Organizational Foresight and the Exxon Oil Spill

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The problem of organizational effectiveness in mitigating hazards is increasingly vexing, and indicates a growing dependence on organizations as agents of rescue. Now, more than ever before, organizational anticipation of mishaps and misfortunes shapes both the likelihood of untoward events and productive responses to them. This is especially true for accidents and unforseen conditions regarding technological risks. Organizations and modern technology provide much of what we value and cherish, but they are simultaneously responsible for terrible hazards. It is little solace that we simultaneously depend on organizations for protection. Hence any assessment of important risks that ignores organizational processes, and the social systems in which those organizations are set, will be seriously flawed.

In this paper I use evidence from the *Exxon-Valdez* oil spill to address one such organizational process--that of foresight. I intend this term to include risk assessment, but also to refer more generally to the ability of organizations to predict the future. All predictions of the future, whether made by organizations or individuals, are inexorably tied to the past and present. Except in dreams and mad minds, expectations about the future are extrapolations from the present, which itself reflects the past.

The ideas developed here are rooted in research on organizational effectiveness (Yuchtman and Seashore 1967; Cunningham 1977; Goodman and Pennings 1977; Weick 1977; Connolly, Conlon, and Deutsch 1980). While traditional approaches to effectiveness failed to account adequately for how different interests shaped organizational goal setting and attainment, modern scholarship explicitly recognizes the importance of asking "Effective for what, or whom?" (Perrow 1977; Mohr 1982). Although posing the question in this manner is more useful than theorizing effectiveness as disembodied from concrete actors, it nevertheless ignores the element of time. That is to say, the issue is not only effective for what or whom, but also when (March 1981). Put more concretely, a legitimate question to ask is "How far into the future must an organization competently plan for to warrant the label 'effective'?" Although I cannot answer this question here, simply posing it suggests the pivotal nature of time horizons in organizational foresight and planning.

First I review the Exxon spill and some of the organizational responses to it. Next I use the Alaska case to consider three main barriers to effective organizational foresight--professional heuristics, over-organization, and spurious consensus. This list is in order of aggregation or generality. Professional heuristics refer to important mechanisms of decision making on the parts of experts and organizational directors. Over-organization refers to organizational structure *sui generis*. Spurious consensus refers to the premature or erroneous imputation of agreement on risk assessment and acceptance. Together, these three barriers can seriously distort or hamper useful organizational foresight. In the final section I consider the relevance of these barriers to the issue of issue of radioactive waste transport.

OVERVIEW OF THE EXXON SPILL

A little after midnight on 24 March 1989 the *Exxon-Valdez*, a supertanker carrying over 50 million gallons of North Slope crude oil, grounded on Bligh Reef off the southern shores of Alaska in Prince William Sound. Before the *Valdez* stopped bleeding, nearly 11 million gallons of oil contaminated the waters and shoreline of Prince William Sound and the Gulf of Alaska. By the end of the first week, oil covered 900 square miles of water; by the end of the second, almost 1,100 miles of shoreline had been oiled. The spill was responsible for considerable loss of wildlife. Official figures of wildlife deaths are vast underestimates, probably missing their mark by 70-90 percent, because most oiled animals sink in the cold Alaskan waters, while those on land become carrion. Further, a large part of Alaska's 1989 salmon harvest was ravaged, and indeed had it not been for the spill, 1989 would have been an extraordinary season. The spill was even worse for the two native communities whose land was polluted; the oil prevented (at least for the first season after the spill, and probably for the subsequent two or three) subsistence fishing and hunting, the cornerstones of those communities' livelihoods and cultures. The Exxon spill was also an aesthetic disaster, spoiling a very large amount of shoreline for an undeterminable number of years. Although some, especially in Exxon, expect the worst of the damage will disappear with the 1989-1990 winter storms, oiled beaches and waters from the spill are likely to remain so for years.

The immediate response to the spill has been a focal point of controversy. Before exploring that controversy for instructive lessons, we must first detail what the responses were. Within hours of the grounding, officers from the Alaska Department of Environmental Conservation (ADEC) were aboard the stricken vessel. To the extent possible, ADEC officials surveyed the damage and began the process of inciting numerous organizations to action. It was a dark night, so officials could not really tell the extent of damage to the ship, but they knew the spill would be large. "The oil was three or four feet deep *on top of the water*," an official told me, "You could have just put a hose in the stuff and sucked it up."[2]

One of the first ADEC officials to board the *Valdez* used the ship's radio-telephone to wake the president of Alyeska Pipeline Service Company. Alyeska is the incorporated organization representing the seven oil companies that own and operate the Alaska pipeline.[3] The ADEC official told Alyeska's president that the spill was "a bad one" and that airplanes with oil dispersants should be readied immediately.[4] The tone of the ADEC official's call was especially urgent, because some of the airplanes and dispersants were in places such as Arizona.

Notifying Alyeska seemed an appropriate reaction, and is indeed the prescribed action, because Alyeska bears the greatest organizational and legal responsibility for immediate oil spill response. This response, or set of responses, is detailed in oil spill contingency plans, considered below. Alyeska's contingency plan (c-plan) called for two

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[2] I spent 10 days in Alaska during July 1989 conducting interviews with key informants, collecting documents, and observing. I conducted additional telephone interviews before and after the research trip. Any quotations, unless otherwise noted, are from my interviews.

[3] These include Exxon, ARCO, British Petroleum, Mobil, Phillips, Hess, Unocal.

[4] Dispersants break oil into fine particles which are then more likely to dissipate.

key organizational reactions: booming the leaking oil to prevent its dispersion and deploying aircraft with dispersants to dissipate the slick. But there were problems with the plan and its implementation. Alyeska's president allegedly thought the alarm from ADEC too unbelievable and went back to sleep. Alyeska's safety barge, the only available mechanism to carry boom to the *Valdez*, was scheduled to be replaced and its 7,000 feet of boom were unloaded at the time. The reloading operation delayed the barge reaching the grounded vessel by 10 hours. By then, booming the spill was as futile as trying to gather the radioactive cloud from Chernobyl.

It should be noted that some believe the spill could have been effectively boomed during the first two days when the waters were "as calm as glass." That the water was indeed that calm was an indication of the generally excellent weather in the Sound. The problem, according to this argument, was that no organization was willing to move quickly enough to contain the spill. Alyeska's full emergency crew, for example, did not arrive at the spill site until at least 14 hours after the grounding, and the *Exxon Valdez* was not boomed for another 21 hours. Moveover, from this view, the organizational chaos then prevailing prevented prompt use of dispersants, which many claim are the single most important tool in mitigating adverse consequences from a spill. The problem, apparently, was that no one was willing to make important decisions on their own initiative. As one official close to the case put it, "It was as if a pilot in a 737 lost one of his engines and got on the radio to the CEO of the airline to ask what to do."

