desired outcome, structured processes focus on intermediary steps that cause heterogeneity to be reliably transformed into enhanced problem formulation comprehensiveness.⁴

⁴ Information economists define a “mechanism” as a specification of how economic decisions are determined as a function of the information that is known by the individuals in the economy (Myerson, 1989). Based on this economic definition, a structured process is appropriately referred to as a mechanism because it specifies how problems can be formulated, which is a necessary aspect of economic decision making. Indeed, prior research supports this conclusion by examining how various structured processes can be effective in improving a variety of outcomes, ranging from decision-making performance to creativity (e.g., Cosier, 1978; Osborn, 1953; Schweiger et al., 1986; Van de Ven & Delbecq, 1971).

The theory of impediments described above provides the opportunity to identify and evaluate alternative structured processes for expanding problem formulation comprehensiveness. Thus, rather than relying on previous ad hoc accounts we evaluate the effectiveness of process elements for mitigating the previously identified impediments. In addition, our approach allows for flexibility in addressing these impediments—understanding exactly how the impediments are caused allows us to adopt any interventions that overcomes them. Put differently, there could be any number of structured processes that could be used to achieve comprehensive problem formulation as long as the process components satisfy the design goals of mitigating our impediments. In the section below, we illustrate one process designed and successfully used to mitigate impediments.

Example of Structured Process to Attenuate Impediments

The process steps and design goals they address are outlined below and depicted in Figure 1. Although we borrow elements from processes previously identified in the literature, the novelty of our approach derives from the particular combination and sequencing of these elements ultimately allowing for the mitigation of the theoretically identified impediments. Following our theory, the process described below is intended for a heterogeneous group charged with formulating a complex, ill-structured problem. It presupposes selection of group members as well as commitment to the process.

Insert Figure 1 about here

Our structured process approach involves splitting the problem formulation activity into two distinct phases, which we refer to as framing and formulating. Framing is the first phase and identifies what symptoms or empirical regularities should be considered in the formulation phase. In particular, this process segment attempts to identify all empirical regularities that are

correlated with the initial stimulus and is comprised of four individual steps. First, a group leader or facilitator specifies ground rules that focus the group members on symptom identification and prevents the discussion of problem formulations or solutions. Second, participants engage in a modified nominal group technique (mNGT) (Van de Ven & Delbecq, 1971) to reveal the set of correlated symptoms. Specifically, group members first silently document all possible symptoms that they can identify along with evidence supporting the inclusion of certain symptoms and then, in a round robin fashion, reveal and discuss each symptom until all symptoms have been exhausted. Third, group members compile the web of symptoms and supporting information in a document on which all members must reach consensus. In the last step, the group distributes the document to relevant stakeholders outside the group for review and additional input.

After the completion of the framing phase, the formulation phase begins. This part of the problem formulation activity follows the identical four-step approach as used during the first phase, with two exceptions. First, the ground rules specified by the group leader focus the group members specifically on the formulation of the problem and on the prevention of the discussion of potential solutions. Second, during mNGT, instead of identifying the web of symptoms, the group now lists and discusses all causes that could potentially explain one or more of the previously identified symptoms. It is each of these causes that represent alternative formulations. With these exceptions, the two phases are identical—engage in mNGT, develop a consensus-based document, and seek reactions from relevant stakeholders. The end product is a document that offers a set of formulations that identifies plausible and relevant causes of the web of symptoms correlated with the stimulus that launched the inquiry.

In sum, our process approach to group problem formulation comprises the following elements: (1) structuring the process with the help of a facilitator into distinct phases (i.e.,

framing vs. formulating) by adopting rules to forestall the discussion of causes and solutions, (2) employing a modified version of the nominal group technique to describe the web of symptoms and its underlying causes, (3) developing consensus-based documents, and (4) using external parties to review these documents. The following section describes how the combination and sequence of elements combine to mitigate impediments describe above.

