

**Leadership in a Network of Communities:
A Phenomenographic Study**

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Abstract:

Purpose

Canada's Chemical, Biological, Radiological, and Nuclear (CBRN) Research and Technology Initiative (CRTI) uses an operating model that is unusual in government. It was created to enable cross-boundary capability and capacity building and learning. Some consider it a model for other federal science initiatives. This study explored the nature of leadership—and its relationship to perceived effectiveness—in this complex network of counter-terrorism communities, where parts of the network were functioning better than others. At a more academic level it explored whether complexity theory can inform leadership theory.

Design/methodology/approach

This qualitative, empirical study uses phenomenography and elements of ethnography as methodologies. Data were gathered through interviews and observation.

Findings

CRTI personnel referred to their initiative as a counter-terrorism network of communities. The leader of each community worked—without positional authority—with participants from many organizations and locations. The study revealed qualitatively different ways of understanding leadership. Even though CRTI groups had much in common, participants' ways of understanding that work varied greatly. Some understood their work environments as complex systems rather than as traditional government structures; this way of understanding was associated with perceptions of effectiveness. This finding can change the ways in which science and technology professionals make sense of their work in complex, trans-disciplinary fields such as counter-terrorism and global warming.

Originality/value

This qualitative, empirical research complements and supports some of the conceptual work about leadership and learning in complex environments.

Keywords

Communities of practice, Networks, Leadership, Learning, Complex systems, Phenomenography.

Paper type

Research paper

1.0 Introduction and Overview

Traditional, vertical structures are often ill-equipped to deal with rapid change. The September 11 terrorist attacks highlighted gaps in North American counter-terrorism capacity. New approaches to learning and innovation were needed, so the Canadian government launched an innovative *network of communities*: the Chemical, Biological, Radiological, and Nuclear (CBRN) Research and Technology Initiative (CRTI). This discipline and organization-spanning network moved well ahead of other countries in its first months of life. However, some communities seemed to be learning and progressing more effectively than others.

Susan McIntyre—who led knowledge management programs in the CRTI Secretariat—initiated this research. The study was to deepen understanding of the network by exploring participant perspectives of their work, leadership and effectiveness. Managers in CRTI and the larger Defence Research and Development Canada (DRDC) Centre for Security Science reported that this study helped them reflect through a complexity lens on their interventions, and influenced their leadership-related decisions.

1.1 The Case Study

In the spring of 2002, Canada's federal government established CRTI as a co-ordinating mechanism for building scientific and technological counter-terrorism capacity and capability. CRTI communities can access funds through a proposal process. The Canadian government sponsors an annual symposium, with presentations by organizations such as the Royal Canadian Mounted Police, Agriculture Canada and Homeland Security. Learning and progress within CRTI can help all linked organizations if they are willing and able to learn from the network.

CRTI communities, which focus on *chemical, biological, radiological-nuclear, and forensic* themes, are sometimes referred to as *clusters* or *communities of practice (CoP)*. The CoP concept emerged from learning theory work by Etienne Wenger and anthropologist Jean Lave (1991, , 1998) at the Xerox Palo Alto Research Centre. CoPs have been used to increase profitability, efficiency or effectiveness. They differ from workplace groups, such as teams, in that they are self-governing and focus primarily on learning. Because of their voluntary nature and connections to different organizations, communities are *structurally and functionally complex*, as described in a framework by Richardson (2005). CRTI community leaders function *without positional authority*.

1.2 Theoretical Context

In contrast with stability-producing practices of management, leadership results in change (Kotter, 2001). Leadership theories can be clustered in themes such as transformative, transactional, charismatic and contingency. These entity-focused models often assume that leadership comes from individual leaders with positional authority. Where relationships are emphasized, they still focus on individuals (Uhl-Bien, 2006). Researchers have provided overviews of entity-oriented leadership literature (e.g., Yukl, 1988, Schneider and Somers, 2006, Osborn et al., 2002, Alimo-Metcalfe and Alban-Metcalfe, 2005). As a whole, these models have been characterized as “products of top-down, bureaucratic paradigms” (Uhl-Bien et al., 2007).

