Imagining a Complex Adaptive System: A Multi-State Transportation Collaborative

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Abstract: The Interstate 80 (I-80) Corridor System Master Plan (CSMP) study is bringing diverse stakeholders from across California, Nevada, Utah, and Wyoming together for an in-depth dialogue. The ultimate goal of the study is to generate a system that continues advocating for the I-80 corridor communities beyond the study period and the support of the consultant team. This essay explores the experiences of applying complex adaptive system (CAS) properties adopted by the consulting team to support the diversity, interdependence, and authentic dialogue (DIAD) theory of collaborative processes. Specifically, achieving the goal of a perpetuating governance system lies in the potential of generating the dynamics of a CAS among the diverse study stakeholders or agents. Using the properties of CAS as a guide, the consultant support team organized virtual conversation meant to introduce a sense of complexity, such as beginning with an economic analysis and livability principles. Agents cope with the complexity using dialogic tools advanced by collaborative practitioners. Ultimately, by using CAS properties as a guide for the ongoing dialogue, it is hoped that a CAS emerges that can adapt and evolve over time. This approach is informed by the theoretical work of Judith Innes and David Booher as compiled in Planning with Complexity: An Introduction to Collaborative Rationality for Public Policy (Routlegde, 2010).

Given the ongoing nature of the I-80 CSMP study dialogue, I would value guidance with regard to the following elements:

- What quantitative tools could be used to assess the level to which the study stakeholders are emulating a CAS?
- What strategies will integrate this information back into the ongoing study in order to enhance the potentiality of achieving the properties of a CAS and an enduring process among the stakeholders?

Introduction

This essay describes the ongoing purposeful process of infusing complex adaptive systems properties in guiding the organization and execution of a multistate transportation collaborative. Essentially, this essay is a status report. Initially, the essay describes the diversity, interdependence, and authentic dialogue (DIAD) (CCP, 2013) theory-based planning framework. Innes and Booher’s (1999a, 2010) integration of complex adaptive systems (CAS) with DIAD theory of collaborative processes dynamics provide an explanation of success. The essay then describes the typical consultant contracting environment for state departments of transportation influenced by both DIAD theory of collaborative processes and CAS properties. Once contextualized, the nature of social interaction when coping with linear and nonlinear worldviews is described. This discussion is followed by an accounting of the ongoing study organized around CAS properties within the multistate collaborative framework. This includes observations
concerning emerging collaborative dynamics and the existence of CAS properties within the collaborative group. The essay concludes with thoughts on further enhancing the infusion of CAS properties into the I-80 CSMP study process.

**DIAD Theory and CAS**

The following is adapted from Gross (2012) and briefly summarizes the salient aspects of the relationship between DIAD theory of collaborative processes and CAS. Booher and Innes (2002) introduced the DIAD theory of collaborative processes as a way of explaining collaborative planning network dynamics. Booher and Innes were both collaborative practitioners and employed phenomenological and interpretive case studies based on their experiences and others’ experiences in developing their theory. DIAD theory is both a descriptive and a normative theory of collaborative processes. Figure 1 shows the relationship between the theoretical elements of diversity, interdependence, and authentic dialogue. Booher and Innes (2002) emphasized that participants in DIAD theory of collaborative processes are not "selfless altruists" but rather driven by "self-interest and rational choice" (p. 227). It is from this position of self-interest that the three elements of the DIAD theory of collaborative processes are believed to generate beneficial system dynamics.

As illustrated in Figure 1, each participant in a collaborative process acts as an independent agent representing individual diverse interests (Innes & Booher, 1999a, 2010). Diversity introduces the complete spectrum of perspectives about the issues being dealt with. Essentially, diversity provides the building blocks for potential innovation (Innes & Booher, 1999a). As Innes and Booher (2003a, 2004, 2005; see also Booher & Innes, 2002) identified, leaving contrarian, often difficult and typically unrepresented and unorganized, perspectives from the process undermines legitimacy. Further, without the full range of diversity there is little chance local or interpretive knowledge can be balanced against professional expert bureaucratic knowledge (Innes & Booher, 2000, 2004, 2005; Booher & Innes, 2002; Yanow, 2009). Without a diversity of perspectives, authentic dialogue has little chance of achieving emancipatory rationality (Habermas as cited by Booher & Innes, 2002, p. 228). Including all perspectives about issues of interest generates the potential for beneficial deliberative dynamics.