Structuring the process into distinct stages. Structuring the process into distinct stages is accomplished with the assistance of a facilitator who, by rule, separates the problem solving process into the distinct phases of framing and formulating, both of which precede the solution generation and implementation stages (Lipshitz & Bar-Ilan, 1996). Given the tendency for actors to propose and endorse solutions before the problem is understood, structuring the process into distinct stages can address several impediments identified earlier. First, and most directly, segmentation mitigates the impediment of being solution minded. Second, segmentation attenuates the limitations associated with bounded rationality by focusing attention and cognitive efforts exclusively on problem framing or formulation. Third, by averting jumping to a solution, the sequential structuring of segments can help to forestall triggering of political reactions and therefore enable the building of convergent expectations. For instance, it is unlikely that discussions of symptoms will trigger political reactions the way that jumping to solutions can (discussing symptoms has fewer direct implications for which actions need to be taken and whom such actions may benefit). By forestalling political reactions, discussing only symptoms or formulations can create a context in which group members can work toward agreement on the goal of eliminating the symptoms. Such convergent expectations, if made possible, can attenuate if not largely eliminate impediments that derive from initially heterogeneous motivations. Previous research indicating that processes that distinguish between problem formulation and

solution generation tend to be superior to those combining these different activities (Brilhart & Jochem, 1964; Maier & Hoffman, 1960) provides preliminary evidence supporting this logic.

Modified Nominal Group Technique. Mitigating other impediments involves sharing information and cognitive structures among group members, and the connected problem of overcoming dominance by those with the highest stakes. Nominal group technique offers one approach that can be adapted to address these issues (Van de Ven & Delbeq, 1971). Specifically, our modified version of the NGT forces individuals to identify and to commit to in writing their information or cognitive structures (depending on whether the segment is framing or formulating) before being influenced by group discussion. Furthermore, it stimulates conversations that reduce representational gaps because every listed symptom and cause must be discussed and evaluated, which encourages the creation of and investment in communication codes and channels needed to transfer cognitive structures. In the same way, dominance is mitigated because everyone must describe and discuss the items that they have written down.

Consensus decision (unanimity decision rule). As noted earlier, another set of impediments involves information sampling and representational gaps and the fact that strategic behavior and distrust arising from heterogeneous motivation may exist and exacerbate these impediments. One procedure that may be used to limit these challenges is using a unanimity decision rule, as opposed to a majority rule, when documenting the output of each segment. Although more time consuming, this approach has several advantages. Given that group members' initial motivations are heterogeneous, despite having a unifying group goal, consensus may make the common group goal more salient relative to each individual's unique goals by highlighting the need for groups to arrive at a mutually agree-upon problem statement. Furthermore, it credibly offers to each member a veto for including symptoms and formulations.

These factors help address at least two of the design goals. First, because groups have difficulty achieving consensus without reducing gaps in information and cognitive structures, participants are triggered and motivated to share information and reduce representational gaps in order to achieve consensus. Following this logic, Mohammed and Ringseis (2001), for example, found that groups that used a unanimity decision rules reduced their representational gaps compared to groups using a majority voting. Second, consensus encourages trust that attenuates strategic behavior by parties thereby freeing up cognitive resources and time that can then be invested into the identification of symptoms and formulations. Because members can veto other's decisions, consensus accentuates common goals, such as eliminating symptoms or counteracting causes, which may then not only lead to superior outcomes but also provide a disincentive for individuals engaging in strategic behavior.

Involving external parties. Working as a team with a particular aggregate set of information and cognitive structures can isolate the team from external ideas and parties who can offer other perspectives and information (Janis, 1982). Leveraging members external to the group holds the promise of improving team effectiveness by overcoming group-level bounded rationality, as Ancona and Caldwell (1992) found in their study of new product development teams. For example, involving external parties by circulating symptoms and circulating problem formulations can expand problem formulation comprehensiveness. Doing so may also help to mitigate political maneuverings. Engaging external community members creates another reason for group members to put aside political considerations because team members may be concerned about suffering reputational losses that arise from broader exposure.

In aggregate, the process described herein is designed to reduce information sampling, narrow representational gaps, forestall jumping to a solution, eliminate dominance, and

undermine political maneuvering. As stated above, our process may not be unique in its ability to increase problem formulation comprehensiveness. Any process thoughtfully designed to attend to the design goals of mitigating impediments should translate into increasing problem formulation comprehensiveness.