Driven by at least four factors, scientists and practitioners are becoming interested in the application of new sciences—such as complexity theory—to organizations. First, a knowledge economy is different than the mechanistic industrial economy, where bureaucratic paradigms evolved. Mintzberg (1999) and Wenger point out that government hierarchies are not designed for trans-disciplinary problem-solving, so we need “knowledge-based, boundary-crossing

structures...to complement formal agency and program structures” (Snyder and Wenger, 2003). Secondly, tools such as multi-year plans are not well suited to complex environments, where apparently clarity is simply a snapshot of interactions amongst sample entities (Allen et al., 2005). Thirdly, diversity, interaction and exchange are important in complex environments (Michaels, 2002, Cilliers, 2005). Finally, organizations can be viewed as interacting entities within larger, complex societal systems. Rousseau and Rivero (2003) contrast the expansion of democracies in political realms with limited democratic practices in organizations. CRTI is part of a larger counter-terrorism network; in this complex collective, all the entities have potential to influence each other.

CRTI work is complex. Communities deal with the likelihood, location and nature of potential terrorist attacks as well as complexities associated with their boundary-crossing nature. Complex system elements interact dynamically in nonlinear ways, making predictions difficult or impossible. They exhibit emergence, and can adapt or reorganize without outside interventions (Cilliers, 2005).

We can learn more about the application of complexity through conversations between complexity and organization specialists and work with science, metaphor, or thoughtful combinations of the two (Allen et al., 2005, Axelrod and Cohen, 2000, Petzinger, 2002, Lissack and Rivkin, 2002, Stacey, 2003). Knowledge management and organizational learning are fields in which such conversations can occur, because work with the social nature of knowledge is more complex than work with data or information. Although literature about complexity and public sector work is growing, especially for the military (e.g., Schmitt, 1997, Beyerchen, 1997, Gaden, 2005, Perino, 2001, Rosenau, 1997, Saperstein, 1997, Bar-Yam, 2004) and health care (e.g., Harte, 2002, Zimmerman et al., 1998, Stacey, 2003, Bar-Yam, 2004, Olson et al., 2001), few departments embrace complexity theory.

Many complexity papers are conceptual in nature (e.g., Uhl-Bien, 2006, Hazy, 2006) and suggest that complex work requires new perspectives and practices (Kurtz and Snowden, 2003, Wheatley, 1999, Kelly and Allison, 1999, Allen et al., 2005, Drath, 2003, Uhl-Bien et al., 2007). For example, Michaels (2002) and McKelvey (2002) write that vision and alignment can be dangerous as they compromise critical diversity which Michaels describes as “a measure of complexity and adaptability” (2002). If we envision organizations as organic systems, these perspectives make sense. The hybrid vigour we prize in plants comes from diversity and redundancy at a genetic level (Blumberg, 2002). Ecological systems containing thousands of species are more resilient than simple ecosystems. However, downplaying vision, encouraging diversity, and valuing redundancy contradict deeply embedded management practices. This may be why managers hesitate to explore a frontier that could enhance effectiveness. “Major shifts in thinking can be frightening, and people sometimes respond by applying familiar solutions more frantically” (Wheatley, 1999).

1.3 Rationale for this Study

Few empirical studies have explored leadership in complex environments such as communities of practice. Susan McIntyre approached me because of my work with leadership, complexity and knowledge management; we agreed to deepen understanding of CRTI through a qualitative study, which relates to Plowman’s exploration of how leaders enable emergent, self-organization (2007). However, the CRTI research was designed to avoid conflation of leadership and leaders as it explored ways in which community participants understood their work. Using those perceptions as data, analysis sought out potential relationships amongst concepts from complexity theory and leadership effectiveness.

2.0 Approach and Methodology

This study uses phenomenography: a methodology that reveals qualitatively different ways of understanding phenomena, often with the goal of improvement. It is qualitative, descriptive, and fits within the naturalistic frame of a “third discipline” approach appropriate for study of complex systems (Schneider and Somers, 2006). Phenomenography emerged in Swedish education studies through the work of Marton, Säljö, Dahlgren and Svensson (Bowden and Walsh, 2000), and has since been used in many countries (Bowden and Walsh, 2000 Chapter 1) and fields. The way of experiencing a phenomenon is the typical unit of analysis (Marton and Booth, 1997).