It is doubtful, however, that even large amounts of organizational will would have constituted an effective response. For even if organizations had all the time in the world, there were only 4,000 gallons of dispersant on hand the day of the accident; to respond effectively would have been required nearly 500,000 gallons. More importantly, there is good reason to be skeptical that any amount of boom would have been able to contain the oil, as the expanding slick was simply too large a task for even state-of-the-art technology. In any case, by the third day of what was quickly becoming a political, environmental, and organizational crisis, 70 mile per hour winds were whipping through Prince William Sound, making it impossible for either aircraft or watercraft to attend the *Exxon Valdez* safely. By the time the storms came up, it was too dangerous, and too late, to apply dispersants to the oil.

There is much to be learned from detailing the problems with initial organizational responses (or lack thereof), and indeed many argue that the problem in Prince William Sound was ineffective implementation of a basically sound strategy. While there is some evidence to support this view, here I will argue that, (1) the c-plans themselves were fundamentally flawed, (2) because they were completely inappropriate for a large oil spill, (3) although all parties, including the regulators, had approved the c-plans as acceptable representations of the risk of, and response to, a catastrophic spill.

The Contingency Plans

There were five, arguably six, contingency plans available at the time of the accident, each with its own ostensible contribution to mitigating the worst consequences of a major oil spill. These included:

- The National Oil and Hazardous Substances Pollution Contingency Plan,
- The Coast Guard's Captain of the Port Prince William Sound Pollution Action Plan,
- The Alaska Regional Oil and Hazardous Substances Pollution Contingency Plan,

- The State of Alaska's Oil and Hazardous Substances Pollution Contingency Plan,
- The Alyeska Pipeline Service Company's Oil Spill Contingency Plan for Prince William Sound.

(The sixth, some might argue, was Exxon's contingency plan. I ignore this plan here, as it pertains mainly to cleanup rather than the immediate response to a spill.) Each c-plan delineates different functions and procedures to be performed by myriad organizations in the event of a minor, moderate, or major oil spill. These plans have been developed over a number of years, some dating back to the beginning of the trans-Alaska pipeline in the early 1970s. Each plan is very detailed, and some contain explicit scenarios of major groundings and founderings of large tankers. These plans also attempt to map out an appropriate cleanup response from many agencies from all levels of government. One of their chief functions is to serve as blueprints for interagency coordination. Such planning seems to be quite sensible, and indeed parts of the plans are fine models of anticipatory hazard mitigation. Yet the c-plans, taken together, were clearly inadequate to respond to a major spill effectively.

I will not discuss all the c-plans but rather will focus on one, Alyeska's Contingency Plan for Prince William Sound (Alyeska Pipeline Service Company 1987, hereafter Alyeska 1987). This plan was most applicable to the Exxon spill because it was, and is, the one that most clearly addresses the problem of spills in Prince William Sound. It states, in no uncertain terms, Alyeska's commitment to assume responsibility for immediate response to a spill in the Sound. Alyeska's c-plan is a vague, general document of 248 pages, perhaps two-thirds of which consists of maps and lists of equipment. Maps and lists are, of course, necessary for responding to a spill, but what is striking about Alyeska's c-plan is the sparsity of detail regarding projected spill scenarios. The lack of significant detail is odd because it is precisely in such detail that organizational assumptions about substantive mitigation systems are embedded. To consider other industries for a moment, when nuclear power plant operators train in simulators they are engaging in active contingency planning. The same is true of airline pilots, workers in chemical plants, and high schools in earthquake-prone California (although such planning is absent in earthquake-prone Tennessee). It should be noted that sparsity of planning detail (and real-time drills) is not uncommon in emergency plans for transporting radioactive materials, perhaps reflecting weak regulatory guidelines.[5], in nearly all (even moderately regulated) industries or systems with the potential to inflict widespread devastation, significant, detailed planning is undertaken. This is not true for oil, especially in Alaska.

Nevertheless, there are two oil spill scenarios in Alyeska's Contingency Plan for Prince William Sound, one for a 4,000 barrel spill, the other for a 200,000 barrel spill. The basic assumptions and projections for each spill are represented in Table 1. The *Exxon Valdez* lost 260,000 barrels (or nearly 11 million gallons). The first Alyeska scenario is for 168,000 gallons, the second for 8.4 million gallons. These scenarios are important because *they are the most concrete plans for a major oil spill in Alaska that have ever been done*. Even so, Alyeska cautions its readers that "the most likely spill volume for vessels underway in trade with the Valdez Marine Terminal during the expected 30-

year operating lifetime of the Maritime Terminal is 1,000 barrels" (Alyeska 1987:3-50)[6]. I will return to this caution shortly.

Table 1: Two Oil Spill Scenarios for Prince William Sound, Alaska

4,000 Barrel Spill	200,000 Barrel Spill
• seas < 5 feet	• seas < 5 feet
• currents < 1.6 knots	• currents < 1.6 knots
• waves < 2 feet	• waves < 2 feet
• at least 2 miles visibility	• at least 2 miles visibility
• weather conducive to cleanup (sunny, overcast)	• weather conducive to cleanup
• winds at 8 knots	• winds at 5 knots
• ship, shore boomed within 3 hours	• ship boomed within 5 hours, shore "immediately"
• dispersants on-site in 9-17 hours	• dispersants unestimated, presumably 9-17 hours
• communications flawless	• communications flawless
• all agencies coordinated	• all agencies coordinated
• 100 barrels unrecoverable	• 10,000 barrels unrecoverable

Source: Alyeska 1987.

The scenario for the 4,000 barrel spill assumes it occurs at six in the morning, the "sea state is less than five feet," "currents are less than 1.6 knots," "waves are less than two feet," with at least two miles visibility. It is "sunny to overcast with some light rain," and eight-knot winds. "The ship and shoreline, which is heavily oiled, will be boomed by 0900 hours [within three hours of the accident] and skimming operations will begin" (Alyeska 1987:3-50). Within six hours of the accident Shoup and Sawmill Bays, particularly sensitive and important salmon hatcheries, will have been boomed (Alyeska 1987:3-50). Alyeska's "dispersant applicator contractor," located in Arizona, will be on scene and working within nine to 17 hours (Alyeska 1987:3-51). Communications among officials and organizations are flawless; interpretations of those communications are unclouded. The cleanup will last two months (Alyeska 1987:3-53), and will be highly effective. Of 168,000 gallons, 16,800 (10%) will be lost to "weathering and evaporation," skimmers will collect 42,000 gallons (25%), 42,000 more gallons "will be dispersed," and 63,000 of the assumed 67,200 gallons to make it to shore will be "recovered" (a shoreline recovery rate of 94 percent). Only 2.5 percent, 4,200 gallons, "would not be recovered and will be naturally dispersed" (Alyeska 1987:3-53).