Qualitative evidence suggests that the structured process derived from the design goals was successful in each of the three real-world situations presented. For example, the consumer products company had undertaken many efforts previously with little success. Surprisingly, senior management quickly adopted many of the recommendations developed from the process and assembled project teams to study the remaining recommendations. One senior leader commented that it was extremely unusual for management to adopt such a broad set of solutions and that the process should be considered extraordinarily successful. In the case of the business school, prior attempts at problem solving to achieve the desired level of analytical and communication skills for the standing committee ended in acrimony. Application of the structured process led to dramatically different results, with a novel and valuable program redesign receiving unanimous support not only from the committee but also subsequently from the entire faculty. Again, implementation went smoothly compared to prior changes. Finally, at the health care company, the outcome was viewed as exceeding objectives by all participants and their senior managers. This qualitative evidence clearly does not provide scientific evidence supporting the process, but it offers promise that can be verified in future research.

DIRECTIONS FOR RESEARCH

Simon (1989: 7) criticized theories of rational decision making for omitting at least three centrally important components of the decision making process: a theory of attention direction, a theory of problem formulation, and a theory of alternative generation. While we do not make

specific progress on the first and third issue, this paper provides what we think is among the first theories to respond to his call for a theory of problem formulation.

While our real-world applications are useful and informative, they do not represent an empirical test of our theory and process design. Thus, an important next step is to empirically evaluate the efficacy of our structured process. This step poses several challenges, given that heterogeneity in motivation is a critical element; laboratory experiments with college students are unlikely to offer an appropriate empirical setting. Any proposed empirical setting must carefully satisfy our assumptions of heterogeneity, with a particular focus on heterogeneous motivation and its interactive effects on information sampling and cognitive gaps.

Our theory is predicated on three types of heterogeneity to be present in groups and on the need to solve complex ill-structure problems. One direction for future theory development is to consider alternative assumptions in which not all dimension of heterogeneity are present. Another direction is to consider problem contexts that are less complex and more structured. We envision that our analytical approach is flexible enough to provide insights for such variation. Our theory also is predicated on the assumption of bounded rationality. Further refinements to our assumptions may lead to incorporating additional impediments not derived from our theory. Such advances may lead to the discovery of other processes that can further improve upon problem formulation comprehensiveness for particular circumstances.

Our analysis focuses on initial phases of the problem solving process—problem formulation. Although not discussed explicitly, our analysis may have important implications for the subsequent stages of the problem solving process, that is, alternative (solution) generation. For example, there is ample support for the perspective that comprehensive problem formulation should not only enhance the quantity and quality of the solutions generated but also increase the

probability of such solutions being eventually implemented (e.g., Niederman & DeSanctis, 1995). Although we do not directly address this issue in our paper, it is logical to conclude that the number of potential solutions should increase simultaneously with formulation comprehensiveness. Comprehensiveness also implies that each alternative formulation illustrates at least one mechanism that causes at least one of the identified symptoms. Given this requirement of relevancy, comprehensiveness is expected to enhance not only solution quantity but also quality, in the sense that the identified solutions are useful and effective in alleviating the various symptoms.

Novelty of solutions may also be affected. As mentioned earlier, when confronted with complex, ill-structured problems, actors often only identify the most obvious symptoms, or those to which they are most sensitive. Naturally, identifying only the most obvious symptoms is likely to result in the production of solutions that are also relatively obvious. Comprehensive problem formulation ensures that all symptoms, even those that are less obvious and to which actors are less sensitive, are addressed. Identifying and addressing the symptoms that are less obvious or less familiar should spur the production of solutions that are relatively more novel. Future research may want to examine the implications for creativity and innovation of applying our structured process approach to complex, ill-structured strategic challenges.