Participants in a collaborative process must have both an interest of gaining something and possessing something of interest to others, an interdependence (Booher & Innes, 2002, p. 229). Again, as Booher and Innes (2002) pointed out, collaborative participants need self-interest in the process and operate under the premise of rational choice. Empirical research on reciprocity and cooperation based on rational choice and game theory established the existence of this dynamic. Specifically, this research suggests that repeated collective action based on self-interest benefits all parties (Booher & Innes, 2002; Innes, Connick, & Booher, 2007). Individual self-interest provides the impetus for engagement.

Capitalizing on the diversity and interdependence of participants in a collaborative process relies on trying to achieve conditions of authentic dialogue among participants. Booher and Innes (2002) argued that generating a dialogue that allows participants to speak openly about their perceptions and interests while other participants listen openly leads to opportunities for shared understanding, reciprocity, actionable
Generating collaborative process dynamics relies on the open atmosphere of authentic dialogue. Booher and Innes (2002) identified four conditions for authentic dialogue: (a) "participants speak with sincerity, accuracy, comprehensibility, and legitimacy" and "they can evaluate each others' statements in these terms"; (b) participants "must be fully and equally informed about the issues and the problems" and often engage in joint fact-finding in order to "assess their own interest and accuracy of other statements"; (c) participants must be able to comprehend each other which often calls for engaging in storytelling and sense making; and (d) participants must have legitimacy for saying what they say and the ability to demonstrate their legitimacy when challenged (p. 230). Further, Booher and Innes (2002) acknowledged that achieving authentic dialogue typically required skilled facilitation that allows participants to learn to listen and generate the deliberative norms required for dialogue.

![Figure 1](http://www.csus.edu/ccp/collaborative/diad.stm)

*Figure 1.* Relationships between diversity, interdependence, and authentic dialogue in the DIAD theory of collaborative processes. Adapted from the Center for Collaborative Policy at [http://www.csus.edu/ccp/collaborative/diad.htm](http://www.csus.edu/ccp/collaborative/diad.htm) in 2013.

Referring again to Figure 1, achieving authentic dialogue generates reciprocity, relationships, learning, and creativity. Shared identities and meanings, new heuristics, and innovation arise from combining diversity, interdependence, and authentic dialogue. Interestingly, earlier work by Innes and Booher (1999a) argued that the complexity of process and outcome dynamics of collaborative processes resembled CASs. Ultimately, the DIAD theory of collaborative processes provides a normative practitioner framework for understanding complex group dynamics.
Context

Recent federal transportation policy and enabling legislation have targeted planning resources and initiatives for multistate corridor planning, principally the interstate system. These efforts are in response to early successes experienced on the Interstate 95 corridor along the east coast during the 1990s. Often these initiatives take on an operational perspective targeting enhance coordination across state and local jurisdictions particularly in the event of severe weather events. Based on the initial success of an Interstate 15 multistate corridor study, the Nevada Department of Transportation (NDOT) published a request for proposals (RFP) to undertake an Interstate 80 corridor system master plan multistate study. The RFP provided a broad scope that invited creative proposals for conducting the multistate study. Our response was to organize a study around the DIAD theory of collaborative processes and properties of CAS in order to potentially accomplish a principal aim of the study. NDOT desired the emergence of an ongoing working partnership among the corridor stakeholders. The other principal aim of the study was to generate a consensus supported list of corridor significant programs, projects, and initiatives for stakeholders to mutually advocate for discretionary funding.

