Complexity and Adaptive Policy Systems: CALFED as an Emergent Form of Governance for Sustainable Management of Contested Resources[1]

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Abstract

In the 1990's, California's paralyzing conflict over the San Francisco Bay-Delta led to the creation of the CALFED process, a collaborative effort involving 25 state and federal agencies and dozens of major stakeholders that evolved to adaptively manage this massive water system. Unlike traditional governance institutions based on hierarchical command and control structures, CALFED is characterized by networks of stakeholders and agency officials who have worked together in a largely self-organizing way. This process has led to adaptation of system operations and created innovative practices such as the Environmental Water Account, which is a complex water banking system designed to deal in a real time way with environmental needs. CALFED has had significant success in improving water and ecosystem management practices. The story of CALFED reflects emergent practices of governance and illustrates the challenges that arise as collaborative self-organizing governance coexists with traditional forms. The science of complex adaptive systems provides a rich source for understanding governance models such as CALFED and their potential to improve public policy. This paper reports on some of the results of over ten years of research carried out by scholars at the Institute of Urban and Regional Development at the University of California Berkeley (www-iurd.ced.berkeley.edu) and the Center for Collaborative Policy at California State University Sacramento (www.csus.edu/ccp).

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The Challenge of Governance in the 21st Century

The problems facing policy governance in the 21st century seem to be overwhelming the organizations society depends upon on to address them. Uncertainty and complexity, fragmentation and diversity, interdependence, new dynamics for trust, and new spaces for decision making all contribute to a changing context for policy governance. Almost 40 years ago J.D. Thompson, in his now classic book warned "Bluntly speaking, social purposes in modern societies increasingly exceed the capacities of complex organizations, and call instead for action by multi-organization complexes." (Thompson 2003, 157) The field of public administration is beginning to catch up with his insights. Kettl's review of the field of public administration contends that, "The challenge facing government administrators in the twenty-first century is that they can do their jobs by the book and still not get the job done." (Kettl 2002, 22-25) He argues that fundamental

transformations are occurring in policy governance, but fields of practice and scholarship have not integrated these. Freeman, an administrative law scholar, argues that traditional governance reform does not respond to the most serious weaknesses of the present system of policy governance because it is based on an adversarial administrative decision-making process driven by interest representation. To address natural resource issues requires, in her view, collaborative governance, joint problem solving, broad participation, sharing of regulatory responsibility across the public-private divide, and flexible, engaged agencies (Freeman 1997).

A growing literature documents experiments in emergent forms of ecosystem governance in, for example, the Everglades, Chesapeake Bay (Koehler 2001) and other large water systems: New York-New Jersey Harbor (Mandanaro 2005); the Sacramento Region (Connick 2006); the New York Bight (McCreary 1999); Queensland Australia (Margerum 1999); Oregon (Margerum and Whitall 2004); and Florida (Scholz and Stiftel 2005). A companion literature analyzes and interprets such efforts (Wondolleck and Yaffee 2000, Sabatier, et al. 2005, Fiorino 2004, Connick and Innes 2003). Those which go beyond immediate conflict resolution to ongoing management are typically caught in the challenges of traditional governance. In response they develop hybrid versions of governance, trying to combine traditional norms and practices with the emergent ones.

The challenges of policy governance raises the question of whether the science of complexity may offer some insights about the dynamics of emergent forms of governance and provide guidance about how organization of policy governance based upon these insights may be more effective than traditional policy governance. Certainly there is a large and growing literature exploring the implications of complex adaptive systems (CAS) thinking for organizations (Stacey 1996, Axelrod and Cohen 1999, Stacey 2001, Allen 2001, McKelvey 2001, Cilliers 2001, Capra 2002, Bar-Yam 2004, Richardson 2005, Tsoukas 2005). Over 20 years ago the futurist Alvin Toffler seemingly anticipated a CAS approach to business: “Instead of being routine and predictable, the corporate environment has grown increasingly unstable, accelerative, and revolutionary…The adaptive corporation, therefore, needs a new kind of leadership. It needs managers of adaptation equipped with a whole set of new, nonlinear skills.” (Toffler 1984, 2) More recently there is a significant literature focusing on case studies from business that offer possible lessons from CAS. For example some of these look at product design, (Chiva-Gomez 2004), innovation (Rose-Anderssen et al. 2005), organizational development (van Eijnatten and van Galen 2005), and business process and strategy (Allen et al 2005).

Studies of the rapidly evolving, complex, and unpredictable technology industry have focused attention on the evolution of emergent modes of governance. Saxenian (Saxenian 1994), for example, found that the most successful high tech businesses work cooperatively to jointly stay at the cutting edge of the industry. Another study found that the most successful of six computer companies in adapting to continuous change, worked with a combination of clear management responsibilities and defined project priorities, while leaving other decisions up to the product design teams. They did not rely on formal plans or reactive behavior, but rather on extensive communication across projects and a wide variety of low-cost probes of the future (Brown and Eisenhardt 1998). Another

study showed that success in the computer industry involved adaptive strategies like experiments, testing, milestones, and multifunctional teams (Eisenhardt and Tabrizi 1995).

To date there have been few similar studies in public policy, although there are notable exceptions to this assessment such as case studies on urban regeneration (Moobela 2005) and health services (Kernick 2005). In our prior research on emerging collaborative planning practices we have taken note of the potential importance of CAS for understanding the dynamics of these practices. We have theorized about the central aspects of collaborative planning: Diversity, interdependence, and interaction based upon heuristics of authentic dialogue (Booher and Innes 2002). We found that traditional approaches used to evaluate public programs did not make sense for evaluating collaborative planning and suggested an evaluation framework based upon CAS (Innes and Booher 1999a, Connick and Innes 2003). We also have suggested the potential importance of CAS for collaborative metropolitan development planning (Innes and Booher 1999c) and for the use of indicators for sustainable community development (Innes and Booher 2000). This and other research has led us to sense a potentially important convergence between the practices of collaborative planning we have been studying and the research and theory on CAS and organizations (Innes and Booher 1999b).

