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Learning in Organizations and Public Policy

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ABSTRACT

This study builds a conceptual framework to guide empirical studies of learning in public policy. Learning in public policy is defined here as a process in which individuals apply new information and ideas to policy decisions. This topic is examined by adapting relevant concepts from studies of organizational learning to the context of public policy. Recent work in the organizational learning literature focuses on institutional structures, procedures, and customs (learning arrangements) that act to promote individual learning. Further work in the policy literature suggests that focusing events (incidents that focus public and political attention on a policy issue) can also shape learning in public policy. Combining insights from these two literatures, this study proposes that both learning arrangements and focusing events can play observable roles in shaping policy change over time. These concepts are developed and examined in the context of hazardous systems.

Learning in public policy is defined here as a process in which individuals apply new information and ideas to policy decisions. The importance of learning is widely acknowledged in studies of public policy (Hall, 1993; Sabatier, 1999; Dodd, 1994; Haas, 1990). However, this literature has not fully developed the empirical study of *learning processes* – defined here as the institutional arrangements and political events that shape individual learning – or the relationship between learning processes and policy change over time (May, 1992; Bennett and Howlett, 1992). This study aims to address this gap by adapting concepts from two literatures (public policy and organizational learning) into a new conceptual framework that can guide empirical research on this topic. This framework is distinctive in that it focuses

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on a specific set of institutional arrangements, political events, and policy domains that allow detailed observations of the interaction between learning processes and policy change. Using this focused approach to analysis, the operation of learning processes can be linked (through an observable chain of events in the policy process) to policy change over time.

The fundamental premise of this study is that continuing advances in science and technology – as well as the accumulation of policy experience over time – create recurring opportunities for individuals involved in policy decisions to learn (Busenberg, 2000). This study argues that certain institutional structures, procedures, and customs (institutional learning arrangements) can act to promote such learning. Second, this study argues that focusing events – incidents that focus public and political attention on a policy issue – can also shape such learning. Third, this study argues that the impact of these two learning processes on policy change can be most clearly observed in policy domains where individuals are pursuing common goals. This study focuses on hazardous systems as a set of policy domains where individuals pursue system safety as a common goal.

This study therefore examines the role of learning arrangements (and focusing events) in shaping policy change within policy networks managing hazardous systems. This study proposes that both focusing events and the operation of learning arrangements can be linked through an observable chain of events in the policy process to enhancements in safeguards against system hazards. It presents empirical examples from a case study of an environmentally hazardous system, the marine oil trade in Alaska. The study identifies a chain of events linking a focusing event and the operation of learning arrangements to a series of safeguard enhancements over a period of twelve years.

I Learning Processes

Any study of learning in politics and policy is ultimately based on a model of how (and why) individuals learn. This study is based on the bounded rationality model, which proposes that individuals have a limited capacity to incorporate information into their decisions (Simon, 1947). This results from limits on the amount of information that individuals can gather and process in a given time span, and limits on the time available for individuals to pursue these tasks (Simon, 1985; Jones, 1994). One implication of this model is that individuals will often be unable to consider all information relevant to their decisions in a complex world (March and Simon, 1958). Given that policy decisions are often highly complex, boundaries on individual rationality

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can lead to policy choices that are not fully informed (Lindblom, 1959; Ostrom et al, 1994). A second implication of the model is that imperfectly informed individuals will have opportunities to learn by gathering and processing new information over time (Simon, 1985). Therefore, while individuals are capable of committing errors in pursuit of their goals, they are also capable of learning from their errors, developing new understanding, and adopting new strategies in pursuit of their goals (Ostrom, 1999).

Building on the bounded rationality model, this study proposes that continuing advances in science and technology (as well as the accumulation of policy experience over time) generally create recurring opportunities for individuals involved in policy decisions to learn (Busenberg, 2000). This evolutionary perspective (which assumes imperfect information and focuses on a dynamic series of decisions over time) forms a contrast with simple economic decision models that assume perfect information and focus on a single decision point.

The importance of bounded rationality and learning has been recognized both within studies of public policy and studies of organizational learning. This study applies relevant concepts developed within both of these literatures. These concepts are reviewed below, and then synthesized into a framework for empirical research.