Research might also explore other factors that impinge upon the success of problem formulation. For example, credible commitment to the process from relevant constituents, which we assumed in our model, may be an important boundary condition shaping the success of the problem formulation activity. That is, even if structured processes adhering to our design goals are employed, problem formulation comprehensiveness may only be achieved if there is a credible commitment by the organization and its senior management. For example, Lyles and

Mitroff (1980) found that organizations frequently avoided certain problem formulations, especially when they indicated poor managerial decision making in the past or had the potential to disrupt the smooth functioning of existing processes and operations in the future. In addition, the authors found that senior management denied the existence of certain problems, for example, by calling into question the validity of the identified symptoms. Both denial and avoidance have the potential to undermine the comprehensiveness of the problem formulation activity by either reducing the symptom space or be eliminating relevant, alternative formulations. Future research may therefore explore the role of these and other boundary conditions and how they affect the successful application of structured processes to problem formulation.

CONCLUSIONS

The goal of this paper was to develop a theory of strategic problem formulation in the context of complex, ill-structured problems. Although this topic has been discussed in literatures that span several academic disciplines, including business strategy, organizational behavior, psychology, and sociology and despite this earlier work having provided important insights into the problem formulation activity, these largely descriptive accounts are scattered across areas and time and have failed to provide a theoretical approach to problem formulation. Perhaps as a consequence, research on this topic has been largely dormant over the last several decades.

As a first step toward developing a theory of strategic problem formulation, we identified a criterion with which to evaluate problem formulation. Past research had not yet settled on an appropriate metric, which naturally makes it difficult for a cohesive research program to emerge. Building on some previous work, we proposed problem formulation comprehensiveness, which is the extent to which *alternative, relevant* problem formulations are identified with respect to an initial symptom or web of symptoms.

Perhaps our most fundamental contribution is that we systematically and theoretically identified a critical set of challenges groups comprised of heterogeneous members have to face when formulating complex, ill-structured problems. Our analysis focused on three types of heterogeneity—information, cognitive structures, and motivation, which, when combined with our assumption of bounded rationality, led to a set of impediments that narrow and limit formulation comprehensiveness. While these and other individual impediments have been described in the literature on group and individual decision making, we developed a theory that not only identifies which impediments are likely to impact formulation comprehensiveness but also describes how they interact to jointly impact problem formation. This set of impediments then provided the basis for our design goals, which, if satisfied by appropriately designed mechanisms, may expand formulation comprehensiveness.

Based on the theoretically derived set of design goals, we designed a mechanism for mitigating the impediments using a structured process.⁵ While the individual process elements may not be new to the literature, their specific re-combination and sequencing is new. Put differently, adopting only some of the structured process elements proffered would unlikely satisfy all of our design goals and therefore not mitigate problem formulation impediments for

⁵ The informed reader may wonder how our approach to structuring the process of problem formulation differs from previous efforts, such as the Strategic Assumption Surfacing and Testing (SAST) planning process (Mason & Mitroff, 1981) or Problem-Purpose Expansion (Volkema, 1983). We believe there are at least two important differences between our approach and these previous efforts. First, although our approach is firmly rooted in behavioral science similar to previous efforts, our work is the first to theoretically identify the impediments most likely to plague the problem formulation process in heterogeneous groups and to derive a set of goals guiding the design of structured processes to overcome these impediments. In contrast, previous approaches of this kind were developed inductively or lacked the level of detail described in our present analysis. Second, approaches such as SAST generally assume the existence of a set of solutions. Different groups are then given the task of surfacing the assumptions underlying these solutions and engage in dialectic debate aimed at resolving conflict between competing assumptions and achieving synthesis (Mitroff et al., 1979). This “reverse engineering” of alternative problem formulations by surfacing the assumptions underlying the various solutions, however, is unlikely to achieve the level of comprehensiveness expected to follow from the problem formulation approach suggested here. Naturally, unless the pre-identified solutions comprehensively capture the entire symptom space and the causal mechanisms producing it, which is unlikely to be the case, solutions, even if their underlying assumptions may have been revealed and negotiated, may fail to capture essential elements of the problem thereby jeopardizing the ultimate success of the problem solving endeavor.

complex, ill-structured contexts. Our theory therefore led to specific guidelines for managers interested in implementing a process guiding the formulation of complex, ill-structured problems. Initial application in real-world settings provided encouraging but limited evidence that our process is useful and can improve strategic problem formulation in potentially fundamental ways.