2.1 Participant Selection

Data were gathered through observation and interviews with 14 of approximately 125 CRTI members. CoP boundaries are fuzzy (Wenger et al., 2002) making it impossible to know exact membership. Saturation in phenomenography usually requires 15-20 participants (Wagner, 2006); Sandberg’s findings of how workers understood competence at Volvo became repetitive after 15 (2000). Researchers do not seek *representative* samples; they look for potentially varied perspectives and conclude there is *at least* as much variation as revealed through the study.

Participants were recruited through three methods. Susan McIntyre provided a list of potential participants and encouraged volunteers at the annual CRTI symposium near Ottawa, Canada; CRTI members suggested additional participants.

2.2 Data Collection and Transcription

The 14 participants from four communities included a named leader from each, males, females, Francophones, Anglophones, and individuals from at least three provinces, two jurisdictions and seven organizations. Almost all considered themselves scientists, with a few years to decades of experience. Most worked as senior managers, sometimes leading their area of specialization nationally or internationally.

Semi-structured interviews were 25 to 90 minutes in length, with open-ended questions such as: *Could you describe a story or two that shows the very best of how your group moves forward?* Participants were given 14 lines (spectrums) drawn on landscape-format paper with a statement—shown in Table 1—at each end, or at each point of a triangle. Participants marked each spectrum to indicate where their community was now, and explained their thinking. Later, they marked and described a desired future.

[Insert Table 1 about here]

Some reactions would not be obvious in transcripts. For example, one person who sounded thrilled said *The work is certainly challenging*; another used the same words while staring downwards and shaking his head. Such situations were probed to enrich transcripts.

The researcher transcribed interviews; participants approved them and granted permission for direct quotes. Additional research journal data included notes from direct observations, reflections, links to theoretical material, and rationale about choices. Names are pseudonyms, with gender sometimes disguised.

2.3 Data Analysis

Atlas.ti™ software was used for analysis. Multiple coding passes captured administrative elements, links to interview questions, identified research themes, emotion, elements of a knowledge management model (described in MacGillivray, 2009) and emergent themes.

Descriptive statistics from spectrum questions aided pattern-detection. If participants assertively chose an end of a spectrum, it was coded 1 or 5. Firm responses such as ‘*we’re right in the middle*’ were 3. Comments such as ‘*we lean in this direction...*’ were 2 or 4. The most negative combined total for the satisfaction and effectiveness questions was 2 and the most positive 10. The fourth type of response was coded *contextualized* without numbers: ‘*In situation X we need to be over here, but when we are doing Y, we move over to this approach because...*’ Descriptive statistics were used for other analyses, such as the percentage of each participant’s emotion-coded statements that were positive.

2.4 Confidentiality and Related Limitation

Phenomenography typically includes participant profiles; profiling was omitted to strengthen confidentiality.

2.5 Ethics and Biases

The Institutional Review Board of Fielding Graduate University approved the design for research with human subjects.

Because participants worked in senior government positions, I expected their training would encourage perspectives more typical of work in predictable systems.

2.6 Quality and Verification

This research included verification strategies recommended by Creswell (2003) including review of interview notes within 12 hours, reflection on coherence between interview data and field notes, attempts to surface and relay biases, peer-debriefing to explore conclusions, review of transcripts by participants and presentation of findings to the Secretariat, noting their comments that findings were illuminating, helpful and coherent with their experiences.

3.0 Findings

This section describes participants, units of analysis, categorization, and findings from two communities, which do not contradict findings from the other two.

3.1 *A Brief Description of Network Members:*

The following are consolidated research journal notes.

I note that some people are fortunate—or skilled—enough to transform their home positions so that their work is primarily CRTI-oriented. Many are acutely aware of the voluntary nature of CRTI, and how important it is to make CRTI activity compelling and valuable. I hear worries about the future. Some feel pulled in two directions; some feel unworthy doing pioneering work amongst international experts.