The concept of learning is a recurring theme in theories of the policy process (Heclo, 1974; Hall, 1993; Sabatier, 1999; Thomas, 1999). This literature suggests that the process of learning and policy change often occurs (1) within networks of multiple organizations and individuals active in a given policy domain, (2) over periods of many years, (3) both through incremental discussions within policy networks, and through responses to political events, and (4) through the diffusion of innovations and experiences between different jurisdictions and policy domains. Furthermore, the literature suggests that this process is shaped by institutional context (Sabatier, 1999). But this literature has not fully developed an empirical research agenda focused on the institutional arrangement and political events that promote (or inhibit) learning, or on the relationship between these learning processes and policy change over time (Sabatier, 1999).

Because the process of learning and policy change usually involves organizational actions, the study of organizational learning (reviewed in Huber, 1991) is potentially relevant to the study of public policy (Huber, 1991; Levitt and March, 1988; Argyris and Schön, 1978). Studies in organizational learning focus attention on institutional arrangements that act to promote (or constrain) learning, and the relationship between learning and organizational performance (Simon, 1991; Huber, 1991; Levitt and March, 1988; Popper and Lipshitz,

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1998). For example, Popper and Lipshitz (1998) propose that learning can be promoted through organizational structures and procedures (learning mechanisms) as well as values or customs that support the learning process (learning cultures). These concepts are potentially valuable because they provide a basis for observing institutional learning processes in action.

This study introduces two general terms describing institutional arrangements that shape individual learning: *institutional learning arrangements* are institutional structures, procedures, and customs that act to promote individual learning, and *institutional learning constraints* are institutional structures, procedures, and customs that act to inhibit individual learning (Sagan, 1993). This study applies the concept of learning arrangements and constraints in the context of public policy by incorporating additional relevant concepts from the policy literature.

The public policy literature indicates that studies of learning and policy change should consider the actions of policy networks, the impact of political events on policy change, and the evolution of policy over time (Sabatier, 1999). First, this study argues that learning arrangements can operate not only within individual organizations, but also within multilateral policy networks (Levitt and March, 1988). Learning arrangements are defined as institutional arrangements that influence individual behavior. Therefore, learning arrangements can operate within any collection of individuals pursuing related goals (Popper and Lipshitz, 1998). That collection may be a single organization or a policy network involving many organizations. Second, the policy literature suggests the possibility of learning that occurs in response to focusing events. A focusing event can be defined as a sudden, unusual, and widely known event that focuses public and political attention on a policy issue (Birkland, 1997). A focusing event can act as a widely known symbol of a policy issue, and raise the prominence of that issue on governmental agendas (Kingdon, 1995). Focusing events can thereby provide the impetus for major policy reforms, as well as new institutional arrangements that can shape future decisions in a given policy domain (Baumgartner and Jones, 1993). Finally, the policy literature indicates that policies often evolve over periods of a decade or more. Therefore, empirical studies of learning processes in public policy should include a data span of a decade or more (Sabatier and Jenkins-Smith, 1999).

The concepts discussed above can be used to develop an empirical research agenda that examines the impact of learning arrangements and focusing events on policy evolution over time. The preliminary goals of this agenda are to (1) identify learning arrangements used by

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a policy network in a given policy domain, (2) identify focusing events that have occurred within the domain, and (3) search for a chain of events that link the operation of these learning processes to patterns of policy change in the domain over a period of a decade or more.

The policy literature suggests the presence of a set of variables that constrain the impact of learning processes on policy change. For a given policy domain, these variables include (1) the characteristics of the issue in question, (2) the distribution of political authority and influence in the domain, (3) the natural, economic, and technical resources available to support policy actions, (4) the institutional structures of the governments active in the domain, and (5) the value structures of the cultures active in the domain (Sabatier and Jenkins-Smith, 1999; Rose, 1993; Kingdon, 1995).

These contextual variables set boundaries on the process of learning and policy change, because they inhibit some courses of action. For example, learning arrangements can generate policy proposals that are infeasible because they are too costly, technically impractical, incompatible with social value structures, or inconsistent with institutional procedures (Kingdon, 1995). Learning may be inhibited in domains where the impacts of policy change cannot be readily measured, as well as domains that involve fundamental value conflicts between different actors (Sabatier and Jenkins-Smith, 1999). In some cases, public and political satisfaction with a given policy program may weaken social support for further learning and improvement (Rose, 1993).