Further, during the initial phases after the grounding, all the appropriate organizations are notified, and they share a common vision of what constitutes appropriate response. In other words, an efficient and effective division of labor among

[6]This notation indicates section three of the plan, page 50.

organizations is instituted almost immediately. Fully understanding their respective roles, the agencies implement those parts of the plan for which they are responsible and best suited. The implemented actions are executed precisely when they are needed by other agencies, who proceed in like manner. Only a computer model would be better coordinated.

The most interesting scenario, though, is the 200,000 barrel spill (8.4 million gallons). Inclusion of this scenario in the c-plan was clearly over strong objections from Alyeska. The second sentence in the scenario reflects this reluctance: "[Alyeska] believes it is highly unlikely a spill of this magnitude would occur" (Alyeska 1987:3-54). The document further reassures its readers that Prince William Sound is safe because "the majority of tankers calling in Port Valdez are of American registry and all of these are piloted by licensed masters or pilots" (Alyeska 1987:3-54).

Nevertheless, state regulators insisted that a large scenario be included in Alyeska's overall plan. The 200,000 barrel scenario assumed the sea-state, currents, waves, visibility, and weather would all be the same as with the 4,000 barrel spill, and winds would be at five knots (compared with eight for the smaller spill). The scenario calls for booms and skimmers to be on-site within two and a half to five hours, although it does not explicitly claim booming will be in place by then. This plan further supposes that several other important actions "would be simultaneously initiated" (Alyeska 1987:3-54). Within twelve hours private commercial vessels and local aircraft from the town of Valdez are enlisted to help, backup personnel and equipment are mobilized, and another barge or ship arrives to lighter the grounded vessel. "All oil spill contractors in the state of Alaska would be asked to mobilize and move to the site" (Alyeska 1987:3-54).

Myriad other organizations would also be activated, many of them moved to the small town of Valdez (whose population is about 3,500). As with the smaller spill, communications are uninterrupted and unambiguous, and interagency coordination is unproblematic. The scenario estimates 50 percent (100,000 barrels) of the oil "will be recovered at sea, either directly after the spill or at a later time by being washed off of the rocks, contained and skimmed off of the water" (Alyeska 1987:3-56). Fifteen percent (30,000 barrels) will evaporate before hitting the shoreline, another 15 percent will be "recovered from the shore," 15 percent "will naturally disperse and approximately five percent [10,000 barrels] will remain in the environment" (Alyeska 1987:3-56).[7]

The most notable aspect of both scenarios is that one would be hard put to construct more favorable conditions for the operation of a projected spill response. Indeed each scenario assumes best-case conditions, surrounding them with something of an aura of implausibility. That the scenarios are nearly as far from worst-case as one could imagine is in sharp contrast, as noted, to training and contingency planning in other industries with the potential to wreak considerable, perhaps catastrophic, harm. Granted, true worst-case scenarios in Prince William Sound would mean *complete* immobilization; the environment there is simply too unforgiving. But in realistic contingency planning one would expect the introduction of *some* untoward conditions in such scenario building. To take an example from nuclear power, no projections of accidents in nuclear plants operate, at least in recent times, under the assumption of no

[7] I am unable to clarify the fine distinction between "evaporation," "natural dispersion," and remaining in "the environment."

confusion among organizations, although this is apparently the case for Department of Energy scenarios involving spent fuel transport accidents and terrorist attacks.

The neglect of conditions that might hinder effective response to a major, or even moderate, spill in Prince William Sound is extremely instructive. As a symbol, or set of symbols, produced by organizations, c-plans signify that organizations are in control of potentially uncontrollable situations. More to the point for present purposes, such plans are direct, concrete reflections of organizational capabilities to foresee the future. Alyeska, the oil companies it represents, and other industry representatives such as the American Petroleum Institute have assiduously asserted the extremely low probability of major spills in Alaska (as well as other places). In interviews with the author, and in public statements since the spill, Alyeska representatives have repeatedly asserted the negligible chance of a major grounding. By beginning its 200,000 barrel scenario with the disclaimer that such a spill was "highly unlikely," Alyeska signals the reader that the oil consortium does not have much faith in the skimpy (two pages of detail) plan that follows. What such a posture ignores is that the severity of consequence varies independently with probability of occurrence.[8] To put this another way, big spills may be rare, but they are awfully bad when they happen.

The Multiorganizational Context

Alyeska drew a great deal of political heat for what seem to be empty contingency plans. The company, in fact, has made itself a highly visible political target, and there are always numerous players in any controversy over important risks who are looking for targets (Walsh 1986; Jasper 1988). One critique of Alyeska on this point is that realistic contingency planning, which involves substantial investments of time, is expensive and part of Alyeska's business is to minimize costs. This is the greed explanation for the lack of adequate preparation for the Exxon spill, and indeed avarice is certainly no trivial motivation in Alaska. No oil company would be there, after all, without the allure of tremendous profits. Yet avarice is not an adequate explanation because it does not take sufficient account of the multi-organizational context in which decisions about risk are made and in which regulations are produced and enforced (Clarke 1989).

Because Alyeska, and the oil companies more generally, *have* in fact been easy targets, scant public attention has been accorded other organizations' contributions to the disaster in Alaska. After conducting about a score of interviews with representatives of many organizations in Alaska, one of the most common themes to arise in those interviews was the word "complacent." The Coast Guard, for example, has systematically reduced the ability of its Valdez station to monitor vessels through the Valdez Arm.[9] Similarly, the Alaska Department of Environmental Conservation, so vocally opposed to Alyeska and Exxon in the months following the spill, gave its stamp of approval to Alyeska's c-plan. The point here is that industry, though an easy target after the Exxon spill, was by no means the only party to the development and acceptance of the c-plan. This fact renders the greed explanation of limited utility in understanding the connection between organizational foresight and the Exxon oil spill. There was indeed complacency

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[8]Taking explicit account of this problem is one of the strengths of formal risk assessment.