This paper is meant to build on that potential convergence by looking at the case of a unique water management process in California, the CALFED Bay-Delta program. CALFED is composed of 25 federal and state agencies and 35 stakeholder organizations. It began in 1994 as a self-organizing entity without any federal or state legislative structure. Since then in a very untraditional and sometimes messy way it has implemented numerous innovative actions to better manage water resources and had a major effect on the historically conflictual culture of California water politics dramatized in the classic film Chinatown. In this article we will delve into the example of CALFED to inquire into how one might think about governance with the analogy of CAS and the practices of collaborative policy in order to understand how a new and emergent form of governance may be seen as an alternative to traditional policy governance.

In the next section we will summarize five of the key societal trends that public policy scholars have identified as factors in the need to investigate new versions for policy governance and we will relate them to the CALFED process. We will then summarize the emergent practice of collaborative planning. We next will briefly describe the research supporting this article and then provide a short overview of the context for the beginning of CALFED in 1994. Next we will describe the structure and several of the innovative governance practices that emerged in CALFED and relate them to CAS. Finally we will speculate about the potential differences for working with governance from a CAS perspective compared to working within traditional governance perspectives.

Trends Challenging Governance in Contemporary Society

Scholars have identified five key trends challenging politics and policymaking in contemporary society that are factors in the emergence of new processes of collaboration (Hajer and Wagenaar 2003, Booher 2005). First, new "spaces" are being created for governance. In traditional policy making the political "space" is based upon government institutions in a hierarchy with clear roles and responsibilities. Local fits within regional, regional fits within state, and state fits within national. Each of these levels of government has their areas of authority and responsibility, both geographically and substantively. But increasingly these traditional spaces for political decision-making are being augmented by new spaces that include both collaborations among traditional agencies and institutions outside traditional political institutions. For example many complex policy problems, such as environmental protection and transportation, transcend jurisdictional boundaries. Public agencies find they must collaborate with other public agencies to find solutions to these shared problems in the context of shared power. As we will see, the case of CALFED represented the creation of such a new space.

In a second trend, the complexity of contemporary society has created an increasing sense of uncertainty. To some extent policymaking has always been constrained by uncertainty. However, the failures of traditional government agencies have created a new awareness among the public of the unintended, sometimes perverse consequences of large scale planning and the limits to centralized hierarchical control by government agencies (Scott 1998). Not only is the public uneasy about this uncertainty, but also public officials are more aware of the impact of this uncertainty on the public. Yet policy must be made despite the lack of complete knowledge. In California water policy, uncertainty permeates the decision making environment. CALFED emerged to a great extent because decision makers had become dissatisfied with the ability of existing institutions to deal with this uncertainty.

The third trend is a result of increasing diversity in society. Solving policy problems now requires decision makers to deal with an array of publics with different languages, values, perspectives, cognitive styles, and worldviews. The importance of difference increases the problem of communication and decision-making among the public and for public leaders seeking solutions for complex and controversial policy problems. The diversity of California is well known and in the case of CALFED the diversity of views and values around water have been a central obstacle to forging policy.

The fourth trend is increased awareness of interdependence among policy makers in policymaking. While diversity poses challenges of communication and understanding, interdependence creates the need to overcome these challenges. When publics and public agencies recognize they cannot solve problems alone, because they share the same resource or physical space or because they share the same social or environmental problem, they recognize that a solution will depend on collaboration. If traditional government agencies are unable to produce accepted solutions then other means must be found to create the capacity to interact, share power, and find shared problem definitions with paths to solutions. From before 1994, after stalemate and dialogue, the agencies and

stakeholders in the CALFED process recognized their interdependence and viewed CALFED as a vehicle to manage this interdependence.

Finally, the issue of the dynamics of trust has changed. Trust has always been a factor in politics. For traditional government, trust and confidence by the public originates in the legitimacy of agencies established by law. In the new context though, in which actors must collaborate across institutional boundaries, they can no longer assume trust. If problems can no longer be solved by traditional government practices and the public feels the need to address them, then new practices must be invented. Creating the dynamics of trust for these practices becomes a critical challenge. Policymaking is not simply about finding solutions but also creating processes for collective action and problem solving that generate trust among the actors. In California the long history of adversarial relationships over water had resulted in mistrust among many agencies and many stakeholders. For CALFED success depended on establishing and nurturing trust among them and greater trust was one of the outcomes from their involvement.

