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Developing collaboration in complex events: A model for civil-military inter-organizational problem-solving and decision-making

Topic 2, 5, 9

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Abstract

Stewardship of complex extreme events requires effective civil-military collaboration. This paper examines the organizational roles and pre-conditions for this collaboration. Firstly, a review of the relevant interdisciplinary literatures identifies various models of problem-solving and decision-making across the range of organizations involved in major events. Secondly, findings from a series of Canadian and international extreme events involving civil-military interaction are examined to identify situational characteristics and features of inter-organizational relationships across an extended event timeline. Finally, a framework for understanding inter-organizational problem-solving and decision-making is presented. Two interrelated components drive the process: situational complexity and approach to problem-solving. The relationship between these components is modified according to problem-solving stage, and various assets such as power, resources and information. Three elements identified as contributing to situational complexity include impact, uncertainty and vulnerability. These elements interact to determine whether the situation is categorized as simple, complicated or complex. Problem-solving is characterized in time as a recursive six-stage process including problem identification, problem definition, solution generation, decision-making, solution implementation and feedback. Three main approaches to inter-organizational problem-solving are described as coordination, cooperation and collaboration. Methods involving the development of an experimental environment for *in vivo* simulation to test the inter-organizational problem-solving model are described.

Keywords: collaboration; coordination; cooperation; military; inter-organizational; decision-making; complexity

Introduction

Large scale emergencies often present a multitude of challenges that are complex and difficult to solve not only due to high levels of uncertainty but also, in part, because of the demands presented by inter-organizational decision-making. A review of the literatures revealed that reports on lessons learned following disasters frequently call for collaborative behaviour between organizations. However, there is a gap in the literature in terms of understanding collaborative behaviour in the context of situational complexity. This paper aims to address this gap through the development of a model of inter-organizational problem-solving spanning the complete event timeline with applications to pre-event, impact and recovery phases of extreme events. The evidence base for the model consists of two independent lines of investigation: a) an extensive review of relevant literatures from multiple disciplines and b) a series of cases studies of Canadian and international events. The intention of this line of research is to shed light on the relationship between complexity and collaboration in addressing complex problems by examining the situational complexity of extreme events, and in particular events involving civil-military collaboration.

The inter-organizational problem-solving model presented in this paper was developed in response to the defined need to better understand collaborative behaviour between different types of organizations engaged in extreme events, such as the Canadian Forces and partnering agencies. A more thorough understanding of the factors contributing to collaborative inter-organizational relationships and collective decision-making processes will assist participating organizations in overcoming social and cognitive barriers to collaboration (Chouinard, 2009, p.2). Given the wide adoption of principles and structures associated with the Incident Command System (ICS) in emergency management, it was critical that the problem-solving model be compatible with existing ICS structures and processes.

Methods

The two main methods implemented to develop the model were a targeted review of relevant literatures of both peer-reviewed and grey literature from a diverse array of disciplines, and case studies of decision-making and problem-solving during recent Canadian and international complex events.

Literature Review – Relevant literature was initially identified using key word searches in electronic citation databases from various disciplines. From this interdisciplinary base, relevant articles and reports were identified and further reviewed according to topics of investigation (e.g., decision-making, problem-solving, collaboration), and organizational type and structure (e.g., meta-organization, ICS). Overall, 198 articles and reports were selected for in-depth review.

Case Studies of Extreme Events – Six Canadian case studies were selected from our compiled list of 63 extreme events that had occurred in Canada ranging from small events to large scale disasters. The research team outlined *a priori* criteria to be considered during the case selection process including timeframe, multi-jurisdictional and multi-level involvement, impacts, involvement of multiple responders, and availability of literature and documents. International case studies were used for comparative purposes, matching on similar timeframes to the Canadian case studies; multiple populations impacted; and the involvement of multiple responder organizations. In addition, consideration was given to cases that included an aspect of success in key aspects of the response. By seeking out key successes, the research team was able to learn not only the challenges facing inter-organizational relationships in disaster response but also the factors that might lead to a more effective response and management. The cases were analysed systematically using a grid that outlined the key analytic dimensions, crossing them with the timeline of the event. The analytic dimensions used to understand key decisions and problem-solving processes were: organizations involved with the decision; content and outcome of the decision; timing of the decision in relation to the event timeline; location where the decision was being made; and

the approach used to make the decision (e.g., unilaterally, coordinated, cooperatively, collaboratively). These various decisions were then positioned within the event timeline of pre-event (planning and preparedness, threat, warning), during the event (impact), and post-event (rescue, recovery, reconstruction). Additionally, observations were made on the outcomes or impacts of the decisions, and the complexity of the event at that particular stage.

Considerations in Model Development

The model of inter-organizational problem-solving was developed based on the findings from the literature review and case studies. In addition, the research team was guided by the following considerations:

1. *Use of an extended timeline* – The model was conceptualized within a risk management paradigm in which extreme events are understood on an extended timeline, from the pre-event phases, to the more acute stages of crisis management, and finally to the recovery and reconstruction phases where the focus is on consequence management. Under this paradigm, hazard mitigation is a constant process whereby the monitoring of interventions is ongoing (Lemyre et al., 2005). A central tenant of the approach assumes that it is important to situate any event within an extended timeline to accurately understand how events evolve into complex situations, along with how organizations work together within these events, and especially so in the early phases when uncertainty is maximum and even before occurrence at time of threat or warning.

2. *No one approach is "best"* – Complex situations require diverse approaches – no single problem-solving approach is best. Organizations must engage and consider multiple perspectives in understanding and defining problems. Moreover, these approaches may combine, unroll in parallel, and interact in a recursive fashion.