[9]The Valdez Arm is a stretch of water from Valdez Harbor to the Gulf of Alaska.

in Alaska, but it was a collective or structural complacency that characterized every actor capable of influencing the process of contingency planning. That collective complacency was one result of a massive failure of organizational foresight.

The Risk of Oil

Before considering some barriers to organizational foresight in Alaska, it is important to outline the case that a major oil spill in Alaska was *not* a far-fetched probability. The very existence of the contingency plans indicates there were very good reasons to predict a disaster like the one in Prince William Sound. The shipping industry loses hundreds of ships every year, although the number of supertankers lost is small. Still, the number of oil spills to expect each year is known (there will be at least one involving over 7.5 million gallons of oil), and there are reasonably informed estimates of the percentage of tankers that will founder or otherwise meet their demise. When oil officials testified before Congress on the construction of the trans-Alaska pipeline, they acknowledged that "accidents are bound to happen," at the Port of Valdez as well as with the pipeline itself. (This acknowledgment, in might be noted, is similar to statements by the Department of Energy concerning accidents involving the shipment of radioactive waste to Yucca Mountain in Nevada. Perhaps the strategy is to gain credibility by claiming a high probability of occurrence, while asserting trivial consequences.)

In addition, every shipper is enmeshed in an extensive web of regulations and contacts concerning tanker and harbor safety. Insurance companies determine their premium rates for individual shippers in part on the basis of calculated risk, and these involve constructing explicit scenarios of groundings and spillage. The Coast Guard, also a key player in the Alaskan drama, exists partly to control tanker movement in and around fragile environments, and has its own contingency plan for oil spills. Moreover, tanker spills are not uncommon in Alaska (there have been several major spills over the last 10 years, and many more minor spills), and dramatic social disruption is not foreign to Valdez itself. The physical town of Valdez was completely destroyed in the 1964 "Prince William Sound Earthquake," which registered 8.5 on the Richter scale and sent nine-meter waves onto shore and displaced the ground by as much as 11 meters. The town was then moved *in toto* to its present location, which is less vulnerable to tsunamis. Indeed there is some sense in thinking of Prince William Sound (and much of Alaska) as a long, discontinuous earthquake, punctuated by periods of calm. Even if that puts the case too strongly, there were obviously many good reasons to expect and be prepared for a major oil spill in Prince William Sound. Still, Exxon Shipping Company, the *Exxon-Valdez's* legal owner, claimed the accident was "worse than our worst-case scenarios."

It is clear that no agent concerned with oil spill risks in Alaska--either in government or industry--effectively evaluated realistic worst-case scenarios for major tanker failures in Alaskan waters. Such scenarios would have, at the very least, changed the assumptions listed in the second column of Table 1 above, to assess the significance of less-than-favorable conditions. That such possibilities were not considered is a dramatic failure of organizational foresight.

BARRIERS TO ORGANIZATIONAL FORESIGHT

The case of the Exxon oil spill reveals several obstacles to effective organizational foresight in terms of risk planning and preparedness. As noted, I label these obstacles professional heuristics, over-organization, and spurious consensus. I discuss each in turn.

Professional Heuristics

Some of the most visible work in risk perception concerns how members of the general public process information regarding risks. The pioneers of this work are the cognitive psychologists Amos Tversky and Daniel Kahneman, though its most effective developers regarding risks are Paul Slovic, Baruch Fischhoff and their co-workers.[10] Work on cognitive functioning centers on the idea that people rely extensively on heuristics to process information regarding risk. Heuristics are stereotypes with a systematic basis, probably the most famous being the availability heuristic. If, for example, people hear of a major airline accident their risk assessments of airline travel increase dramatically, at least for the short run. As Slovic, *et al.* (1985:246) explain, "the availability heuristic highlights the vital role of experience as a determinant of perceived risk. If one's experiences are misleading, one's perceptions are likely to be inaccurate." Another type of heuristic discussed by psychologists is that of overconfidence (Slovic, *et al.* 1979). This heuristic leads people to be overly confident that their judgments about risks are accurate. For example, most people think they are good automobile drivers and hence unlikely to be in an accident, even though the overall chance of experiencing a car accident is fairly high.

Although most work in this genre concentrates on the ways heuristics hinder accurate risk estimation, it is in fact not always the case that using heuristics necessarily constitutes poor decision making. Indeed the research of Slovic and his colleagues (1979) suggests that much of the time heuristics fit data about risks reasonably well. Nevertheless, heuristics can lead to serious biases and distortions about the nature of the world and the nature of risk. With individuals, heuristics can easily become habits, not of behavior, but of mind.

Although most research on heuristics has been concerned with cognitive processes among members of the general public, heuristics are equally in evidence among professionals and experts. This observation is important because it forces us to recognize explicitly that professional judgments, like all judgments, must viewed skeptically. It is even more important because of its implications for understanding organizational foresight.

When professional reliance on heuristics becomes systematic, stable, with common threads running throughout, heuristics can constitute a paradigm.[11] The term paradigm, as used here, indicates a structure of reasonably coherent ideas that define a worldview. More straightforwardly, a paradigm is a set of ideas that orders information in a systematic way, thereby helping to make sense of uncertainty (see also Nelkin 1971, 1974; Knorr 1977). For example, although there are important exceptions, the early years of civilian nuclear power were marked by a safety paradigm. Though objective evidence

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[10] Kahneman, *et al.* (1982) has the best collection of this work; see Heimer (1988) for an interesting sociological treatment of heuristics.

[11] See Clarke (1988) for an assessment of professional bias in risk assessment.

was sparse, professionals were extremely confident that nuclear power posed no important risks to the public (Ford 1982a, b; Winner 1986). For present purposes, what is important about this confidence is not the actual safety of nuclear power, but that the safety paradigm tended to blunt candid and direct public debate over studies that cast doubt on the safety of civilian nuclear power (Yellin 1976; Hertsgaard 1983; Ford 1986).[12] Both heuristics and paradigms operate to make sense of uncertain information. Let us turn to how such sense making occurred in the case of the Exxon oil spill.