Collaborative Planning Practice

Collaborative planning is a broad term encompassing many types of cooperative efforts (Healey 1997, Innes and Booher 1999b, Booher 2005). This paper focuses on processes in which individuals representing differing interests engage in long-term, face-to-face dialogue, seeking agreement on strategy, plans, policies, or actions. The processes are often *ad hoc* and self-organizing. They are sometimes established by government agencies or legislative bodies to deal with what seem to be intractable problems, and sometimes put together by private players frustrated by years or conflict and stalemate, or by loss of a limited, common resource (Ostrom 1990). Processes range in size from a handful of participants to hundreds organized into interlocking groups, each working on different aspects of complex questions. Collaborative planning is summarized here at its purest form as a process that is truly facilitated, as opposed to merely chaired. A professional neutral facilitator or a chair acting as a neutral facilitator can help change normal heuristics for interaction and achieve the ability to have a free-wheeling dialogue. The processes use special meeting management techniques that ensure a civil environment where all can express their interests and become informed, where constructive dialogue can occur despite conflict, and where consensus is the goal (Susskind et al. 1999). Such face-to-face communication allows the sincerity, legitimacy, comprehensibility, and accuracy of statements to be tested, and the inclusion of opposing stakeholders makes it highly likely that assumptions are questioned. We have equated this communicative ideal to communicative rationality as articulated by the philosopher Jurgen Habermas (1984) (Innes 1998). A process of joint fact finding is often used to explore assumptions (McCreary 1999). Notably our research has shown that story telling, role playing, and group intellectual Bricolage are more prevalent forms of discussion and joint reasoning than trade offs and logical argumentation (Innes and Booher 1999b). The techniques discourage the taking of positions, instead following the interest-based model of bargaining (Fisher and Ury 1981).

A number of conditions distinguish ideal collaborative planning from other forms of cooperation:

1. Inclusion of a full range of stakeholders.
2. A task that is meaningful to the participants.
3. Participants who set their own ground rules for behavior, agenda setting, making decisions, and many other topics.
4. A process that begins with mutual understanding of interests and avoids positional bargaining.
5. A dialogue where all are heard and respected and equally able to participate.
6. A self-organizing process unconstrained by conveners in its time or content and which permits the status quo and all assumptions to be questioned.
7. Information that is accessible and fully shared among participants.
8. An understanding that "consensus" is only reached when all interests have been explored and every effort has been made to satisfy these concerns (Innes 2004).

The Research

The data for this article is based upon ten years of research on the CALFED process. It included interviewing numerous participants, observing scores of meetings, and reviewing hundreds of documents (Innes et al. 2006). When the research began we were looking at the phenomenon of collaborative planning practice. It was only recently that we began to see the potential importance of CAS thinking to help understand the dynamics of CALFED and its importance as an emergent form of policy governance. As we mined the data for new insights we embraced the views of many researchers in the field of complexity and organizations that complex adaptive systems are not objective realities that researchers can stand outside of and observe so that they can be modeled, predicted, and in some way controlled (Stacey 2001, Cilliers 2005, Tsoukas 2005). We agree with Stacey that "…we have to give up the notion that we can understand the system by formulating hypotheses and then seeking to disconfirm them. Instead we have to reformulate what we are doing as trying to make more sense of our own and others' experience of organizational life" (Stacey 1996, 262). As we interpreted the data we recognized that meaningful use of CAS in this case depended upon flexible application and translation of complexity concepts (Uden 2005). Our purpose followed from Stacey's argument that "The purpose of the theory and research is then to undertake how conditions might be established within which spontaneous self-organization might occur to produce emergent outcomes" (1996, 264).

To inform our interpretation we used five features of CAS drawing on Stacey (2001), Cilliers (2005), and Tsoukas (2005). We particularly found useful Stacey's argument that it is most productive to focus on the interactions and relationships rather than the "system" as a whole when applying analogies from CAS. The five features we used are:

1. Agents: The system comprises large numbers of individual agents.
2. Interactions: The agents interact dynamically, exchanging information and energy based upon heuristics that organize the interactions locally. Even if specific agents only interact with a few others the effects propagate through the

system. As a result the system has a memory that is not located at a specific place, but is distributed throughout the system.

3. Nonlinearity: The interactions are nonlinear, iterative, recursive, and self referential. There are many direct and non direct feedback loops.
4. System behavior: The system is open, the behavior of the system is determined by the interactions, not the components. Hence the behavior of the system cannot be predicted by examination of the components. Coherent and novel patterns of order emerge.
5. Adaptation: With sufficient diversity the heuristics will evolve, the agents will adapt to each other, and the system can reorganize its internal structure without the intervention of an outside agent.

Water in California and the Origins of CALFED

In California water is perhaps the most deeply contested and most economically important issue. With rain only six months of the year and most of the water stored in the snowpack of the northern Sierra Nevada, a vast infrastructure of dams, channels, levees, and pumping facilities is required to move water to the urban populations and the state's massive agricultural industry. At the center of this water system is the San Francisco Bay-Delta, which funnels Sierra water to more than 22 million people, through a maze of marshes, islands and sloughs the size of Rhode Island. This ecosystem nurtures half of the Pacific flyway and 80% of the state's commercial fisheries. A thousand miles of poorly built and aging levees protects the Bay-Delta and prevents flooding of the city of Sacramento. The Bay-Delta and California's major rivers are also home to endangered species, including important anadromous fish. California's "water wars," which date back more than a century, became even more contentious in the early 1990s after court decisions which essentially required the release of more water into the Delta to protect the environment. Figure 1 shows the basin for the San Francisco Bay-Delta.

Figure 1. The watershed of the Bay-Delta drains much of California.

In a context with more claims on the water than can be met and periodic droughts further limiting supply, state and federal agencies with conflicting mandates for supplying water or protecting the environment could only work at cross purposes. Water suppliers' usual recourse of pressuring Congress or the state legislature was increasingly ineffective as public support for new dams dwindled and their efforts to increase water supply were stymied by environmental lawsuits. Economic growth was jeopardized by the limitations on the supply of water while its unreliability threatened the state's agriculture. The formal governance system of pluralist pressure on legislatures, hierarchical public agencies with narrow and conflicting mandates, and adversarial legalism through the courts offered no opportunity for collective problem solving (Freeman 1997).