I listen to four men from agencies rooted in standard operating procedures. Each wrestles with cultural changes they consider important. One will retire soon; he talks about the need for an open mind, province-wide perspective and integrative thinking. He is drawn to these ways of viewing the world, but others in his agency are not; he is worried no one will replace him. Another has the physique and presence of an enforcer, yet uses metaphors from nature to describe the need for connections across jurisdictions, and resilience in the face of change. Another wrestles with how to express a concern respectfully: he thinks the time-consuming risk assessment tool used by his community leader has inherent risks, saying “I find it *very* improbable that one could speculate accurately and precisely to cover all situations.” The fourth describes the dangers of mechanistic metaphors; they drive organizations towards a standard operating procedure for absolutely everything, which isn’t the way to work in this field.

When prodded, all acknowledge they have helped to move things forward, yet they say leadership happens around them, not by them. Perhaps humility and a complexity-orientation keep them from calling themselves leaders?

3.2 Building Community Profiles

The analysis deliberately explored ways of understanding three themes: *leadership*, *complexity* and *knowledge management* (knowledge generation, sharing and mobilization). A fourth theme of *boundaries* emerged through analysis. Management texts do not emphasize boundaries, but complexity theorists do. Cilliers highlights complex systems as *open* systems (2005). Richardson (2001, Richardson and Lissack, 2001) describes boundaries as social constructs, which map to temporary complex system boundaries with varying degrees of accuracy, and describes boundaries' influence on thought and action. Midgley (2000) emphasizes ethical implications of boundary choices. This paper focuses on leadership and complexity; the knowledge and boundary themes are described elsewhere (2009, MacGillivray, Forthcoming (2009)).

Initial analysis revealed ways of understanding, independent of participants. Individuals almost always identified strongly with one category per theme. If individuals spanned categories, findings reflect their dominant category.

Building on individuals' associations with categories, community patterns emerged. The most useful analysis for CRTI explored relationships between community patterns and levels of perceived effectiveness.

Qualitatively different ways of understanding are shown in Table 2, with category labels drawn from interviews.

[Insert Table 2 about here]

Categories on the left show coherence with complexity theory; those on the right with traditional management practices. A complex (*connecting*) view fits with permeability of boundaries (*integrating*). Knowledge is more of a flow than a thing, ideally moving through multiple boundaries. In a complex, unpredictable environment without clear boundaries and with *free-flowing* knowledge, leadership was often seen as multifaceted and distributed.

The four communities were more independent than one would expect in “a network of communities.” Each was oriented to complex/connecting ways of understanding their work (see Community 3) or to ordered/focused ways (Community 1). Category 1 participants spoke about strengthened boundaries to protect organizational mandates. Category 3 perspectives often incorporated different approaches in different situations.

[Insert Tables 3 and 4 about here with legend]

3.3 Differences across Categories

The complexity theme illustrates differences across categories. The categorized ways of understanding complexity are *connecting*, *reassessing* and *focusing*. Descriptors and sample quotes are shown below, with more detail about connecting and focusing.

3.3.1 Connecting:

Participants acknowledged the unpredictable nature of their work and

- wanted their community to be very ecosystem-like, or more ecosystem-like and less like a well-oiled machine than at present;
- wanted their group to be fluid and resilient—rather than solid and stable—for at least some specific aspects of their work; they often shared contextualized responses;

- responded to at least one other question derived from complexity literature with responses that suggested value in treating the communities as complex systems.

The following participant comments reflect the connecting category:

Barry talks about why the CRTI communities should be ecosystem-like: “An ecosystem reacts to changes in circumstances and environment. And if the environment changes...as threats emerge, or they back off, you really want to be towards this [gesturing to ecosystem end of spectrum] where you’re reacting, you’re evolving. It’s an evolution... it truly is.”

Ken and Brenda described unexpected surprises from expanded social networks that build within and beyond communities. Martin spoke about community membership as a passport for new relationships.

3.3.2 Reassessing:

These participants struggled with tensions between complex and ordered perspectives. Stan described himself as cautious and analytical, yet acknowledged that CRTI work needs spontaneity. He enabled conversations, not knowing “where we’re going to be this time next year.” He contrasted his analytical nature with front-line realities: “Where we have a dirty bomb, or we might have a biological event or a chemical event you can’t be too structured in your approaches. You have to be open to a wide variety of options, consider a wide number of things. Thinking on your feet is probably the best way to say it.”