In sum, the policy impacts of institutional arrangements and political events are shaped by the context in which they occur. Furthermore, that context can shift over time. For example, a shift from one governing coalition to another can create new support for value choices (and policy proposals) that received less support in the past (Rose, 1993).

For the purpose of preliminary empirical research, it is useful to narrow the focus of inquiry onto those contexts where the variables of central concern can be most clearly observed. This study is primarily concerned with the impact of learning arrangements and focusing events on policy change over time. These variables can be most clearly observed in contexts where the members of a policy network are pursuing common (and stable) goals over long periods of time, where their performance in pursuing those goals can be readily measured, and where social support for improved performance is both significant and sustained. This study therefore establishes an empirical research program within a prominent set of policy domains (hazardous systems) that contain these characteristics (Sagan, 1993).

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II. Learning in Hazardous Systems

A hazardous system is defined here as a system capable of generating harmful events (accidents) that virtually every member of the network managing the system seeks to avoid. Examples of hazardous systems include those used in the production, storage, and transportation of environmentally harmful materials, such as oil or radioactive waste. Under these conditions, the fundamental safety goals of the network are both stable and clear. Furthermore, the dire consequences of accidents often lead to sustained social support for safety improvements (Sagan, 1993). Therefore, the performance of the network in pursuing its safety goals can be precisely measured, and variations in its performance can be studied over long periods of time. Network members pursue the common goal of system safety, and can use learning arrangements in attempts to achieve this goal.

This study examines the use of learning arrangements (and responses to focusing events) by policy networks managing hazardous systems, and links these two processes to enhancements in the capabilities of system safeguards. System safeguards are defined here as defenses against system hazards. This study does not predict the relationship between the capabilities of system safeguards and the safety performance of a given system. This complex question of systems engineering remains unresolved in the literature on hazardous systems, and is beyond the scope of this study (Perrow, 1984, 1994; Sagan, 1993, 1994; Rochlin, La Porte, and Roberts, 1987; La Porte, 1996).

Policy networks can use learning arrangements to identify (and apply) both innovations and experiences relevant to system safety. For example, learning mechanisms (in the form of institutional structures and procedures) can be used to promote learning through performance and error analyses, experiments, models, simulations, and analyses of the experiences and innovations of other policy networks. Because competing interpretations of information can delay (or block) the translation of that information into action, learning mechanisms will be most effective when they are designed to generate information that is commonly accepted within the network (Ozawa and Susskind, 1985; Busenberg, 1999). Learning mechanisms can also include rules and incentives that aim to promote the implementation of enhanced safeguards. Furthermore, the search for enhanced safeguards can be promoted by a learning culture, consisting of informal customs that support the operation of formal learning mechanisms (Wildavsky, 1988; La Porte, 1996; Huber, 1991; Sagan, 1993; Rochlin, La Porte, and Roberts, 1987; Levitt and March, 1988; Perrow, 1994; Carroll, 1995; Kingdon, 1995; Popper and Lipshitz, 1998).

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While learning arrangements act to promote learning in a policy network, other institutional arrangements can act to constrain it. In a hazardous system a learning constraint is any institutional arrangement that suppresses or distorts information or choices concerning safety. For example, institutional procedures or customs of secrecy can promote the concealment of errors, and thereby inhibit learning from errors.

In addition to learning that occurs through the operation of institutional arrangements, policy theory also suggests the possibility of learning from system accidents that act as focusing events (Birkland, 1997). By focusing public and political attention on the issue of system safety, such accidents can provide the impetus for major safety reforms in the system. These reforms can include both safeguard enhancements and new institutional arrangements intended to improve system management in the future (Baumgartner and Jones, 1993). This process of learning from accidents is primarily driven by sporadic crises, rather than through the systematic use of learning arrangements.