REFERENCES

- Ackoff, R. L. 1978. *The art of problem solving*. New York: Wiley.
- Ackoff, R. L., & Emery, F. E. 1972. *On purposeful systems*. Chicago: Aldine-Atherton.
- Allen, R. W., Madison, D. L., Porter, L. W., Renwick, P. A., & Mayes, B. T. 1979.
Organizational politics: Tactics and characteristics of its actors. *California Management Review*, 22: 77-83.
- Allison, G. T. 1971. *Essence of decision: Explaining the Cuban missile crisis*. Boston, Little Brown.
- Amason, A. C. 1996. Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management teams. *Academy of Management Journal*, 39: 123-148.
- Ancona, D.G. & Caldwell, D.F. 1992. Demography and design: predictors of new product team performance, *Organization Science*, 3: 321-41.
- Arrow, K. J. 1974. *The limits of organization*. New York: W. W. Norton.
- Bantel, K. A., & Jackson, S. E. 1989. Top management and innovations in banking: Does the composition of the top team make a difference? *Strategic Management Journal*, 10: 107-112.
- Barney, J.B. 1991. Firm resources and sustained competitive advantage. *Journal of Management*, 17: 99-120.
- Bartunek, J. M., & Murnighan, J. K. 1984. The Nominal Group Technique: Expanding the basic procedure and underlying assumptions. *Group & Organization Studies*, 9: 417-432.
- Boland, R. J. 1978. The process and product of system design. *Management Science*, 24: 887-898.

- Boland, R. J., & Greenberg, R. H. 1988. Metaphorical structuring of organizational ambiguity. In L. R. Pondy, R. J. Boland, & H. Thomas (Eds.), *Managing ambiguity and change*: 17-36. New York: Wiley.
- Brilhart, J. K., & Jochem, L. M. 1964. Effects of different patterns on outcomes of problem-solving discussion. *Journal of Applied Psychology*, 48: 175-179.
- Camillus, J. C. 2008. Strategy as a wicked problem. *Harvard Business Review*, 86: 98-106.
- Carnevale, P.J., & Probst, T. 1998. Social values and social conflict in creative problem solving and categorization. *Journal of Personality and Social Psychology*, 74: 1300-1309.
- Chi, M. T. H., Feltovich, P. J., & Glaser, R. 1981. Categorization and representation of physics problems by experts and novices. *Cognitive Science*, 5: 121-152.
- Churchman, C. W. 1971. *Design of inquiring system: Basic concepts of systems and organizations*. New York: Basic Books.
- Cosier, R. A. 1978. The effects of three potential aids for making strategic decisions on prediction accuracy. *Organizational Behavior and Human Performance*, 22: 295-306.
- Cosier, R. A., & Rechner, P. L. 1985. Inquiry method effects on performance in a simulated business environment. *Organizational Behavior and Human Performance*, 36: 79-95.
- Cowan, D. A. 1986. Developing a process model of problem recognition. *Academy of Management Review*, 11: 763-776.
- Cronin, M. A. & Weingart, L. R. 2007. Representational gaps, information processing, and conflict in functionally diverse teams. *Academy of Management Review*, 32: 761-773.
- Csikszentmihalyi M., & Getzels, J. W. 1971. Discovery-oriented behavior and the originality of creative products. *Journal of Personality and Social Psychology*, 19: 47-52.