3.3.3 Focusing:

These participants:

- did not want their community to be very ecosystem-like, and sometimes wanted it to be less ecosystem-like and more like a well-oiled machine than they think it is at present;
- wanted a strong emphasis on a clear vision and milestones;
- responded to at least one other complexity question with responses that suggested they did not see value in treating the communities as complex systems.

In contrast to complex system approaches such as Kurtz and Snowden's probe-sense-respond model (2003), formal leader Jordan referenced legislation, precedents and long-established norms in government, with statements such as: "We're federal departments: we can't just try things out and see what happens." When members suggested projects, Jordan sometimes provided feedback such as "But isn't that PSEPC's responsibility or mandate?" Jordan worked to achieve alignment: another example of good practice in government, not recommended by complexity authors (McKelvey, 2002, Lissack, 2002, Michaels, 2002).

Gord revealed *focusing* perspectives through his descriptions of emergent phenomena: "letting the agenda topic *run off*," and "the leadership we have isn't *completely scattered*...we *allow* cluster members to assume sub-leadership."

Some participants in all categories assumed complexity-oriented statements were negative. In reference to taking time to learn from a diverse membership, one participant emphatically stated: "I think it's positive; I'm not thinking it's a negative thing." Some read questions aloud, replacing relatively neutral words with negative ones, such as *wasting* time as opposed to *spending* time.

3.4. Perceived Effectiveness

Perceptions of effectiveness were categorized as *mutual benefit*, *shared opportunity* and *difficult*. Variation manifested in the affective domain, from excitement through frustration. Success stories sometimes included evidence of external measures such as international recognition, publishing and awards.

All members of Community 3 were in the *mutual benefit* category at the positive extreme.

- They had effectiveness indicators of 9 or 10, with an average of 10.
- More than 50% (average 65%) of all statements coded by emotion were positive.
- They described specific, achieved benefits for themselves personally and professionally, their community, organizations, government, country and international groups.

All members of Community 1 were at the negative extreme in the difficult category.

- They had effectiveness indicators < 8 with an average of 5;
- Fewer than 25% (average 18%) of all statements coded by emotion were positive.
- They saw benefits and value, but were struggling more than the other communities with cost/benefit ratios, identity, direction, communication, support from home organizations, personal effectiveness in the community setting, and how to manage workload.

3.5 Differences across Communities

3.5.1 Community 1

Tables 3 and 4 show very different community profiles.

The Community 1 leader rarely acknowledged uncertainties in CRTI work and employed traditional good practices such as a clear vision and milestones, alignment, emphasis on doing over learning, having an accountable leader and respecting organizational “turf”. Community conversations focused on common ground. Participants’ having very different ideas about

direction was discouraged. Approaches were cautious: trying things out (as long as they were safe) to see what might happen was not an option. Participants did not feel satisfied or effective in relation to CRTI potential.

3.5.2 *Community 3*

Community 3 provided a rare opportunity to work with a complexity orientation.

The Community 3 leader acknowledged uncertainty and emergence in CRTI work., using tools like milestones and agendas sparingly. In contrast with his home position, he employed his growing knowledge of CoP literature: “In this situation, the model that has to work is the communities of practice model, simply because I don't have the line management authority to say *go do this*. And neither does anyone else in CRTI.” When asked: “Do you think it would work any better if you did?” He replies: “No to be quite honest with you. I don't think it necessarily would work better. Because, like the scope [he stretches his arms to gesture breadth] you want to be across these sorts of things...the communities of practice model is good.” Most of his spectrum question responses were contextualized with concrete examples. Where he was definitive, his ideas were coherent with a complexity lens: bringing out diversity and stimulating conversation about new ideas and content.

This community was not as homogeneous in ways of understanding as was Community 1 (see Tables 3 and 4). This may relate to the community leader's support of diversity. For example, he had a firm idea about where his work sat in the prevention-through-mitigation spectrum. This differed from some members' views, yet he praised the exciting work they did outside his description of scope. He also modeled diversity through his shifting roles (as a line manager, entrepreneur, participant in international networks, community leader, and so on) in order to get through barriers. Part of his focus on making connections was an implicit assumption that

connections would lead to independently initiated high-quality work. He described how hearing nothing in a hierarchy is usually bad news and how the opposite is true in his community: silence indicates activity.