It is clear that some type of professional heuristic, or paradigm, was at work among decision makers and experts regarding the risk of a major tanker failure in Prince William Sound (or indeed along any part of Alaska's 33,000 miles of coastline). When Coast Guard Vice-Admiral Clyde E. Robbins, now the Captain of the Valdez Port and once the Federal On-Scene Coordinator for the Exxon spill's cleanup, heard of the accident his reaction was incredulity. "That's impossible," he said, "we have the perfect system" (Egan 1989). What is important about the Admiral's response is that it reflects a faith that all contingencies had been considered, and were covered. Alyeska, similarly, had apparently grown so confident in the safety of the system that it seriously diluted its oil spill response team in the early 1980s. Where at one time it employed a group whose sole task was to prepare for and respond to spills, now the primary responsibilities of Alyeska's response team lay elsewhere. Likewise, ADEC officials, charged with monitoring contingency planning and oil industry operations, approved Alyeska's plan and developed none of their own. The Commissioner of ADEC, Dennis Kelso, remarked that regulators "placed too much trust in industry" (Egan 1989). Devoid of its political charge, this statement is indicative of the fact that regulators became highly dependent on industry assessments of oil spill risks and assurances of immediate and effective response. ADEC had in fact systematically neglected to consider the risk of significant oil spills in Prince William Sound.

Interpreting this collective oversight of oil's risks on the water will occupy scholars (and lawyers) for many years to come. For present purposes, I shall make only a few such comments. As noted, one hears a lot about complacency in Alaska regarding the lack of preparedness. This is certainly accurate for the expert contingency planners. It seems unassailable that some sort of professional heuristic systematically excluded serious consideration of adversity. Perhaps 12 years without a catastrophic pipeline spill (the pipeline opened in 1977) induced a false sense of security concerning tanker traffic. Organizations in Alaska employed what we might call a *disqualification heuristic*, which is a mechanism that filters out bad information (the possibility of contaminating many miles of Alaskan coastline) while highlighting the good (12 years without a major accident), to process information on the risks of oil spills.

The disqualification heuristics unduly narrows the range of alternatives considered so that particularly troublesome ones are not thoroughly considered. This heuristic is frequently attended by an exclusion of dissenters from participating in making important choices in which they assert an interest. For example, in the early years of big oil in Alaska (the early and mid 1970s) there was sufficient objection to development plans to

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[12]McCaffrey (1982:408) notes a similar phenomenon in occupational regulation, when "people in a profession...share working orientations."

force many concessions from industry. Perhaps the most celebrated was the original proposal to bury the entire pipeline. It was only after substantial outside protest that burial would threaten the permafrost, thus weakening the major support for the pipeline, that the proposal was reconsidered.[13]

For oil transport in Alaska, the disqualification heuristic worked systematically to disqualify evidence that disconfirmed a set beliefs about the system's safety. The disqualification heuristic, I hasten to add, is not unusual among organizations. Tamuz (1988) reports that air safety inspectors welcome even inaccurate accident reports because they expose possible system failures not previously anticipated. Such a practice, however, is not standard among organizations, and indeed was barely in evidence at all for Alaskan oil spills. The most important manifestation of this heuristic was the institutionalized belief that major oil spills were impossible.

Over-Organization

Since the Exxon oil spill, much critical attention has been directed at all the organizations charged with responding to it. Exxon and Alyeska have been taken to task for reacting poorly or not at all. Alaska's Department of Environmental Conservation has drawn criticism for ineffectiveness or obstructing initial efforts by Exxon and Alyeska. The Coast Guard has been faulted for insufficiently controlling the waterways and neglecting to "federalize" the response quickly. The list goes on. At the collective level, a frequent lament has been that responsible organizations were inadequately (or ineptly) coordinated, spending too much time in the first critical hours and days figuring out who was to take charge of what. This line of reasoning further charges that once some semblance of organization among organizations was instituted, the resulting division of labor was not flexible enough to implement available solutions constructively, let alone devise creative ones.

The common element in the logic of these critiques is that the problem of foresight in the Valdez case was fundamentally a *lack of organization*. Such a perspective posits that the involvement of too many actors with different interests compromised organizational effectiveness. The indictment implies that the problem of organizational foresight (and learning) is one of information and coordination. If so, future accidents and disasters can be averted, or their consequences diminished, by creating and enforcing more explicit expectations for what organizations ought to do when untoward events arise. Although there is some justification in all these charges, the implicit theory of organizational behavior that informs them is simply not supported by the available evidence.

One of the distinctive facts about the Exxon spill was *not* in fact a lack of available structure that would coordinate strategy. As noted above, there was a wealth of contingency plans in place at the time of the spill. These plans included (and include) a set of directives for arranging more than a dozen organizations. For example, the National and Regional plans (mentioned above) prescribe the activation of an interagency task force called the Regional Response Team, which includes all the major actors with interests in a spill. It is numbing to list all that is supposed to happen once

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[13]Presently, part of Alyeska's official tour of the terminal gives the impression that only half the pipeline is buried because of industry's foresight.

the Regional Response Team is activated; it will suffice to note that there are elaborate plans and designs for organizational action.

These observations suggest the thesis that there was *too much* organization after the Exxon spill, not too little. A strong form of this argument would be an overstatement, but to state the thesis strongly highlights some ignored but important aspects of the case. There are two senses in which over-organization was a problem. First, the disqualification heuristic, discussed in the last section, was not only a set of ideas adopted and advanced by professionals. In fact this heuristic became institutionalized in organizational structure. The notion that "it can't happen to here" was more than a paradigm that ordered realities of risk, it also became standard operating procedure to presume the risk innocent until proven dangerous. While some have argued these are signs of massive stupidity, such a naming of the problem merely begs the important issues.

One of the major reasons for formal organization is to simplify decisions, and it is in the nature of organizations to institute routines for handling decisions (March and Simon 1958; Simon 1976). These routines then become the templates through which organizations filter information, and hence organize action. Organizations are, in fact, organized to be inflexible. In other words, organizations are organized to do some things well and other things poorly. My university, for example, services 35,000 undergraduates every year. Add to them graduate students, faculty, staff, and administrators and one has a sizable organizational problem. Just to arrange parking for this many people requires considerable organizing effort, great attention, and resources. And yet most of us find parking spaces, and the system works fairly well.[14] On the other hand, trying to secure a refund for any type of over-payment entails more effort than the refund is worth.

To return to the problem at hand, Exxon (and Alyeska) is well-prepared for Arctic exploration, oil management, and political influence. It is less well-prepared for crisis management. Or, considering all the organizations involved in Alaska, the risks of tanker failure are insufficiently covered by any organization or set of organizations. If organizations were infinitely flexible they would generally be ineffective in day-to-day operations. Further, even infinite flexibility would not guarantee effective response to off-standard demands like massive oil spills.