- Cyert, R. M., & March, J. G. 1963. *A behavioral theory of the firm*. Englewood Cliffs, NJ: Prentice Hall.
- Dean, J. W., & Sharfman, M. P. 1996. Does decision process matter? A study of strategic decision-making effectiveness. *Academy of Management Journal*, 39: 368-396.
- Dearborn, D.C., & Simon, H.A. 1958. Selective perception: A note on the departmental identification of executives. *Sociometry*, 21: 140-144.
- Delbecq, A. L., & Van de Ven, A. H. 1971. A group process model for problem identification and program planning. *Journal of Applied Behavioral Science*, 7: 466-492.
- De Dreu, C. K. W., & Weingart, L. R. (2003). Task versus relationship conflict and team effectiveness: A meta-analysis. *Journal of Applied Psychology*, 88: 741-749.
- DeMatteo, J. S., Eby, L. T., & Sundstrom, E. (1998). Team-based rewards: Current empirical evidence and directions for future research. In B. M. Staw & L. L. Cummings (Eds.), *Research in organizational behavior*, vol. 20: 141-183. Greenwich, CT: JAI Press.
- Dewey, J. 1938. *Logic: The structure of inquiry*. New York: Putnam.
- Drucker, P. F. 1954. *The practice of management*. New York: Harper.
- Duncker, K. 1945. On problem solving. *Psychological Monographs*, 58: Whole No. 270.
- Einstein, A., & Infeld, L. 1938. *The evolution of physics*. New York: Simon & Schuster.
- Eisenhardt, K. M. & Zbaracki, M J. 1992. Strategic decision making. *Strategic Management Journal*, 13: 17-37.
- Fernandes, R., & Simon, H. A. 1999. A study of how individuals solve complex and ill-structured problems. *Policy Sciences*, 32: 225-245.
- Ferrin, D. L. & Dirks, K. T. 2003. The use of rewards to increase and decrease trust: Mediating processes and differential effects. *Organization Science*, 14: 18-31.

- Fredrickson, J. W. 1984. The comprehensiveness of strategic decision processes: Extension, observations, future directions. *Academy of Management Journal*, 27: 445-466.
- Funke, J. 1991. Solving complex problems: Exploration and control of complex systems. In R. Sternberg & P. Frensch (Eds.), *Complex problem solving: Principles and mechanisms*: 185-222. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Getzels, J. W. 1973. Problem finding. The 343rd convocation address, The University of Chicago. *The University of Chicago Record*, 7: 281-283.
- Getzels, J. W. 1975. Problem finding and the inventiveness of solutions. *Journal of Creative Behavior*, 9: 12-18.
- Getzels, J. W., & Csikszentmihalyi, M. 1976. *The creative vision: A longitudinal study of problem finding in art*. New York: John Wiley & Sons.
- Grant, R.M. 1996. Toward a knowledge-based theory of the firm. *Strategic Management Journal*, 17: 109-122.
- Heiman, B., Nickerson, J.A. & Zenger T. 2008. Governing knowledge creation: A problem finding and problem solving perspective. In N. J. Foss & S. Michailova (Eds.), *Knowledge governance: Processes and perspectives*. Oxford University Press.
- Hewitt, J. P., & Hall, P. M. 1973. Social problems, problematic situations, and quasi-theories. *American Sociology Review*, 38: 367-374.
- Janis, I. L. 1982. *Victims of groupthink*. Boston: Houghton-Mifflin.
- Kepner, C. H., & Tregoe, B. B. 1965 *The rational manager: A systematic approach to problem solving and decision making*. New York: McGraw-Hill.
- Kilmann, R. H., & Mitroff, I. I. 1979. Problem defining and the consulting/intervention process. *California Management Review*, 3: 26-33.

- Larson, J. R., Christensen, C., Abbott, A. S., & Franz, T. M. (1996). Diagnosing groups: Charting the flow of information in medical decision-making teams. *Journal of Personality and Social Psychology*, 71: 315-330.
- Lipshitz, R., & Bar-Ilan, O. 1996. How problems are solved: Reconsidering the phase theorem. *Organizational Behavior and Human Decision Processes*, 65: 48-60.
- Loasby, B. 1976. *Choice, Complexity, and Ignorance*. Cambridge: Cambridge University Press.
- Lyles, M. A. (1981). Formulating strategic problems: Empirical analysis and model development. *Strategic Management Journal*, 2: 61-75.
- Lyles, M. A., & Mitroff, I. I. 1980. Organizational problem formulation: An empirical study. *Administrative Science Quarterly*, 25: 102-119.
- Maier, N. R. F., & Hoffman, L. R. 1960. Quality of first and second solutions in group problem solving. *Journal of Applied Psychology*, 44: 278-283.
- March, J. & Simon, H. 1958. *Organizations*. New York: John Wiley & Sons.
- Mason, R. O. 1969. A dialectic approach to strategic planning. *Management Science*, 15: B403-B414.
- Mason, R. O., & Mitroff, I. I. 1981. *Challenging strategic planning assumptions*. New York: John Wiley & Sons.
- Mintzberg, H., Raisinghani, D., & Theoret, A. 1976. The structure of unstructured decision processes. *Administrative Science Quarterly*, 21: 246-275.
- Mitroff, I. I., Emshoff, J. R. 1979. On strategic assumption-making: A dialectic approach to policy and planning. *Academy of Management Review*, 4: 1-12.
- Mitroff, I. I., Emshoff, J. R., & Kilmann, R. H. 1979. Assumptional analysis: A methodology for strategic problem solving. *Management Science*, 25: 583-593.