My use of the term *leader* is convenient but misleading. He lacked positional authority, enabled leadership because he could see connections others might not, and was adamant that leadership was distributed throughout the community. This wasn't false modesty; he provided unsolicited, concrete, examples of leadership that built knowledge, capacity and capability. Although his role might be seen as having elements of servant or transformational leadership, there was a more systemic and holistic emphasis on potentially constructive connections, conversations and relationships within and across open systems. He referred to this as *cross-pollination*, the label for the complexity-oriented leadership category. Paradoxically, this leader was as adamant that leadership came from the community as the members were that leadership came from him. Members implicitly acknowledged their leadership when prodded. Brenda described early exercises where her areas of interest were excluded. So she “threw in” a chaotic twist, which helped—along with other work—to push the community into “more complex scenarios.” But she insisted that the formal leader not only had the label, but was “encompassing” and “inclusive of ideas.” She glanced at her computer screen with a smile saying she may be have been slanted that day because “he just sent a supportive note.”

3.6 Three Layers of Leadership: Founding, Nominal and Functional

Unsolicited stories about founding leaders' creation of CRTI described big challenges without obvious solutions, openness to new ideas, established human connections, trust and the creation of new relationships.

Secondly, participants felt they had to mention official community leaders. Sometimes—as with Brenda’s story—they described connections between those persons and *leadership*.

A third, functional level of leadership focused on progress, involving respect, connections, conversations and collaborations. Knowledge of each discipline was important. Behaviours included questioning, injecting energy and passion, and interacting without a leader/follower hierarchy. These fit with Cilliers’ description of complex system attributes: “Since the nature of a complex organization is determined by the interaction between its members, relationships are vital...Complex organizations are open systems...energy and information flow through them...” (2005). Authentic motives were important, as reflected in Lloyd’s statement: “My personal belief from my involvement in science has been that one of the fastest ways to get new ideas to the forefront is to have lots of interaction with people. And to generate lots of ideas.”

4.0 Discussion and Conclusions

From a practical perspective, the intent of this study was to explore why parts of CRTI work were more successful than others by exploring participants’ perspectives. Based on feedback from the CRTI Secretariat—this has been successful: more is understood about different ways of understanding CRTI work, how they are illuminated by complexity theory and how they relate to different levels of satisfaction and effectiveness.

4.1 Theoretical Implications

The study was also an empirical exploration of leadership and complexity. Leadership literature often assumes that individual leaders (entities) motivate others to move towards a predictable future. Complexity literature emphasizes relationships over entities. Leadership-

complexity links have been explored conceptually by authors including Marion (2001), McKelvey (2002), Drath (2003), Uhl-Bien (2006, Uhl-Bien et al., 2007) and Snowden (2007). However, few authors have done empirical work such as Regine and Lewin's (2000) or Plowman's (2007) exploring links between emerging theory and practice. Continued qualitative research could reveal richness needed beyond "cross-sectional survey data using limited measures" (Uhl-Bien, 2006) to enhance theory.

The study's most important conclusion is that in CRTI, comprehensive, distributed leadership approaches coherent with complexity thinking were associated with higher levels of perceived individual and collective effectiveness than were approaches associated with traditional good practice. This conclusion supports some conceptual literature. Just as it is difficult to adopt the idea of leadership as influence rather than control (Marion and Uhl-Bien, 2001), it is difficult to reconsider leader-as-individual and leader-follower paradigms (Gronn, 2002). Almost all the *implicit* examples of leadership in this study focused on relationships, interactions and emergence. And yet most *explicit* comments about leadership by participants were about named leaders. Is this evidence of mental models and language lagging behind practice, or something else?