If the concepts discussed above are accurate, then it should be possible to observe a chain of events in the policy process linking the operation of these learning processes to policy change in a hazardous system. Therefore, these concepts provide the foundation for two empirical propositions concerning learning within a policy network managing a hazardous system. First, the network's use of learning arrangements in the pursuit of system safety will be linked (through an observable chain of events in the policy process) to recurring enhancements in the capabilities of system safeguards. This first process is referred to here as learning by design. Second, system accidents that act as focusing events will be linked (through an observable chain of events in the policy process) to sporadic enhancements in system safeguards. This second process is referred to here as learning from accidents.

This study makes a preliminary test of these propositions in one environmentally hazardous system: the marine oil trade in Alaska. This system contains all of the components necessary for a useful study, including a clearly identifiable policy network managing the system, a major system accident that acted as a focusing event, a set of institutional arrangements designed to promote learning in the pursuit of system safety, and a highly detailed set of data that traces the process of safeguard enhancements in the system over a period of twelve years.

III. Oil in Prince William Sound: A Case Study

Since 1977, oil has flowed through the Trans Alaska Pipeline System to a terminal at the edge of Prince William Sound in Alaska. Tankers

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are loaded with oil at the terminal, and then sail through the waters of the Sound to the Gulf of Alaska. A network of public and private organizations manages this system. The Alyeska Pipeline Service Company (Alyeska) manages the oil terminal on behalf of seven oil corporations, and provides oil spill prevention and response services in the Sound. A number of oil corporations operate tankers in the Sound. State and federal regulations on oil spill prevention and response in this system are implemented by the Alaska Department of Environmental Conservation (ADEC) and the United States Coast Guard, respectively (Salvador, 1999; Alaska Oil Spill Commission, 1990; RCAC, 1999a).

The oil trade in the Sound meets this study's definition of a hazardous system, because this system is capable of generating environmentally harmful events (major oil spills) that virtually all members of this network seek to avoid. Marine oil spills can cause massive casualties in wildlife populations. The prevention of oil pollution in the Sound is an expressed goal of all the organizations in this network (Alaska Oil Spill Commission, 1990; RCAC, 1999a; Salvador, 1999). In a 1996 interview, a manager in the regional oil industry concluded that 'it's in nobody's interest to have oil in the water'. This system provides a useful case study because it contains examples of (1) a major system accident that acted as a focusing event, and (2) the use of institutional learning arrangements in the pursuit of system safety. In 1989, the oil tanker *Exxon Valdez* collided with a reef and spilled approximately 11 million gallons of oil into the Sound (Alaska Oil Spill Commission, 1990; RCAC, 1999a). After this disaster, innovative learning arrangements developed within the network managing this system. A longitudinal case study is used here to examine the effects of the disaster – and the new learning arrangements – on policy evolution in this system. Case study methods were used to examine the evolution of safeguards against marine oil pollution in this system from 1989 through 2001. Data were gathered from 1996 through 2001 from (1) semi-structured field and telephone interviews with a snowball sample of 47 respondents, (2) a series of document analyses, and (3) conference presentations on this topic. Interviews were used to gather data from respondents working within the regional oil industry, citizens' groups, ADEC, and the Coast Guard. Public reports generated by these organizations provided a highly detailed chronology of events in this policy domain. These documents were used as additional sources of data.

Learning from accident occurred when the *Exxon Valdez* oil spill focused public and political attention on the problem of marine oil pollution. This focusing event triggered the enactment of a new regulatory framework governing the oil trade in the Sound (Birkland, 1997; Wilkinson, Pittman, and Dye, 1992; Beaver, Butler, and Myster, 1994).

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The statutory basis of this new regulatory framework included the Federal Oil Pollution Act of 1990 (Public Law 101–380) and Alaska Statute Title 46. The new regulatory framework mandated enhancements in three critical system safeguards in the Sound: (1) tug escort vessels, which could help tankers to correct course errors that might otherwise lead to collisions and oil spills, (2) vessel tracking equipment, which could be used to warn tankers of navigational hazards, and (3) spill response equipment, which could be used to recover oil spilled from tankers. Prior to the 1989 disaster, laden tankers were not protected by either escorts or vessel tracking for most of their passage through the Sound and only a limited amount of response equipment was deployed at the terminal. The new regulatory framework required two escorts and vessel tracking for laden tankers during their entire passage in the Sound, as well as the deployment of a large amount of new response equipment throughout the Sound (RCAC, 1993b, 1995c, 1999a).