- Mitroff, I. I., & Featheringham, T. R. 1974. On systemic problem solving and the error of the third kind. *Behavioral Science*, 19: 383-393.
- Mohammed, S., & Ringeis, E. 2001. Cognitive diversity and consensus decision-making: The role of inputs, processes, and outcomes. *Organizational Behavior and Human Decision Processes*, 85: 310-335.
- Myerson, R. B. 1989. Mechanism Design, in *The New Palgrave: Allocation, Information, and Markets*, eds. J. Eatwell, M. Milgate, and P. Newman, New York: Norton, 191-206.
- Newell, A. & Simon, H. A. 1972. *Human problem solving*. Englewood Cliffs, NJ: Prentice-Hall.
- Nickerson, J. A., Silverman, B., & Zenger, T. 2007. The problem of creating and capturing value. *Strategic Organization*, 5: 211-225.
- Nickerson, J. A., & Zenger, T. R. 2004. A knowledge-based theory of the firm—The problem-solving perspective. *Organization Science*, 15: 617-632.
- Niederman, F. & DeSanctis, G. 1995. The impact of a structured-argument approach on group problem formulation. *Decision Sciences*, 26: 451-474.
- Nutt, P. 1977. An experimental comparison of the effectiveness of three planning methods. *Management Science*, 23: 499-511.
- Nutt, P. C. 1984. Types of organizational decision processes. *Administrative Science Quarterly*, 29: 414-450.
- Nutt, P. C. 1992. Formulation tactics and the success of organizational decision making. *Decision Sciences*, 23: 519-540.
- Osborn, A. F. 1953. *Applied imagination: Principles and procedures of creative thinking*. New York: Charles Scribner's Sons.

- Ouchi, W. G. 1977. The relationship between organizational structure and organizational control. *Administrative Science Quarterly*, 20: 95-113.
- Pettigrew, A. M. 1973. *Politics of organizational decision-making*. London: Tavistock.
- Pfeffer, J. 1981. *Power in organizations*. Marshfield, MA: Pitman.
- Postmes, T., Spears, R., & Cihangir, S. 2001. Quality of decision making and group norms. *Journal of Personality and Social Psychology*, 80, 918-930.
- Pounds, W. 1969. The process of problem finding. *Industrial Management Review*, 11: 1-19.
- Redmond, M. R., Mumford, M. D., & Teach, R. 1993. Putting creativity to work: Effects of leader behavior on subordinate creativity. *Organizational Behavior and Human Decision Processes*, 55: 120-151.
- Rittel, H. W. J., & Webber, M. M. 1973. Dilemmas in general theory of planning. *Policy Sciences*, 4: 155-169.
- Rynes, S. L., Bartunek, J. M., & Daft, R. L. 2001. Across the great divide: Knowledge creation and transfer between practitioners and academics. *Academy of Management Journal*, 44: 340-355.
- Sagasti, F. R., & Mitroff, I. I. 1973. Operation research from the viewpoint of general systems theory. *Omega*, 1: 697-709.
- Schein, E. H. 1969. *Process consultation: Its role in organization development*. Reading, MA: Addison-Wesley.
- Schweiger, D. M., Sandberg, W. R., & Ragan, J. W. 1986. Group approaches for improving strategic decision-making: A comparative analysis of dialectical inquiry, devil's advocacy, and consensus. *Academy of Management Journal*, 29: 51-71.