The terms complex leadership (Marion and Uhl-Bien, 2001) and complex leader (Plowman et al., 2007) don't fit neatly with these findings. Some participants shifted approaches depending on the complexity of the situation; "complex leader" can imply an emphasis on intrapersonal characteristics, or imply that organizations have complex leaders *or* other types of leaders, marginalizing important questions of situational assessment. This study revealed examples of multi-faceted relationship-building beyond the leader-follower construct described as limited by Uhl-Bien (2006) and that fit with elements of Marion and Uhl-Bien's work (2001). For example, Martin learned from cross-connections between his international search and rescue work and CRTI. Networks provided fitness in participating systems as illustrated by participants saying

the R&D work had “all but disappeared” in their organizations, and results of CRTI work were perceived as extremely valuable. The Community 3 leader catalyzed “bottom-up network construction” providing encouragement, connections and space in which to learn and collaborate. Brenda’s example of injecting an exercise with chaotic elements exemplifies the creation of “organized disorder” (Marion and Uhl-Bien, 2001 citing Regine & Lewin). The sole Community 1 member who had a complexity orientation shared an example of thinking systemically. He valued his reputation as an international expert and felt that CRTI pulled him away from the work that gave him credibility. He saw potential to improve results for CRTI, his home organization and his career by moving some CRTI research upstream, but he had been unsuccessful in proposing that approach.

Complex systems cannot be understood simply through exploration of their components. Participants revealed how their CRTI work intersected with numerous scholar and practitioner networks and organizations such as scientific associations, INTERPOL, federal and provincial ministries, universities, consultants and technology firms. The Secretariat was presented with two graphic representations of CRTI: the first was a typical communities-of-practice model, with each community spanning formal structures. The final was an aerial photo of a landscape in which water flowed and pooled in evolving patterns. This image reflected meta-aggregate landscape “linked by direct dependence on common resources or events” (Marion and Uhl-Bien, 2001). The changing flows of water were paths rejected and adopted for progress at any given time, thereby reducing the influence of conflicts and constraints. Superimposed translucent images of the communities extended off the edges of the landscape into unknown territory. When this image was projected, there were nods around the table: recognition of the openness of the system. This sort of structure—or lack thereof—is very rare in government.

4.2 Limitations

Further data analysis could reveal other patterns that might strengthen, complement or challenge those found in this study. Omission of participant profiles reduces the depth with which readers can interpret the results. Communities of practice exist in all sectors, but these findings are most relevant for governments.

From a theoretical perspective, this study is promising in that findings support conceptual work by complexity theorists. However, more empirical work is needed at this rich intersection.

5.0 Summary

CRTI has attracted talented and committed professionals, attempting to work in a communities-of-practice model, which differs dramatically from familiar government structures. Almost two thirds of the participants understand the CRTI environment as complex, and these are among those most satisfied with their progress. Many expressed concerns about traditional tools, which can limit learning and innovation. Many spoke seamlessly about related work in various jurisdictions, task forces, committees, ministries and conference circuits: CRTI is a much larger initiative than it appears on paper. In a complex, open system, context is interwoven with all dynamics (Cilliers, 2005). Differences from community to community may relate to isolation, differences emerging from the epistemic cultures of disciplines (Knorr Cetina, 1999), formal leaders' perspectives or other factors.

These findings support the theoretical propositions that leadership in complex, knowledge-rich environments is fundamentally different than leadership models commonly presented through academic, business and development forums. According to CRTI members, strong leadership includes comfort with complexity, a passion for supporting other community participants without

positional authority, the infusion of energy, humility, social network stimulation, multifaceted approaches to enabling knowledge creation and flow, encouragement of diversity, and strategic shifts in roles and identities.

Based on this research, aspects of the CRTI community initiative are working extremely well. One participant stated that Canada—despite expressing an interest in using CRTI as a model—does not fully appreciate the nature and ramifications of the successes. Based on these findings, the researcher emphasizes this is a paradigm shift achieved in a small pocket of government, which could hold the seeds of success for much more effective use of increasingly limited public sector resources. If this conclusion is correct, there are two major factors to consider. The first is that the rules, regulations and norms carefully designed for relatively predictable government work can be counter-productive. The second is that a shift from ordered to complex approaches cannot be achieved through superficial change. Decision-makers need to understand innovative practices in CRTI as effective *alternatives*; implementation challenges will not be fixed with familiar solutions.

On a larger scale, this study may catalyze reflections, insights and new leadership approaches amongst professionals who work in complex, trans-disciplinary fields.