CALFED was possible because of the social, political and intellectual capital that stakeholders and public agencies had accrued in the years before through a series of collaborative processes and dialogues, including the San Francisco Estuary Project (Innes and Connick 1999), a policy council set up by the governor, and years of dialogue among the three major stakeholder groups. These dialogues created a favorable interest group configuration (Rieke 1996), in which interests from the north and south, as well from

agriculture and urban water purveyors and from environmental groups, had already created coalitions as they had come to understand that they could not get their needs met working on their own.

In the summer of 1994 federal and state officials, flanked by stakeholders, announced joint state-federal Principles for Agreement to protect Bay-Delta natural resources and provide reliable water supplies. One of the architects of this agreement said it "heralded more water for the environment, less water but more certainty for agricultural and urban users, and a return to state primacy in water-quality decisions" (Rieke 1996, 349). In December the state and federal agencies signed a memorandum of understanding in which they committed to jointly address: 1) substantive and procedural aspects of water quality standard setting; 2) improved coordination of water supply operations with endangered species protection and water quality standard compliance; and 3) development of a long-term solution to fish and wildlife, water supply reliability, flood control, and water quality problems in the Bay-Delta Estuary. This became known as the Bay-Delta Accord, and it laid the foundation for CALFED.

The Structure of CALFED

CALFED operated within the shadow of the existing institutions, that is, within the existing legal framework of environmental protection, water rights, and agency mandates, but not as an agency with its own mandate, procedures or rules. It can be understood as a shadow system at work amidst the traditional system (Stacey 1996). As Stacy has pointed out this has a major implication for management: "…the tremendous importance of the shadow system as the generator of the mess and disorder that are vital if a learning, evolving system is not to be trapped on a local fitness peak" (Stacey 1996, 264). CALFED did things for which there was no official authorization, in ways that were not business as usual. Moreover the CALFED process deeply engaged stakeholders in teams which actually did the work of designing programs and participated directly in water management decisions. Agency heads participated, contributed resources, and even adapted their agencies' activities, but the CALFED process remained for eight years an informal, self-organizing networked system.

Although there were 25 agencies and 35 stakeholder groups participating in the CALFED process, all of these agencies and groups had numerous agents actually participating, including agents working at local and regional levels. An accurate account of the total number of agents is probably impossible because of the fluidity and open nature of the system. However, there were at least hundreds of direct agents and probably thousands of indirect agents. The structure was characterized by the "patching" hierarchy that Kauffman (1995) has articulated. As Stacey has proposed, "patching reduces the number of connections across the whole system and so tends to stabilize it enough to avoid the destructiveness of highly unstable dynamics" (Stacey 2001, 177)

The CALFED process was led by a Policy Group made up of heads of state agencies and high level officials from federal agencies. It was directly accountable to the governor and the U.S. Secretary of the Interior. The group met regularly, presided over by an executive

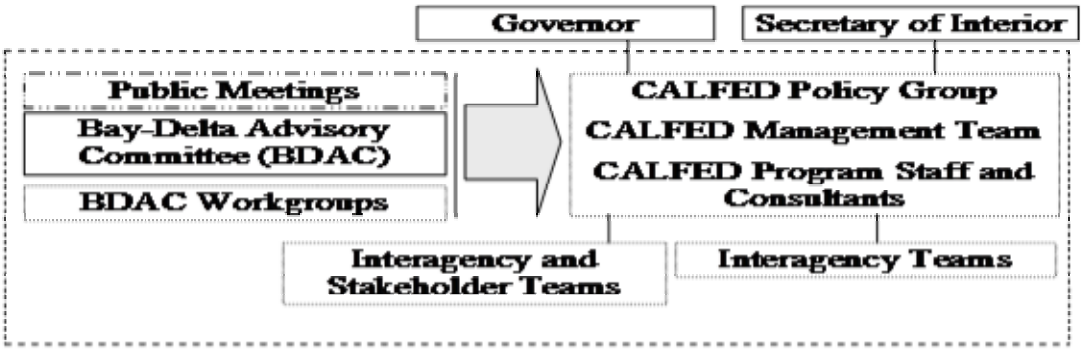
director. The meetings were hours long, closed to the public, and provided the opportunity for agency directors to get to know one another and understand each other's perspectives, worries, and objectives. They built social and political capital among themselves. They built intellectual capital in terms of shared understanding of water management issues and constraints. A Management Team of agency deputy directors turned Policy Group decisions into action.

The CALFED process provided for stakeholder and public involvement in the early years through its Bay-Delta Advisory Council (BDAC), made up of nongovernmental stakeholders drawn from agriculture, environmental justice, business, tribal, and other interests. BDAC became a forum for stakeholders to air concerns. Agencies looked to BDAC, in the words of one participant, as a group where they could "gauge the likely zone of agreement" and "vet proposals [to] find out if you're in the range of a deal." BDAC meetings in different parts of the state also served as a "moving road show" for CALFED to present its ideas to the public, obtain information, and try to win support.

Subcommittees to BDAC did real work that became part of what CALFED did, and they operated in an informal way, relying more on collaborative interactions. These groups focused on a range of tasks including ecosystem restoration, assurances, finance, water use efficiency, water transfers, drinking water, and watersheds. Subcommittee composition depended on the topic, but each committee included a diverse set of knowledgeable stakeholders, experts, and agency personnel.

The CALFED process involved a shifting set of ad hoc task groups, engaging over time hundreds of players and typically building trust and joint learning as well as finding creative solutions to issues or setting direction. These work groups offered forums for ideas to be aired, developed, tested, and improved. The groups created many of the processes and ideas that have carried forward till today. The CALFED structure is roughly depicted in Figure 2.