- Simon, H. 1955. A behavioral model of rational choice. *Quarterly Journal of Economics*, 69: 99-118.
- Simon, H. A. 1957. *Models of man: Social and rational*. New York: John Wiley & Sons.
- Simon, H. A. 1962. The architecture of complexity. *Proceedings of the American Philosophical Society*, 106: 467-482.
- Simon, H. A. 1973. The structure of ill-structured problems. *Artificial Intelligence*, 4: 181-201.
- Simon, H. A. 1989. *Problem formulation and alternative generation in the decision making process*. International Society for Inventory Research (ISIR)—IVth International Conference on the Foundations and Applications of Utility, Risk and Decision Theories—Budapest, Hungary: 1-7.
- Simon, H. A., & Hayes, J. R. 1976. The understanding process: Problem isomorphs. *Cognitive Psychology*, 8: 165-190.
- Simons, T. L., & Peterson, R. S. 2000. Task conflict and relationship conflict in top management teams: The pivotal role of intergroup trust. *Journal of Applied Psychology*, 85: 102-112.
- Stasser, G., & Titus, W. 1985. Pooling of unshared information in group decision making: Biased information sampling during discussion. *Journal of Personality and Social Psychology*, 48: 1467-1478.
- Stasser, G., Taylor, L. A., & Hanna, C. 1989. Information sampling in structured and unstructured discussions of three- and six-person groups. *Journal of Personality and Social Psychology*, 57: 67-78.
- Thompson, J. D. 1967. *Organizations in action*. New York: McGraw-Hill.
- Van de Ven, A. H. 1992. Suggestions for studying strategy process. *Strategic Management Journal*, 1: 169-188.

- Van de Ven, A. H., & Delbecq, A. L. 1971. Nominal versus interacting group processes for committee decision-making effectiveness. *Academy of Management Journal*, 14: 203-212.
- Van de Ven, A. H., & Johnson, P. E. 2006. Knowledge for theory and practice. *Academy of Management Review*, 31: 802-821.
- Van Kippenberg, D. & Schippers, M .C. 2007. Work group diversity. *Annual Review of Psychology*, 58: 515-541.
- Volkema, R. J. 1983. Problem formulation in planning and design. *Management Science*, 29: 639-652.
- Volkema, R. J. 1986. Problem formulation as a purposive activity. *Strategic Management Journal*, 7: 267-279.
- Volkema, R. J. 1988. Problem complexity and the formulation process in planning and design. *Behavioral Science*, 33: 292-300.
- Volkema, R. J. 1997. Managing the problem formulation process: Guidelines for team leaders and facilitators. *Human Systems Management*, 16: 27-34.
- Volkema, R.J., & Gorman, R. 1998. The influence of cognitive-based group composition on decision-making process and outcome. *Journal of Management Studies*, 35: 105-121.
- Walsh, J. P. 1988. Selectivity and selective perception: An investigation of managers' belief structured and information processing. *Academy of Management Journal*, 31: 873-896.
- Wanous, J. P., & Youtz, M. A. 1986. Solution diversity and the quality of group decisions. *Academy of Management Journal*, 29: 149-159.
- Watson, C. E. 1976. The problems of problem solving. *Business Horizons*, 19: 88-94.

- Webber, S. S., & Donahue, L. M. 2001. Impact of highly and less job-related diversity on work group cohesion and performance: A meta-analysis. *Journal of Management*, 27: 141-162.
- Williamson, O. 1975. *Markets and hierarchies*. New York: Free Press.
- Williamson, O. 1985. *The economic institutions of capitalism*. New York: Free Press.
- Wittenbaum, G. M., Hollingshead, A. B., & Botero, I. C. 2004. From cooperative to motivated information sharing in groups: Moving beyond the hidden profile paradigm. *Communication Monographs*, 71: 286-310.
- Wittenbaum, G. M., Hubbel, A. P., & Zuckerman, C. 1999. Mutual enhancement: Toward an understanding of the collective preference for shared information. *Journal of Personality and Social Psychology*, 77: 967-978.
- Yadav, S. B., & Korukonda, A. 1985. Management of the Type III error in problem identification. *Interfaces*, 15: 55-61.

FIGURE 1

Example of Structured Process Satisfying Design Goals