The barrier of over-organization played a vital role in inhibiting organizational foresight in Alaska. Perhaps a dramatic example will help make the point. There are a number of very sensitive, and very important, salmon hatcheries in Prince William Sound. Many of these hatcheries were directly in the path of the oil slick. One of the most important salmon hatcheries is called Sawmill Bay. This is one of the bays Alyeska's contingency plan says will be boomed within six hours of a 4,000 gallon spill. Unfortunately, for the first several days after the accident, no major organization moved to boom Sawmill Bay, or any other hatchery for that matter. The fishers of Cordova, along with other fishing villages, asked first Exxon, then ADEC to boom Sawmill Bay, to no effect. In frustration, the fishers banded together, pooled their monies and purchased boom from as far away as Japan and Europe, saving the Bay from oil contamination.

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[14] Undergraduates would disagree sharply with this analysis. One never escapes distributional issues when organizations are involved.

Officials responsible for mitigating the effects of oil spills were apparently immobilized by their own organizations. The fishers, unencumbered by organization, were able to exploit their resources to win what is referred to locally as the Battle of Sawmill Bay.

It bears pointing our that, from the point of view of any specific tanker trip, the Exxon spill was a low-probability event. Indeed the probability of any *specific* spill remains low. But from the point of view of exploring oil in Alaska, the probability of oil spills must be considered fairly high (although I would not venture a precise prediction). The point here is not simply that reality and the future are complex, although that is true enough. Rather the point is that in the main organizations do routine things well, and since catastrophic failures are (fortunately) uncommon, we should be surprised when organizations *do* respond well to problems like the grounding of the *Exxon Valdez*.

Spurious Consensus

Perhaps the most politically intractable problem in issues of risk estimation and acceptability is that of social consensus. There is now a great deal of research on the problem of consensus in technical disputes (e.g., MacRae 1976). Here I shall follow the bulk of that work by discussing the issue of public consensus. It is important to note, however, that equally central topics of research involve consensus among organizations, or among organizations and groups. For present purposes, the important points about consensus among experts were noted above in the section on professional heuristics.

Consensus is not a static property of situations, but is instead fundamentally a product of *interaction* among groups, organizations, and professions. Hence consensus is ineluctably tied to agreement, persuasion, and coercion. Further, several basic asymmetries usually characterize instances in which dissension prevails, but consensus must be negotiated. Although most work on consensus concerns the general public, it is in fact organizations and their elites that are the major players in creating and responding to danger. Organizations, not the public, are also the major actors in setting the terms of debate over risk acceptability.[15] The mechanisms available to organizations for fostering consensus on their own terms are inherently more powerful than those available to disparate members of the general public. The general public is not powerless, of course, once it organizes, secures recruits, and gains media attention (Clarke in press; Mazur 1988). Once such a process occurs, however, the sociological relevance of a *public* consensus becomes less relevant than the capabilities of social movements.

For organizations charged with ensuring or enhancing safety, the stability of consensus is very sensitive to the initial conditions of its formation. In particular, the more organizations determine the early conditions of consensus, the higher the intensity of future public opposition.[16] I do not propose this principle in a mechanical way, but rather present is an hypothesis. For it is certainly not the case that, as with a strong house, if the infrastructure of consensus is carefully constructed then later misfortunes

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[15]For related issues see Offe and Wiesenthal (1980).

[16]In truth, there is a probably a curvilinear relationship between the degree of such organizational determination and intensity of public opposition. Here we will be concerned only with one side of the curve.

will not befall it. However if such an infrastructure is poorly constructed, later opposition will be stronger and more acrimonious than would otherwise be the case.

This suggests the problem of spurious consensus in technical disputes. A spurious consensus is when organizations and decision makers assume that other, particularly non-organizational, players (e.g., the public) share their estimation and acceptance of risk. A spurious consensus is thus an elemental barrier to effective organizational foresight. For when crises in legitimacy arise, organizations (from their view at least) have failed to foresee a set of problems that hinder operations. There are no mechanisms guaranteed to produce genuine consensus, but we can analyze some instances of spurious consensus and then try to derive some lessons from them.

In Alaska, those involved in controlling and developing oil operated under several assumptions from the early 1970s, some of which are now being questioned as if they had never been publicly considered before. And for good reason: they have not. The assumption that there was no choice but to develop the oil was not so far off the mark as to compromise later legitimacy. There was enough poverty in Alaska, and enough lasting public consensus, to move ahead with exploration and development. This part of the consensus regarding oil in Alaska is still generally in place, and reinforced by a resource constraint: 85% of the state government's budget derives from oil.

But organizations and decision makers in Alaska erroneously made several other assumptions. These assumptions formed the basis of projected probabilities of failure, and as such seriously distorted, albeit unwittingly, organizational foresight. These assumptions include the following:

- Given the enormous financial gain (for either corporations or governments), any risks associated with oil development were acceptable,
- Estimating the risks of the pipeline exhausted the range of legitimate risks that needed to be considered, and
- Responsibility for responding to water-borne oil spills was clearly assigned and well-understood.

Several general mechanisms contributed to the creation of a spurious consensus in Alaska, and hence seriously impaired organizational foresight. One such mechanism is the tendency of organizations, especially those involved with technological risks, to continually claim control over what may in fact be uncontrollable. Many of our most politically charged risks--nuclear meltdowns, toxics leaching into water tables, ozone destruction, large oil spills--seem to be ones that defy control. Yet our organizations are the most controlled and controlling devices we know, and publics are baffled and angered when organizations seem incapable of adequate response. The problem is that organizations rarely admit their failings (though they are generally ready to point out the failings of others). When the often substantial gaps between what organizations *say they can do* and what they *can actually do* become public, institutional legitimacy is threatened and the probability of popular distrust increases.

By pretending to more control and understanding than they actually possess, organizations increase the probability of engendering public distrust. This distrust is exacerbated when organizations fail to acknowledge the ambiguity inherent in big decisions about risk, as they almost invariably do. In Alaska, there was never a point when the risk of tanker spills was seriously, publicly debated. Rather, attention was directed almost solely upon the vast benefits of oil development: the enhanced tax base,

more jobs, and so on. One result of constructing public consensus around oil in this manner was that organizations assumed that lack of significant public opposition indicated a wide-spread consensus regarding possible environmental costs of oil exploration. That assumption has cost industry (and state government, although to a lesser extent) dearly in the wake of the Exxon spill.

CONCLUSION: ORGANIZATIONAL FORESIGHT AND NUCLEAR WASTE TRANSPORT

Many moments in making decisions about the future are vulnerable to distortion and mistake. These moments are central components in any organizational system: information processing, organizational perception, choice of technologies, program implementation, and perhaps most difficult, anticipating the reactions of outsiders to organizational decisions. Failure of any of these components can cascade into organizational failure more generally. Here I have folded these moments into a single category that constitutes a particular type of organizational failure--one of foresight. I have not focused on failures of foresight (as opposed to successes) because I think organizations are inherently worse predictors of the future than other social actors (e.g., individuals, nations). To the contrary, organizations are generally *better* predictors of the future than most other actors. My focus has been on failure for the simple reason that we usually learn more from critical examination than praise.