A second set of safeguards deployed in the Sound since the 1989 disaster (including a new training program for marine fire response, new weather reporting equipment, and new tug escort vessels with enhanced capabilities) was not specifically mandated by the new regulatory framework. The data gathered in this study indicate that these additional safeguards were developed through the operation of institutional learning arrangements.

IV. Institutional Learning Arrangements

1. The Prince William Sound Regional Citizens' Advisory Council (RCAC) is a learning mechanism mandated by OPA 90. The mission of the RCAC is to oversee the environmental management of the marine oil trade in the Sound. The members of the council are appointed by local governments and interest groups from the region directly affected by the *Exxon Valdez* spill. OPA 90 states that the RCAC will (1) remain in operation for as long as the Trans Alaska Pipeline remains active, and (2) receive funding from the oil industry during that period. Alyeska has funded the RCAC since 1990, under a contract that guarantees the council's independence from Alyeska (RCAC, 1991a, 1999a).

The RCAC acts as a learning mechanism in the form of an organization. It supports a broad range of studies and activities that aim to (1) identify weaknesses in system safeguards, (2) identify opportunities to develop (and deploy) enhanced safeguards, and (3) promote the implementation of such enhancements (RCAC, 1999a).

2. The Best Available Technology (BAT) review is a learning mech-

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anism used by the State of Alaska. The general purpose of the BAT review is to compare the performance of existing system safeguards with the performance of alternative safeguards used in similar situations elsewhere (RCAC, 1997a). It allows state regulators to periodically identify and examine alternative safeguards (from anywhere in the world) that might outperform safeguards in this system. The review process uses multiple criteria including the feasibility, cost, and environmental impacts of each alternative. If state regulators determine that an alternative safeguard technology is the best available for use in the system, a provision in state law (18 AAC 75) requires the adoption of that technology in the system. This process can promote the diffusion of innovations, alternatives, and experiences from other policy domains into the system.

3. Collaborative studies are a new approach to the analysis of risks and safeguards in this system. In a collaborative study, a group of researchers studies an issue under the direction of a joint policy group (including representatives from the oil industry, RCAC, ADEC, and Coast Guard). The participating groups pool resources and information in support of the study. The goal of this approach is to generate a body of knowledge that is mutually acceptable to all of the participating groups (Busenberg, 1999; Ozawa and Susskind, 1985). These studies have used experiments, models, and simulations to generate new information on system hazards and countermeasures (RCAC, 1994b, 1995c, 1997a).

Collaborative studies act as learning mechanisms in the form of research procedures. Such studies can be used to identify weaknesses in the system, as well as opportunities for enhancing system safeguards. Unlike the BAT review, collaborative studies do not incorporate rules for the implementation of enhanced safeguards.

4. In the years following the *Exxon Valdez* disaster, a cultural shift in favor of cooperative learning efforts became evident in this policy network. Prior to the disaster, a generally uncooperative relationship existed between the regional oil industry and the other members of the network. The oil industry maintained that a major oil spill in the Sound was 'highly unlikely' (Alyeska, 1987) and repeatedly declined to implement safeguard enhancements recommended by ADEC and the Coast Guard (Clarke, 1993; Alaska Oil Spill Commission, 1990). This custom of noncooperation acted as an informal learning constraint within the system prior to the *Exxon Valdez* disaster.

In the years following the 1989 disaster, a new partnership in the pursuit of system safety emerged between the members of this network. The regional oil industry, RCAC, ADEC, and Coast Guard began to collaborate in a series of voluntary learning efforts aimed at preventing

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future oil pollution in the Sound (Salvador, 1999). This partnership may have emerged in response to the harsh consequences of the *Exxon Valdez* spill. Following the disaster, the oil industry, ADEC, and Coast Guard were criticized for their performance in managing the system (Alaska Oil Spill Commission, 1990). The economies and lifestyles of local communities were severely disrupted by the spill (RCAC, 1999a). New state and federal laws, enacted in response to the spill, significantly heightened the potential financial penalties for entities spilling oil in the Sound (Wilkinson, Pittman, and Dye, 1992; Beaver, Butler, and Myster, 1994).