Figure 2: The CALFED Structure



Making Sense of the CALFED Experience

In this section we will look at the functioning of CALFED. In particular we will look at how CALFED adapted to the existing formal governance requirements in order to pursue a CAS based governance practice. In addition we will describe three of the innovative practices that emerged. These include new norms and heuristics governing interactions (what Stacey has characterized as "local rules") (2001), developing and applying distributed intelligence, and the Environmental Water Account. We will next describe a few of the tangible outcomes so far and consider the continuing challenges.

Adaptations to Requirements of Traditional Governance

Since the CALFED process was a new space created in the shadow of the traditional system, the agents participating in CALFED were faced with how to sustain such a new practice within the limitations of traditional governmental requirements. As Stacy has noted from the perspective of CAS "The key notion here is that of a space for creativity at the operational level, which consists of a psychological state in the shadow system that puts it in tension with the legitimate system" (Stacey 1996, 265). We identified two of the most interesting adaptations the agents evolved. The first of these is a modified approach to planning, and the second is the instrument they created to move to implementation: the Record of Decision (ROD).

Critical to the degree of success that CALFED had was the fact that the agencies began with an agreed-on framework for working together on an agreed-on set of issues. No one had to pre-commit to anything. Moreover they did not set up detailed procedures. They could develop their interactions in their own way, relying on trial and error. The CALFED planning approach can be understood as emerging from a tension between the need to comply with the procedural mandates for agency decision making and the desire to have a long range planning process, using extensive stakeholder involvement, for an extremely complex resource system.

To comply with procedural mandates Phase 1 of CALFED followed standard early steps for linear planning: defining problems; identifying possible actions; and refining them into alternatives for evaluation. This phase produced a mission statement, definition of problem areas and program, identification of critical conflicts, definition of the geographic solution area, articulation of a set of general objectives and solution principles, and three alternatives. In collaborative interactions, however, defining issues takes time and only occurs once agreement begins to emerge on solutions. Much happens simultaneously as agents become aware of the complexities and uncertainties. They needed a package of actions with linkages among them and assurances to all the agents that their interests would be met. This could not be done in a linear way. Stepwise decision making would not assure the balanced outcomes necessary to resolve conflicts over the course of the program. Accordingly the CALFED process moved away from the standard approach in Phase 2 as they jointly looked for a path they could all follow and began taking agreed on actions.

CALFED developed six solution principles in Phase 1 that did provide useful heuristics for further discussion. These were criteria for choosing actions: Solutions should be affordable, equitable, implementable, and durable and they should reduce conflict and not redirect negative impacts. Establishing such principles early on exemplifies the notion of interest based negotiation (Fisher, Ury, and Patton 1991).

In the second adaptation, the collaborative creation of the ROD moved the CALFED process from a planning phase to an implementation one (CALFED Bay-Delta Program 2000). Although the agents used words like "plan" and "blueprint" for the ROD, it was not really a plan or blueprint, but rather a marker of the agreements so far to guide the process. But it had gaps in it and areas that remained unsettled. The idea of a plan was not necessarily compatible with the ongoing collaboration. By contrast a contemporaneous water management project, the Sacramento Area Water Forum, created an agreement and at the same time set up a collaborative "successor effort" to address the emergent challenges it would have in the implementation phase especially as conditions and knowledge changed (Connick 2006).

In keeping with its shadow governance approach CALFED never sought legislative adoption of a plan. State and federal law would however require an environmental impact report before implementation of the ROD actions (though aspects of the ROD were already underway as different partners modified their activities). The ROD came to be embodied in a Programmatic Record of Decision[2] which was approved by the quasi-judicial State Water Resources Control Board and signed by the state Secretary of Resources. This approach was novel. The term "record of decision" normally refers to the findings of the decision making body about the proposed program and not to the program itself. The use of the concept was an ad hoc adaptation of the EIR/EIS process. The ROD did not have the force of law behind it, though it had an understanding among the players that they would jointly implement it. This informality had its advantages in that none of the agencies or stakeholders had to make formal commitments, which might have been politically difficult. They could however follow the ROD in practice. Operating in the shadow system was at the time in most agents' interests.

Innovative CALFED Governance Practices

We identified three important innovations that emerged from the CALFED process. First the agents created new norms and heuristics for governing their interactions, something they came to call "the CALFED way." Second the agents developed a system of distributed intelligence that they used to operate the release of water in California. Third the agents created a new method to provide for environmental use of water while protecting the reliable use of water for agriculture and urban interests.

The CALFED Way

CALFED has transformed norms and heuristics for interactions of those involved in California water management. CALFED staff, participants, and observers refer to "The

CALFED way" as shorthand for the difference between the new way of doing governance and the old. Staff identified seven elements of this contrast depicted in Table 1,[3] to which we have

Table 1: Comparison of Governance Heuristics before CALFED and after

Before CALFED	**After CALFED**
Gridlock and litigation driven process	Collaborative process
Project-by-project decisions	Comprehensive framework with linkages and balancing requirements
Single agency, single purpose projects	Multiple purpose, interagency projects
Centralized decision making	Emphasis on local and regional solutions
Limited public involvement	Extensive public involvement and leadership
Internal agency science; no peer review	Independent science reviews
Limited or no accountability or transparency	Public governing body and planning and tracking systems
Mechanistic decision-making based upon assumptions and mandates	Flexible, adaptive management and learning

added an eighth. The "CALFED way" means, first, that collaboration has largely replaced gridlock and litigation as a form of governance. Secondly instead of each agency making project decisions independently, the ROD is the framework into which all decisions must fit. Participants understand that there must be balance and linkages among projects to keep all stakeholders at the table. Most recognize as well that they need to support the whole package and thus the whole system. The "CALFED way" also involves a shift from single agencies pursuing single-purpose projects, to coordinated multiple-purpose projects which meet several objectives. In the past, grants for projects were offered and administered by separate agencies, each with its own requirements and timelines, but CALFED developed an integrated grant-making process. Another major change is a shift toward more local and regional initiative and problem solving to replace top-down, centralized decisions. CALFED provided technical and fiscal support to regional efforts; conducted statewide grant programs that required regional review; appointed regional coordinators and teams; conducted regional workshops; and integrated regionally developed goals and objectives into CALFED implementation.