By way of conclusion, I shall reiterate the key points of my argument and briefly discuss the argument's implications for nuclear waste transport. I have argued that organizational foresight of oil spill risks in Alaska was attenuated by several barriers. It is important to remember that, in Alaska, these barriers to organizational foresight operated in a situation that was well-suited to overcome them. As noted, much is known of the threats posed Alaska's environment; much is also known of what can go wrong with shipping systems. Nevertheless, the institutional system charged with managing and responding to oil spill risks in Alaska failed to anticipate both the likelihood and the consequences of a large oil spill. It is, therefore, particularly appropriate to ask the question: How well can we expect organizations to anticipate nuclear waste transport problems--at least some of which are likely to remain unclear for many years into the future--given how well, in Alaska--with much less uncertainty regarding key variables--they predicted major oil spills?

Before addressing this question, it bears noting that the comparative data necessary to answer it with certainty are sparse. To be sure, most books on civilian nuclear power consider the risks of the nuclear fuel cycle in general and usually mention the specific problem of moving highly hazardous materials from reactors (for example) to their final (or semi-final) resting place. But thorough treatments of transport problems are rare, and indeed most attention regarding hazards management is directed to either the generation of radioactive material or its disposal (e.g., Lipschutz 1980). We can, however, draw upon other aspects of the nuclear industry to make some comparisons.

The Barrier of Professional Heuristics. The history of nuclear power in the United States has been significantly shaped by the disqualification heuristic. One result has been to foster the conviction, within the industry, that technical solutions can be found to social and political problems (Woodhouse 1983:172). Further, partly because civilian nuclear power was long geared to military purposes (Clarke 1985), through the years the

industry tended to neglect possibilities of catastrophe. This (sometimes deliberate) neglect, until recent years at least, thrived on a lack of outside scrutiny. In any case, the disqualification heuristic helped hinder debate over alternative reactor designs, safety equipment, and disposal technology by disqualifying contrary perspectives. For example, at the 1977 licensing hearings on Three Mile Island, environmental groups critical of the plant were allowed only one expert witness, while 55 experts were allowed to testify in support of it (Woodhouse 1983:160). A professional, disqualification heuristic places inordinate value on the opinions of experts and technical advances while tending to disregard critical data and viewpoints. It was the paucity of early debate that would later draw charges of mis- and malfeasance toward those claiming to protest public interest.

The implication of this analysis for nuclear waste transport is that there should be extensive, explicit consideration of realistic worst-case scenarios. Although such analyses do not guarantee that all contingencies will be considered adequately, they at least create the opportunity of calling into question assumptions that any risks (or consequences) of transport failures will be minimal. Further, decision makers should take explicit account of real-life events in which failures of organizational foresight have attenuated satisfactory anticipation of future risks (and consequences).[17] Such exercises force a direct confrontation of realities that seem unlikely or even absurd in imagined scenarios (who would have believed a huge ship on autopilot would be allowed to fly onto a well-known, huge underground rock? who would have believed it was standard operating procedure to test for air leaks next to a nuclear reactor core with lit candles, as was the case at Brown's Ferry). Worst-case thinking is not alarmist or unreasonable. It is, to the contrary, essential to reasoned estimation of probable organizational failures.

The Barrier of Over-Organization. Organizations usually institute new procedures when responding to new problems; such procedures are based on past experience. Put differently, when organizations prepare for uncertainty they draw on routines constructed for recurrent problems. This observation suggests why preparation for rare, catastrophic events is inherently vexing for organizations. It is difficult indeed to develop routines for responding to nuclear transport accidents or major oil spills primarily because such events do not happen frequently enough to permit accumulation of knowledge regarding them. Thus does a structurally induced ignorance prevent extensive preparation for untoward events. Problems of uncertainty are exacerbated when organizational jurisdictions overlap. For example, in 1984 a truck loaded with U.S. Navy torpedoes spilled its cargo near Denver. Although no one was killed, "the accident happened at the intersection of several freeways during rush hour," and nine hours passed before the city of Denver could find any information on the proper way to respond (Peterson, *et al.* 1987:63). Part of the difficulty in than incident was a lack of clearly delimited jurisdictions that would have created a division of labor among organizations so that an effective response could be executed. That many technological risks, such as those associated with nuclear waste (Gould 1983), are chronic threats further hinders developing continuing, effective response.

Not only change, but also time, conspire against organizational readiness, as time horizons are frequently unclear for organizations. When the constraints posed by far-

[17]This paper is one such exercise.

away time horizons are given scant attention, the stage is set for future failure and hence, future criticism of organizational programs and decisions. In shortening the time horizons defined as within their legitimate purview, organizations tend to concentrate on short-run benefits, even though the long-run costs may be very high indeed. An apt example is the case of Nuclear Fuel Services in West Valley, New York. That case involved the construction and operation of a nuclear waste reprocessing plant, with all organizations involved failing to accord sufficient attention to time horizons. The plant is now abandoned (at least for reprocessing), although the problems created by its construction will remain for some time.

Problems of uncertainty and time are closely tied to the barrier of over-organization. I have argued that organizations are by their very nature somewhat inflexible. Indeed their particular strengths are found precisely in the arrangement of organizational resources to do some things well, even though such arrangements damn them to do other things poorly. Were the organizational world constructed otherwise, the most frequent call would be for more bureaucracy.

At the same time, there is a special onus on organizations charged with planning for and responding to serious risks, like those that attend nuclear waste, and oil, transport. In effect, we expect organizations to go against their nature when we ask them to be flexible enough to be able to respond to events whose sequences and timing cannot be known, and whose frequency cannot, even in principle, be estimated. Nevertheless, there are several implications for nuclear waste transport.

Precisely because it is possible to know the limitations inherent in formal organization (i.e., over-organization, short time horizons, erratic or unreliable responses to uncertainty), it is possible to construct mechanisms that help counter those limitations (although it is not likely they can actually be overcome). Since organizational solutions are tightly bound to (though not, I should emphasize, completely determined by) past practices and problems, decision makers should seek out and develop networks of advice and criticism that do not have an immediate or direct relationship with their organizations. This would be a difficult recommendation to institute, as it means deliberately fostering scrutiny of organizational missions by parties who may have an interest in seeing that mission founder. On the other hand, this risk is no more perilous than the technical problems with which these organizations must deal. Hopefully, such outsiders would have some special facility to ignore immediate constraints to stretch the time horizons considered in the process of making difficult decisions.