By providing a clear example of the consequences of system failure, the 1989 spill may have driven this cultural shift in favor of collaborative learning. The proceedings of a 1999 conference on this issue concluded that 'the spill forged a partnership that has assessed risks, pioneered innovative technologies, and continues to implement improvements designed to achieve the safest marine transportation system in the world' (Salvador, 1999).

This partnership is a learning arrangement in cultural form; it is not embedded in a formal structure or procedure but it has played a central role in supporting the operation of formal learning mechanisms.

V. Policy Evolution After the Disaster

Through data gathered in three cases, this study identifies a chain of events linking the operation of the learning arrangements described above to enhancements in system safeguards. The first two cases illustrate the operation of the RCAC as a learning mechanism, while the third case illustrates the operation of all the learning mechanisms described above (the RCAC, collaborative studies, and BAT review). Furthermore, each of the three cases illustrates the role of the new learning partnership in supporting the operation of formal learning mechanisms.

Learning has occurred within one enduring constraint. Because Alaska oil production is a key strategic resource for the United States, the alternative of stopping it to prevent regional oil spills is nto viewed as feasible within the managing network (Alaska Oil Spill Commission, 1990).

In 1992, the RCAC began considering planning for fires at the terminal and aboard tankers in the Sound (RCAC, 1995b). Such fires which could trigger major oil spills. In 1996, the council funded a study of marine fire response in the Sound. The study recommended the development of a joint training program for the different fire teams that might respond to marine fires in the region (RCAC, 1997a). The

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council responded by organizing marine fire fighting symposia in 1997 and 1999. These symposia trained fire teams from across the state in the coordinated actions needed to combat a major marine fire. Funding and logistical support for these symposia were provided jointly by the RCAC, oil industry, Coast Guard, state and local governments, and a local community college (RCAC, 1997b, 1997c, 1997d, 1999b, 1999c).

In 1993, the RCAC proposed the deployment of new weather reporting equipment in the Sound to reduce the risk of bad weather endangering an oil tanker in the Sound or the Gulf of Alaska (RCAC, 1993a). The RCAC succeeded in building broad support for its proposal among the other members of the network (including the oil industry, ADEC, and the Coast Guard). In a 1996 interview, an RCAC staff member commented that 'all of the stakeholders thought it was a grand idea'. The RCAC then presented the proposal to Alaska's congressional delegation. In 1994, two members of the delegation responded by proposing a federal appropriation to fund the new equipment (RCAC, 1994a). The appropriation was approved, and used to deploy the new equipment in the Sound in 1995 (RCAC, 1994b, 1995a).

In both of the cases examined above, the RCAC acted as a learning mechanism by identifying opportunities to enhance system safeguards, and by promoting the implementation of those enhancements. Furthermore, in both cases the RCAC worked in voluntary partnerships with other members of the network to achieve the implementation of its proposals.

In 1991, the RCAC proposed a study of the tanker escort and navigation system in the Sound. Between 1992 and 1994, the RCAC conducted this study in collaboration with the oil industry, ADEC, and the Coast Guard. The study was based on computer simulations, as well as data from experiments with tug vessels and tankers. The RCAC provided 61% of the funding for the study; additional contributions of funding and equipment were provided by the oil industry. This collaborative study demonstrated that the existing system could not save a disabled tanker from grounding under certain conditions. Based on this new information, in 1994 the oil industry and Coast Guard adopted new escort and navigation procedures designed to counteract risks of this nature (RCAC, 1991a, 1991b, 1994b, 1995c).

The RCAC further proposed that the oil industry deploy highly maneuverable *tractor* tug vessels in one region of the Sound, and a *rescue* tug vessel (with an enhanced propulsion system) in a second region of the Sound. The council argued that the advanced capabilities of these new tug vessels would further reduce the risk of an oil spill in the Sound. The oil industry initially opposed this proposal, on the grounds that a similar margin of safety could be achieved with the conventional tug vessels then operating in the Sound (RCAC, 1994b, 1995b).