CALFED was more open and inclusive of public involvement than its member agencies were, with its many stakeholder teams and open meetings. CALFED also made an effort to improve the quality and accuracy of science used in decision making by establishing its own independent science program. Before CALFED, scientific research for California water policy was conducted solely by internal agency scientists or consultants to the agency. No matter what agency sponsored the study, many regarded the data as untrustworthy. CALFED was also predicated on transparency, opening up the workings of various agencies to each other and to the public. Finally CALFED embraced adaptive management and learning to address the uncertainty, rapid change, conflict and complexity of California's water system.[4]

Developing and Applying Distributed Intelligence

Small work groups played key roles in what became CALFED's system of distributed intelligence and adaptive policy making, as the members linked to agents across the state and brought in up-to-date information from their direct knowledge about conditions and political issues. It exemplified the notion of a networked water space (Medd and Marvin 2005). Four interlinked groups played a central role by collectively providing advice about changes in operations[5] of the water projects, advice which the Policy Group typically followed. These groups were made up of stakeholders and agency staff from around the state. The Operations group (Ops) coordinated operations of the water projects; another evaluated water supply alternatives; a third looked at the effects of water diversions on fisheries, and a fourth was a coordinating team made up of members of the other groups. Members of the groups provided indicators about fish or water levels, which they monitored in their areas. They met by conference call when conditions required and worked together to analyze the implications of the data. They thus operated on a real-time basis, reacting quickly to changing conditions. This is in stark contrast to the traditional governance style, where formal decisions would have to await formal analysis, rule-making, and public comment. Though this process did not follow conventional practice, it had a remarkable degree of legitimacy among stakeholders because they were engaged in it themselves and the effort was so transparent.

The Environmental Water Account

The Environmental Water Account (EWA) also exemplifies collaborative governance and the ways it can provide for adaptive management of a resource. It was born in 2000 in dialogues of Ops and its associated groups and supported by almost all major interests. The state Legislative Analyst's Office (LAO) in 2001 described its understanding of EWA.

> The objective of the program is to acquire water for endangered species protection and recovery and to hold this water in reserve to use when endangered species need it most. The goal is to reduce the likelihood of fishery agencies placing new restrictions on the operations of state and federal water projects that could reduce deliveries to agricultural and urban users.[6]

LAO was not satisfied with EWA's informal approach. Its report contended that EWA should be established by the Legislature. The LAO was working in the traditional governance model: namely everything should be worked out in detail before anything is started. However the Legislature chose to ignore the LAO recommendations and EWA was able to move forward.

One of EWA's original architects emphasizes how it differed from the traditional, formal governance approach.

> EWA creates a water supply for fishery needs without relying on regulatory edicts. Instead, its operators …acquire water for the environment from existing water right holders or from maximizing the use of water project facilities. With this water supply at their disposal water project operators can make timely, critical adjustments in operations to make water available to fulfill the needs of listed species and project contractors while preventing reductions in deliveries due to such adjustments.
>
> EWA … [works] better than fixed prescriptive standards that restrict water project operations for the benefit of several particular listed species. Such an account can share the benefits of wet hydrology and new facilities, allowing both the ecosystem and water users to enjoy improved conditions (Brandt 2002, 427-428).

Setting seasonal pumping restrictions by biological opinion under the Endangered Species Act does not allow for a quick response to constantly changing conditions. Under the earlier regime, only when project operations exceeded official fish take limits did the fishery agencies seek pumping reductions. At that late stage, the required reductions are often substantial, as well as too late to prevent the excess fish take. With EWA water as collateral, the fishery agencies can instead call for early and moderate pumping reductions, which are less problematic for other water users. Thus EWA is anticipatory rather than solely reactive. It involves extensive data gathering and detailed modeling, done in a transparent, inclusive, and collaborative way, which assures buy in from the stakeholders. It uses computer modeling of the water flows and fish impacts, and gaming and simulations among the stakeholder experts to develop and improve the models, as well as to anticipate scenarios. Stakeholders question data and bring new information and insight into the process. Participants share their knowledge and understanding, which in turn become part of the analysis. This is a clear case of joint fact finding (McCreary 1999).

According to an independent review panel,[7] EWA has assured supply reliability to contractors while providing a level of fish protection probably higher than could have been attained by the fixed standards that would have otherwise been applied. The panel found that EWA got agencies and stakeholders to work together in real time collaboration to provide water for fish protection. The report

also said that the ability to make timely, reasonable decisions in the presence of scientific uncertainty had become one of the hallmarks of the program. Importantly too, the panel found that EWA advanced scientific knowledge and that new insights were incorporated into improved models. These insights, in turn, fueled critical and creative thinking and formed a basis for more effective management. The gaming and modeling, the panel found, were valuable in identifying unanticipated consequences of proposed actions and allowing rapid management response. Finally the panel noted that management criteria have grown more complex as it moved away from using a single indicator (usually fish take at the pump, a simple measure which works with a traditional regulatory approach) to looking at multiple, interrelated dynamics of the fish populations.