The Barrier of Spurious Consensus. The history of nuclear waste siting provides instructive lessons for the consequences of a possible spurious consensus regarding nuclear waste transport. The nuclear industry today is beleaguered in large part because of a lack of widespread consensus regarding the risks of nuclear technology. One key area of dissension concerns disposal of radioactive waste, especially spent fuel rods and other contaminated materials from civilian reactors. The United States now faces a $130 billion dollar nuclear waste problem (Lemons, *et al.* 1989).[18]

This is one of the areas in which the public probably knows little about the technical aspects of the risk, although most people are able to voice an opinion on it.

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[18]This is probably a conservative estimate.

Reviewing a plethora of studies on public attitudes toward nuclear waste, Nealey and Hebert (1983:97) note that although nuclear waste is an "obscure topic for a significant segment of the public," strong opinions on its risks began to develop after a 115,000 gallon leak of highly radioactive liquids at the Hanford Reservation in Washington. "A substantial part of the public," they write, "doubts that adequate waste disposal techniques are now known, and a growing number mention radioactive waste problems as a reason for halting further nuclear development" (Nealey and Hebert 1983:97). In fact one of the increasingly vehement critiques leveled against the nuclear industry over the past 15 years is that the industry (including regulators) has failed to adequately estimate problems associated with waste siting (Nealey and Hebert 1983). Part of the reason for this vehemence is that the industry and regulators have assumed their view on solutions to the waste problem was consonant with that of a wide variety of other actors. A spurious consensus on the risks of nuclear waste transport (and siting) could cripple future efforts to develop disposal technologies.

In addition to considerable dissension and distrust from below (i.e., on the public's part), there is mounting dissension from above (from experts, organizations, and governments--particularly the state of Nevada) concerning problems of nuclear waste disposal and transport. Indeed it seems highly likely that the consensus the Department of Energy (DOE) has been trying to construct will almost certainly end up being a spurious one. DOE's recent announcement that the planning process in Nevada will be begin anew reflects the precarious foundations upon which its attempted consensus was constructed (Wald 1989).

Congressional legislation, although designed to assuage the concerns of states and citizens who might be the recipients of a nuclear waste depository, set the stage for the lack of technical and political consensus among experts and organizations regarding depository siting, and also, by extension, nuclear waste transport. In 1982 Congress passed the Nuclear Waste Policy Act (NWPA).[19] The mechanism in NWPA that would create the hoped-for consensus was the requirement that DOE seriously consider several potential sites, with the final result being one repository in the east and one in the west. NWPA further required DOE to negotiate directly with the states and Native American tribes who had direct interests in the outcome of the decision process. Although these stipulations ensured delay of decision and political disagreement, they were steps in the direction of creating a genuine consensus. Unfortunately, the NWPA also allowed DOE to sidestep the National Environmental Policy Act's requirement of an Environmental Impact Statement for such decisions. As might be expected, the Department of Energy has stated that any nuclear waste site will be in full accordance with NEPA, although it assiduously avoids providing the kind of proof required by that legislation. This is precisely the stuff that spurious consensuses are made of.

Fiat is probably the most unstable basis on which to build consensus. Although decision by fiat is efficient, it is a primary condition under which consensus disintegrates and organizational legitimacy is lost (Bella 1987; Bella, *et al.* 1988a, 1988b). Although DOE was not required to prepare Environmental Impact Statements for the sites it was

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[19]For the history of this act, and its subsequent amendment, I am relying on Lemons, *et al.* (1989) and Lemons and Malone (1989).

considering, it did have to prepare formal environmental assessments. By 1986 DOE "had narrowed the number of candidate repository sites from nine to five and then issued final statutory [environmental assessments] in accord with NWPA procedures" (Lemons, *et al.* 1989:29). These environmental assessments then provided ample fodder for criticism, partly because they were not as stringent as EISs and partly because they made more explicit the technical assumptions (and faults) that underlay DOE's choices. The next step in the selection process was to winnow the list from five states to three--Nevada, Texas, and Washington. These states were chosen largely on the basis of political and economic criteria, which, while certainly legitimate criteria on which to base decisions, were not the criteria with which the decisions were justified. This gave an aura of capriciousness to DOE's decision process.

Congress, with DOE input, then placed the final nail in the coffin of consensus regarding nuclear waste siting in Nevada. In 1987 Congress amended the Nuclear Waste Policy Act, mandating that only one site be developed--Nevada. There were a number of reasons for the amendment, but the important point here is that technical decision by fiat, when consensus will later be required, sets the stage for considerable future dissension. The amendment stipulated that Nevada be compensated for having a nuclear waste dump within its borders, but only if it waived veto power over the Yucca Mountain site, actively participated in DOE's program, relinquished any oversight role in the depository's management or even "the rite to contest the site's suitability before the NRC in license proceedings" (Lemons, *et al.* 1989:35-36). It would be difficult to imagine a better recipe for dissension.

I would be wrong to claim I knew how to construct a non-spurious consensus, especially regarding the risks of nuclear waste transport. At the same time, the history of decisions concerning nuclear waste siting affords at least a few positive suggestions. Because a spurious consensus is partially based on the assumption that many different actors share the same perspective, some way must be found to question such an assumption, perhaps even to annul it. For a variety of reasons, this is unlikely to emerge from within the organization with the primary responsibility for responding to risk. Outside criticism and thorough scrutiny is mandatory for any realistic hope of developing genuine consensus. Hence decision makers should develop mechanisms to recruit and develop points of view with which they may disagree. Further, some mechanisms should be developed that will foster compromises from all interested parties--simply having different opinions will not create the consensus necessary to agree on how to plan for and respond to nuclear waste transport risks. My suggestions will perhaps sound impossible, or maybe even obvious. I doubt they are impossible, although I would concede they will be difficult to implement. If they are obvious, there is little or no evidence that they have occurred to major decision makers--the Department of Energy or Congress.

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In this paper I have examined several barriers to organizational foresight. The analysis suggests that developing organizational foresight, and avoiding organizational folly, requires: 1) changing decision making procedures so that a wide range of heuristics are used, 2) deliberately encouraging criticism of existing organizational arrangements to increase the likelihood of transcending institutionalized solutions, and 3)

avoiding premature closure on consensus. Acting otherwise invites political and technological catastrophe.

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