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In 1995, the oil industry, RCAC, Coast Guard, and ADEC agreed to pursue a second collaborative study of this issue, in the form of a comprehensive risk assessment of the marine oil transportation system in the Sound (RCAC, 1995a, 1995b). Joint funding for the risk assessment was provided by the oil industry (64%), RCAC (28%), and Coast Guard (8%) (RCAC, 1995b). This study developed risk models based on data collected from the oil industry and other members of the regional maritime community (Busenberg, 1999).

In 1995, ADEC also began to review the escort system according to the best available technology requirement (RCAC, 1995a, 1995b). ADEC subsequently collaborated with the RCAC and oil industry in two projects designed to (1) develop the BAT regulatory procedure, and (2) investigate the performance of different tug vessel technologies, using data from computer simulations, experiments, and operational experiences from several marine transportation systems (RCAC, 1996, 1997a).

New information generated by the risk assessment demonstrated a clear need for a rescue tug vessel in the Sound. In response, the oil industry deployed a rescue tug vessel in the Sound in 1997 (RCAC, 1997a, 1997b). In a 1997 interview, an oil industry manager concluded that this action 'was a direct result of the risk assessment'.

The risk assessment did not determine if tractor tug vessels would systematically outperform conventional tug vessels in the escort mission (RCAC, 1997a). However, information gathered in the BAT review demonstrated that tractor tug vessels could outmaneuver conventional tug vessels. With support from the governor of Alaska, ADEC held that the advanced maneuvering capabilities of tractor tug vessels constituted the best available technology for the escort mission (RCAC, 1996, 1997b). The oil industry responded by (1) deploying two tractor tug vessels in the Sound in 1998, and (2) constructing two new tractor tug vessels with enhanced propulsion systems, and deploying them in the Sound in 1999 (RCAC, 1997b, 1998, 1999a, 1999b).

The decision to deploy new tug vessel technology in the Sound occurred as a learning process in several stages. The RCAC began the process by proposing a study of the escort system. The process matured with the development of two collaborative studies and the BAT review of the escort system. Each of these projects was pursued as a partnership between the network members (despite disagreements over the proposal to deploy new tug vessels). These projects gathered data based on experiments, models, simulations, and operational experiences. The results of the first collaborative study led to changes in tanker escort and navigation procedures. The results of the second collaborative study led to the deployment of a rescue tug vessel in the Sound. The BAT process drove the deployment of tractor tug vessels in the Sound.

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VI. Conclusions

This study has built a conceptual framework to guide focused empirical research on learning processes and policy change over time. This framework synthesizers relevant concepts from studies of learning in public policy and studies of organizational learning. The concepts developed in this study form the basis for an empirical research program examining the impact of institutional learning arrangements and focusing events on policy change in hazardous systems. Preliminary empirical research on this topic demonstrates a chain of events linking the operation of both learning arrangements and a focusing event to safeguard enhancements in one environmentally hazardous system. In sum, this new line of research shows promise for further empirical study.

The concepts developed in this study may contribute to further research relevant to both the theory and the practice of public policy. Indeed, the concept of learning is found not only in theories of the policy process, but also in proposals for policy design. A longstanding argument in the design tradition proposes that policies be treated as experiments, with the aim of promoting continual learning and adaptation in response to experience over time (Dewey, 1927). This prescriptive argument is the foundation of adaptive management strategies, which consist of policy experiments designed to detect (and correct) errors in a reliable, efficient manner (Lee, 1993). For example, an adaptive management strategy might include a number of parallel policy experiments designed to test different policy measures, as well as procedures for measuring (and communicating) the results (Brunner and Klein, 1999). These arguments suggest designing institutional arrangements to promote learning and adaptation in policy practice (Ostrom, 1999; Schneider and Ingram, 1997; May, 1992).

The concepts developed in this study raise numerous questions for future research on the topic of learning processes and policy change. What forms of learning arrangements (and learning constraints) can be identified in different policy domains? What observable impacts do these institutional arrangements have on policy change over time? In what way do the impacts of learning arrangements (and focusing events) vary according to the characteristics of the policy domains in which they occur? How does the process of learning differ in policy domains marked by conflicting values? Answering these questions will require comparative studies across a broad array of jurisdictions and policy domains.

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