Tangible Outcomes and Continuing Challenge

By 2004 the CALFED process had produced significant progress in sustainable management of the state's water. It reached agreement on the ROD. Its stakeholders jointly built the public support to raise billions of dollars in state bond issues to support projects and operations, including major ecosystem restoration efforts. CALFED added 500,000 acre-feet to the state's water delivery system, and it maintained or improved some 700 miles of levees. Real-time cooperative management of water operations allowed timely response to changing water and fishery conditions impossible under a traditional governance model. Through EWA the CALFED process has helped assure water supply reliability while protecting fish and it has built knowledge, identified unanticipated consequences, and developed a more nuanced and systemic approach to management than was possible with reliance on a single trigger indicator. It has coordinated agency actions and the agents have evolved new cooperative norms and heuristics. The interactions of the agents have resulted in social, political and intellectual capital among opposing agencies and stakeholders who formerly could not work together. As one CALFED leader noted "we have kept the various factions at the table - they haven't been going to court,"[8]. CALFED has weathered three changes in governors and one in presidents. It has provided a way for stakeholders and agencies to move forward together in the face of continuing conflict, ended policy paralysis, and achieved balance and understanding among most players.

Perhaps the most significant challenge facing CALFED is the tension with the traditional form of governance. In 2003, in an effort to formalize CALFED, the Legislature set up the California Bay-Delta Authority (CBDA). It was to be an oversight body combining public members, key agency directors and, ex officio, legislators. The Policy Group and Management Team ceased to meet. Ironically the new entity did not actually have authority over the agencies, which remained free to fulfill their own mandates. Ironically also, according to some staff, during the first year of CDBA operation preparing for presentations to Authority meetings drained agency attention away from coordination and joint planning it had been doing. The idea of creating a formal oversight structure, in a networked and self-organizing system, is paradoxical since a formal hierarchical authority is a very different concept of governance from CALFED's CAS form of structure based upon collaborative interactions.

The state's Little Hoover Commission in the fall of 2005 reviewed CALFED's governance system. Commissioners and witnesses seemed to agree the CDBA is largely toothless, but disagreed on whether it can be "fixed" with more authority and different membership or whether it should be abolished. Clearly collaboration and cooperative action was considerably greater before CBDA was established than afterward. Some faulted it for not resolving the thorny issue of increasing water storage capacity. Others simply could not make sense of how CALFED works, much less trust the process. For many who looked at this through the lens of traditional governance and authority the "structure" was mystifying. One member of the Commission for example exclaimed: "I have no concept in my mind as to who is running this ship. I don't get it" (Taugher 2005). In the end the Commission recommended that the newly created CBDA be eliminated and a new structure established by the State Legislature to govern CALFED (Little Hoover Commission 2005). While the report was couched in the language of traditional governance, ironically the Commission's proposal looked very much like the structure prior to the establishment of the CBDA. The California Legislature is currently engaged in debate about this new proposal, but it's not clear what, if anything, the Legislature will do.

CALFED as a Collaborative CAS

As we discussed earlier, CALFED's emergence reflected the trends challenging policy and politics in contemporary society. We think it is clear the form and patterns that became the CALFED process took on the features of a CAS listed earlier. In addition, the patterns of interaction that emerged could be characterized as collaborative practice.

Hundreds of self-organizing agents made up CALFED. There was no external legislative direction and no formal traditional governance structure. Instead they organized themselves into a network of patches, many of which were *ad hoc*. These subcommittees in turn were connected through their members to many other groups of interested agents in a distributed networked water space throughout the state (Medd and Marvin 2005). The focus of the process was on the interactions in the many subcommittees and other connected groups.

The agents interacted dynamically, exchanging information and energy. The heuristics they evolved to guide these interactions can be characterized as collaborative. For that reason the CALFED process might be called a collaborative CAS. It had many players working in diverse task groups that linked to each other and to the agencies based upon their perceived interdependence. Its networks extended among agencies and stakeholder groups and into many regions and communities, each with differing knowledge and perspectives. Information flowed both to and from CALFED about regional conditions, needs, priorities, and ideas. These networks provided rapid feedback on how things were working in the field and on new challenges. CALFED interactions functioned as a CAS in considerable part because its process of interaction and selection largely applied the conditions for authentic dialogue in the small groups and in the Policy Group and Management Team. CALFED staff assured diversity on the task groups. Each group had

a clear purpose, but groups were self-organizing and allowed to pursue their work in their own way. They had access to high quality information and could do joint fact-finding among themselves. They could and did challenge assumptions, as the many innovations amply demonstrate. As participants challenged one another, offered one another unfamiliar information, and created shared understandings, they produced new strategies for dealing with thorny issues. Innovation emerges from such free-flowing, networked systems among interdependent agents because it brings diverse ideas into play along with diverse needs. They did not settle on the lowest common denominator solutions, but hammered out packages that dealt with the needs of all the players before sending recommendations forward. Not all groups achieved all of this. Even the least successful did achieve some of the outcomes we outlined in earlier papers on evaluating consensus processes (Innes and Booher 1999a; Connick and Innes 2003) like relationship building and learning, which in turn, built the system's adaptive capacity.

Although there were a myriad of groups engaged in the interactions and not all agents interacted with all other agents, the information propagated through the system, resulting in a memory that was distributed, not located in a specific place. The resulting interactions were nonlinear, iterative, recursive, and self referential, with many feedback loops among the groups.

The system was open. Indeed it is hard to identify a specific boundary to the CALFED process. Its behavior was determined by the interactions and relationships, not the components. As a result the agents did adapt, evolving their interaction heuristics, regularly reorganizing their internal structure by creating new subcommittees and eliminating others, and creating new practices for governance of water.