The approach we developed for the proposal advocated for three interrelated strategies. These strategies aimed to promote the environment for the potential emergence of critical network and collaborative governance elements identified by theorists. Foundationally, Hammond & Sanders, (2002) point to the complexity of communication as the potential nexus for the “life giving and system building” energy for self-organization (p. 10). Morçöl (2005) adds that undertaking complex dialogic exposes participants to phenomenological perspectives for generation of knowledge. This exposure “disturbs the Newtonian/positivist belief in the universality and objectivity of scientific knowledge” (p. 15). Challenging global dialogue perturbs local established institutions. In this state, local institutions potentially experience what Meek (2008) identified as a “system-wide effect” leading to “locally driven metropolitan system adaptations” such as “the creation of intermediate (third-party) structures” (p. 416). Kolibas and Zia (2009) recognize the need for self-organizing governance networks, or third-party structure to explore their legitimacy as democratic governments accountably for providing public goods and services. Hibbert & Huxhan’s (2010) caution about the effects of the temporal components of organizations and institutions, in the form of traditions should be accommodated throughout the process. Likely underpinning the entire process is what Ansell and Gash (2008) identified as the practicality of generation of trust principally through “small wins” (p. 543). In a sense, ultimately the effort roughly approximates Giddens’ (1984) restructuration of existing social, intellectual, and political relationships to enhance governance accountability through collaboration.

These fundamental theoretical perspectives were integrated into the proposal strategies in the following manner. The first strategy was to introduce a geographic information system (GIS)-based platform for compiling existing information for consideration by corridor stakeholders. This provided the group with the means to access high-quality information and collectively validated for any potential decision-making processes. The second similar strategy was to advocate for developing a web-based working environment to support collaborative dialogues undertaken and provide a
common location for study resources. The third strategy advanced the need for multiple, scalable, and adaptable forums for stakeholder dialogue. The proposal described the rationale for relationships between these study strategies. However, less attention was paid to the typical rigorous requirements for a detailed schedule, study milestones, and deliverables. Specifically, these three strategies were organized to facilitate authentic dialogue of DIAD theory of collaborative process. Arguably these three study elements could provide for Habermas’ (1984) ideal speech conditions: legitimacy, sincerity, veracity, and comprehensibility. Additional proposal strategies targeted broad stakeholder recruitment, for diversity and a focus on Sustainable Communities (http://www.sustainablecommunities.gov/aboutUs.html#2) six livability principles, for interdependence. The six livability principles provide comprehensive concepts that cross traditional planning domains forcing the consideration of interdependencies.

**Coping with Complexity in a Linear Paradigm**

This discussion focuses on the linguistic shift that occurred among the study’s leadership teams through the contract negotiation, study startup, and initial stakeholder engagements. These linguistic shifts demonstrate the viability of CAS language as an organizing metaphor. Our basis for this linguistic shift lies in Axelrod’s (1984; 1997) foundational demonstration that cooperation is the natural state for social interaction over time. This realization provides the chink in the armor of what Yanow (2009) labels “the language of certainty” (p. 579). Thomson, Perry, & Miller (2009) further demonstrate through a statistical model that the collaboration mutuality, cooperation dimension may be on par with the dimensions of governance, administration, autonomy, and trust norms. This implies the need to be linguistically consistent across all elements of the study process. Yanow (2009) further identifies linguistics as the center of a reflective practice focusing on the “language of inquiry” (p. 579). Finally, Chettiparamb (2006) connects the use of metaphors, specifically CAS metaphors as the nexus for theory transfer throughout the study process. The practical application of this linguistic approach emerged with an emphasis on study process, the value of potentially conflicting perspectives, organizing groups based on their topical dialogue, and emphasizing the uncertainty of potential outcomes among others.

**Introducing CAS Properties into a Collaborative Planning Process**

collaborative participants in recognizing their interest instead of focusing on their stated positions. This opens the space for mutual gains solutions. Other practitioner resources are incorporated situationally to accommodate emerging group dynamics. The following discussion assesses CAS properties as they are introduced and integrated into I-80 CSMP study based on the DIAD theory of collaborative processes.