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We interact when we meet face to face.	We interact regularly in many different ways.	
Our new ideas spread easily to the people who need them	Our new ideas stay within our group.	
I think I am a worthwhile contributor	I think my expertise is not well used	
In our meetings, we stick to a pre-determined agenda.	In our meetings, the agenda evolves as we interact.	
We try things out (as long as they are safe), and see what happens.	Before trying things out we carefully plan and analyze.	
The leadership we have comes from a single cluster member	The leadership we have comes from many cluster members	
We're solid and stable.	We're fluid and resilient.	
Because we are such a diverse group, we confine our conversations to common ground, where it's easy to understand each other and work is efficient.	Because we are such a diverse group, we spend a lot of time trying to understand each other and establish new common context.	
Our work isn't challenging	Our work is challenging	
We are pioneers in uncharted territory.	We have a clear vision and milestones.	
We focus on learning.	We focus on doing.	
I can recall many times when individuals' contributions were recognized or celebrated	I cannot recall any times when individuals' contributions were recognized or celebrated	
We are like a healthy ecosystem	We are not yet functioning well	We are like a well-oiled machine

Table 1: Text from “spectrum” questions where descriptive statistics were used

Themes	Ways of Understanding Themes		
	Most Complex		Least Complex
Perceived Satisfaction and Effectiveness • from most to least	Mutual Benefit	Shared Opportunity	Difficult
Perceived Complexity • from most to least, or complex to ordered	Connecting	Reassessing	Focusing
Knowledge Management • from flowing to static	Free-flowing	Increasing	Stuck
Perceived Nature of Boundaries • from permeable to impermeable	Integrating	Overlapping	Constrained
Leadership • from multifaceted to less varied	Cross-pollination	Roles	Title

Table 2: Summary of ways of understanding work in CRTI communities

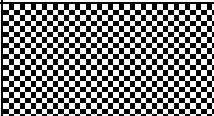

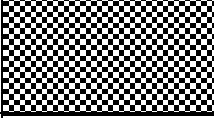
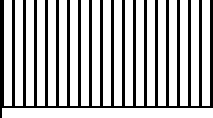
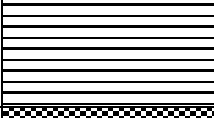
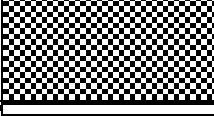
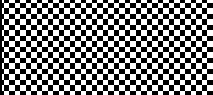
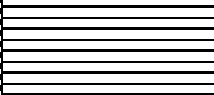
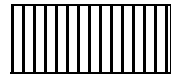
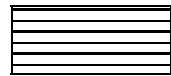
Research Element	Ways of Understanding Research Elements		
	Most Complex		Least Complex
Perceived Satisfaction and Effectiveness • from most to least • mutual benefit, shared opportunity & difficult			
Perceived Complexity • from most to least • connecting, reassessing and focusing			
Knowledge Management • from flowing to static • free-flowing, increasing and stuck			
Perceived Nature of Boundaries • from permeable to impermeable • integrating, overlapping and constrained			
Leadership • from multifaceted to less varied cross-pollination, varied roles and title			

Table 3: Community 1's ways of understanding research themes



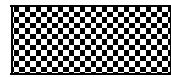
Formal community leader's way of understanding



Community participants' way of understanding



Single community participant's way of understanding



Formal leader and community participants' way of understanding



No one in community had this way of understanding

Research Element	Ways of Understanding Research Elements		
	Most Complex		Least Complex
Perceived Satisfaction and Effectiveness <ul style="list-style-type: none"> • from most to least • mutual benefit, shared opportunity & difficult 	[Cross-hatch pattern]		
Perceived Complexity <ul style="list-style-type: none"> • from most to least • connecting, reassessing and focusing 	[Cross-hatch pattern]		
Knowledge Management <ul style="list-style-type: none"> • from flowing to static • free-flowing, increasing and stuck 	[Vertical lines pattern]	[Horizontal lines pattern]	[Diagonal lines pattern]
Perceived Nature of Boundaries <ul style="list-style-type: none"> • from permeable to impermeable • integrating, overlapping and constrained 	[Cross-hatch pattern]	[Diagonal lines pattern]	
Leadership <ul style="list-style-type: none"> • from multifaceted to less varied • cross-pollination, varied roles and title 	[Vertical lines pattern]	[Diagonal lines pattern]	[Horizontal lines pattern]

Table 4: Community 3's ways of understanding research themes

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