It is important to recognize that the interactions and the subsequent patterns did not eliminate conflict or remove the constraints of power. However as Stacy has argued power enables as well as constrains (Stacey 2001). While at times conflict and power disrupted the collaborative interactions, as Stacey has also argued "…without such disruptions to current patterns of collaboration and power relations there could be no emergent novelty in communicative interactions and hence no novelty in any form of human action. The reason for saying this is that disruptions generate diversity (and) …the spontaneous emergence of novelty depends upon diversity." (149).The resulting dynamic was one of both stabilizing continuity and transformation, also consistent with Stacey's argument. "Nevertheless, coherence emerges in the vast complexity of communicative interactions across enormous numbers of local situations because of the intrinsic capacity of self-organizing interaction to pattern itself coherently" (2001, 176).

The experience of the CALFED process and other similar processes raises the question of whether policy dynamics characterized by uncertainty, diversity, and interdependence require policy governance systems that take advantage of the features of collaborative CAS.

Collaborative CAS as an Alternative Governance Process

Drawing on the experience of CALFED and the literatures of CAS, collaborative planning, and social network theory (Kickert et al. 1997) offers sufficient information to suggest that a new process for governance is emerging that is in sharp contrast to traditional processes of governance. Understanding these differences can help us understand "how conditions might be established within which spontaneous self-organization might occur to produce emergent outcomes" (Stacey 1996, 264) for shadow systems like CALFED. It seems to us that they differ along at least 14 dimensions as portrayed in Table 2. Traditional governance is characterized by a top down hierarchy under central control with a closed boundary and a single authority. In contrast a collaborative CAS, similar to CALFED, is characterized by interdependent network clusters under distributed control with an open boundary and divided authority.

Table 2. Comparing Traditional Governance and Collaborative CAS Governance

Governance Dimension	Traditional Governance	Collaborative CAS Governance
Structure	Top down hierarchy	Interdependent network clusters
Source of direction	Central control	Distributed control
Boundary condition	Closed	Open
Goals	Clear with defined problems	Various and changing
Organizational context	Single authority	Divided authority
Role of manager	Organization controller	Mediator, process manager
Managerial tasks	Planning & guiding organization processes	Guiding interactions, providing opportunity
Managerial activities	Planning, designing, leading	Selecting agents & resources, influencing conditions
Leadership style	Directive	Generative
Nature of planning	Linear	Nonlinear
Criterion of success	Attainment of goals of formal policy	Realization of collective action
System behavior	Determined by components	Determined by interactions
Democratic legitimacy	Representative democracy	Deliberative democracy

The goals of agencies in traditional governance are ideally clear with defined problems. The goals in a collaborative CAS are various and changing, again similar to CALFED. The management and leadership functions are also different. For traditional governance the manager is an organization controller who plans, designs, and leads in order to guide the organization processes. The best leadership style is believed to be directive. For collaborative CAS the manager is a mediator and process manager who selects agents and resources and influences conditions, in order to guide interactions, and provides opportunities for the agents. The optimal leadership style is generative (Roberts 1997). In

traditional governance planning is linear and the criterion for success is attainment of the goals of policy. In collaborative CAS planning is nonlinear and the criterion of success is the realization of collective action by the agents. Although planning was nonlinear in CALFED, because it functioned in the shadow of traditional governance it was constantly under pressure to establish goals and be judged by their achievement.

Finally in traditional governance the theory of democratic legitimacy that is thought to be appropriate is representative democracy. It may be more appropriate for the legitimacy of collaborative CAS to be founded on deliberative democracy (Richardson 2002). Again because CALFED operated in the shadow of traditional governance there was constant tension between its patterns of interaction and the demands of representative democracy for direction by the Legislature. This was evident, for example, in the proposal by the Legislative Analyst's Office for the EWA to be reviewed and decided by the Legislature.

As we have learned from physical and biological systems, a complex adaptive system is constantly at the edge of chaos. CALFED and similar experiments can help us understand the tensions between traditional and collaborative CAS governance. The experience from the CALFED process indicates a need to think in terms of new processes for governance for controversial, complex, and fast changing issues. Charles Lindblom offers a vision of a self-guiding society in which solutions to problems emerge, not from design or central authority, but from continual reconsideration of problem definitions and mutual adjustment of volitions. In this context there "exists no route to be discovered, only routes [participants] must create." (Lindblom 1990, 302). CALFED exemplifies such a self-guiding system, its agents trying in a turbulent context to create their own shared path to the future.

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NOTES

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2. CALFED Bay-Delta Program, "Programmatic Record of Decision", August 28th 2000. Sacramento California. http://calwater.ca.gov/Archives/GeneralArchive/RecordOfDecision2000.shtml

3. This is adapted from a presentation made by Patrick Wright, former Executive Director of CALFED, at the California Bay-Delta Authority transition workshop in Sacramento CA, July 21, 2003. The last item was added by the authors.

4. See more detail on each of these points in the working paper (Innes, et al. 2006). http://www.csus.edu/ccp/publications/WP-2006-01.pdf

5. These included such things as closing or opening the Cross Delta Channel, changing the pumping at various facilities or releasing water for the environment.

6. Legislative Analyst's Office. "Environmental Water Account: Need for Legislative Definition and Oversight" LAO Report. Sacramento, January 29, 2001.

7. Review of the 2003-04 Environmental Water Account (EWA) submitted by the 2004 EWA Review Panel, submitted 1/17/05.

8. Hearing before the California Little Hoover Commission, October 2005.