**Agents**

Agents represent individual actors within the system connected to multiple networks (Innes & Booher, 2010). In this collaborative dialogue, agents are comprised of individual representatives for the different parties involved with the study. Plowman, et al (2007) as well as Boal and Schultz (2007) provide a salient representation for the role the consultants are taking in the collaborative process. Specifically, we operate as enablers that “disrupt existing patterns of behavior, encourage novelty, and make sense of emerging events for others” (Plowman, et al, 2007, p. 341). This approach is similar to Yanow’s (2009) language of inquiry. All other parties, agents in the I-80 CSMP study engaging in collaborative dialogue operating independently. Further, they are encouraged to represent both personal and organizational perspectives across multiple dialogues. Individual agents engage at multiple scales within the study such as in working groups and task forces explained below.

**Interactions**

Innes and Booher (2010) explain interaction as the dynamic exchanging of information between agents through multiple local interactions thus allowing even small group interactions to propagate through the system. Again, the quality of this information exchange relies on Habermas’ (1984) ideal speech conditions of sincerity, veracity, comprehensibility, and legitimacy. As Mennin (2007) argues, these interactions are the basis for small-group problem-based learning. The collaborative process is organized with large and small group processes. Large group processes are undertaken by the Partner States, Planning, Technical, Implementation, and Joint Task Forces. These groups interact through conference call presentations and feedback loops such as brief web-based surveys. The small group processes are undertaken in the form of 13 different working group dialogues with topics such as alternative energy infrastructure, tourism, freight and logistics, truck parking, and wildlife crossings. The specific topics emerged from the initial dialogue of the task forces. Each working group is self-organizing with the facilitation of a consultant chair and NDOT co-chair for establishing institutional traditions. The results of working group dialogues will be presented to the various task forces for broad consideration. It is expected that concepts from various working groups will be refined into study initiatives at the task force level. With these interactions propagating across the system, the collective distributed memory is expected to emerge within the system. Ultimate the properties of a CAS are envisioned to emerge from these extensive interactions.

**Nonlinearity**

The system generates multiple feedback loops, both direct and indirect. These feedback loops produce iterative, nonlinear, and self-referential interactions (Innes & Booher, 2010). I-80 stakeholders are engaged in formal and informal feedback
mechanisms including electronic surveying, email exchanges, and informal one-on-one conversations. Working group dialogues are goal driven without prescriptive schedules or deliverables. The intent with this approach is that the group's collective sense-making will invoke nonlinear thinking among group members while encouraging them to recognize their “ah ha” moments. This approach to reflective practice is meant to reinforce the need for self-organization and enhance the potential emergence of innovations (Gross, 2012; Rhodes & Murray, 2007).

**System behavior**

Systems cannot be understood by observing component parts sense system behavior is determined by interactions between components operating in an open environment. Order coherence is understood at the system level to the degree a systems boundaries are understood (Innes & Booher, 2010). Participating in this multistate collaborative planning study is open to all individuals who legitimately represent a corridor stakeholder broadly defined. Wagenaar’s (2007) study of community dynamics using a CAS framework provides guidance on how to think about the relationship between component part and the overall system. In particular, paying attention participant interactions and contemplating strategies for harnessing the inherent complexity (p. 17). Gross’ (2012) use of an interpretive framework comprised of CAS, dialogic, and subjectivity theory provides potential for gaining insights to system dynamics.

**Robustness and adaptation**

A CAS has the ability to continue operating at the edge of chaos because of the ability to evolve as agents adapt to each other and reorganize the system's internal organization (Innes & Booher, 2010). Early indications for the I-80 corridor stakeholders as they continue to organize their dialogues indicate these CAS properties may potentially emerge. Just as with DIAD theory of collaborative process, these CAS properties will likely only be identified in the future as the systems continues to emerge.

**A Request for Intellectual Feedback**

Early signs indicate positive potential for the purposeful process of infusing complex adaptive systems properties into a multistate transportation collaborative as a guiding organizational concept. This essay brief described the context and overall framework for how CAS properties are considered in organizing the social interactions of this DIAD theory-based collaborative process. The initial organizational efforts have facilitated the experiential learning of the consulting team’s working group chair. This learning includes the generation of a certain level of comfort with uncertainty and the lack of a sense of control: both challenges for engineering and planning professions. The process is currently accelerating the frequency and diversity of dialogic elements through the 13 working groups and weekly update podcast. This effort would benefit greatly from the collective intellect of the COMPACT community.
REFERENCES