3. *Decision-making is only <u>one</u> stage in problem-solving* – Decision-making is just one stage within the overall problem-solving process. Other stages include identifying the problem, defining the problem, generating solutions, decision-making, implementing solutions, and monitoring implementation.

4. *Multi-disciplinary approach is appropriate* – A multidisciplinary approach, which integrates findings from diverse disciplines and fields of practice will lead to a more robust and relevant model of inter-organizational problem-solving.

Findings from Literature Review

The purpose of the review was to gain a broad understanding of the various types of organizational structures potentially involved with problem-solving during complex events, decision-making strategies used by different organizational structures, and key organizational characteristics such as types of authority, interaction and roles. Organizational context is central to the way that organizations make decisions both within organizations and between them (Cray et al., 1988; Nutt, 1976). Decision-making and organizational context mutually influence one another and co-evolve within organizations (Gaudine & Thorne, 2001). Consequently, it was necessary to examine the context of a number of special types of organizations. The literatures covered by the review included: risk, crisis and consequence management; individual and organizational decision-making; Incident Command Systems (ICS); meta-organizational decision-making; decision-making in a public administration context; approaches to decision-making in inter-jurisdictional partnerships; the public policy consultation model; approaches to decision-making in a community development model; private sector organizations; high reliability organizations (HRO model); learning organizations; and the role of technology in collaborative decision-making. The review of the

literature also identified the benefits and challenges of organizational structures within an inter-organizational problem-solving context with similar and dissimilar organizations.

The review found that decision-making strategies varied considerably from one type of organization to another. For example, while a strong hierarchical approach was found to be appropriate within the context of ICS-based organizations, hierarchy is weakened in the context of a meta-organization (or organization comprised of other smaller organizations as members) because of the meta-organization's dependence on its members for survival and its lack of central authority structure (Ahrne & Brunsson, 2005; Ahrne & Brunsson, 2008; Brunsson & Jacobson, 2000). The main findings from the literature review are presented in Table 1 which includes a breakdown of the key organizational types and structures, problem-solving and decision-making characteristics, distribution of authority, interaction and role patterns, and associated sectors.

Table 1 Overview of organizational types

Organizational Type	Organizational structure	Problem-solving & Decision-making	Authority	Interaction / Roles	Sector
Incident Command System (e.g., emergency management organizations, National Incident Management System (NIMS))	-Top-down -Expands and contracts according severity of situation	-Hierarchical -Based on guidelines and on the scene information	Hierarchical	-Defined roles	-Government -Military
Meta-organizations (e.g., United Nations (UN), World Trade Organization (WTO), European Union (EU))	-Organization of organizations -Membership orgs. of the same type or of the same field	-Consensus building -Deferral to experts	Shared	-Shared vision -Strengthened by similarities	-Government -Military -Business -Healthcare -Non-governmental organizations
High Reliability Organizations (HRO)'s (e.g., air traffic control, chemical processing plants, space programs, nuclear power plants, hospitals)	-Centralized knowledge and goals -Decentralized tasks and responsibilities	-Distributed	Hierarchical	-Decentralized -Organic network	-Government -Military -Business -Healthcare
Community Development Partnerships (e.g., Needs based issues such as: health, housing, neighbourhood safety)	-Issue focus -For the community, with the community -Partnered with researchers, granting agencies, etc.	-Bottom-up -Community consultation	Shared	-Diverse, fluid membership -Community empowerment	-Government -Healthcare -Non-governmental organizations
Private Sector (e.g., sole proprietorships, multi-national corporations, publicly-traded corporations)	-Variable	-Hierarchical -Analytic -Speculative	Hierarchical	-Profit driven	-Business
Public Sector (e.g., crown corporations, Federal, provincial/territorial, municipal department and agencies)	-Top-down	-Hierarchical -Public consultation -Networking	Hierarchical	-Equality -Impartiality -Rationality	-Government

Findings from the Canadian and International Case Studies

The case studies focused on inter-organizational problem-solving and decision-making processes associated with six recent extreme events in Canada, and three international events. Based on the selection criteria, the Canadian cases selected include: the Eastern Canada ice storm (1998), the Red River flood (1997), SARS (2003), the Kelowna fires (2003), Gander, Operation sleepover (2001), and the Blackout (2003). The criteria for selection of these case studies are summarized in Table 2. The

international cases included: Hurricane Katrina (2005), the London transit bombings (2005), and the Indian response to the Tsunami (2004).

Table 2 Canadian and International Case Studies

Event	Timeframe	CF Involvement	Multi-jurisdictional	Multi-level	Multiple populations impacted	Multiple responder organizations
Ice Storm	1998	✓	✓	✓	✓	✓
Red River Floods	1997	✓	✓	✓	✓	✓
Kelowna Fires	2003	✓	✓	✓	✓	✓
SARS	2003		✓	✓	✓	✓
Operation Sleepover	2001	✓	✓	✓	✓	✓
Blackout	2003		✓	✓	✓	✓
Hurricane Katrina	2005		✓	✓	✓	✓
London Transit Bombings	2005		✓	✓	✓	✓
Indian Tsunami	2004		✓	✓	✓	✓

These cases, in total, provide some insights into different approaches to planning for and responding to an extreme event, and illustrate a variety of inter-organizational problem-solving approaches. A number of observations were derived from the various details and descriptions outlined in the case study analytic grids. These are described in general terms below in Table 3.

Table 3 Summary of Case Study Findings

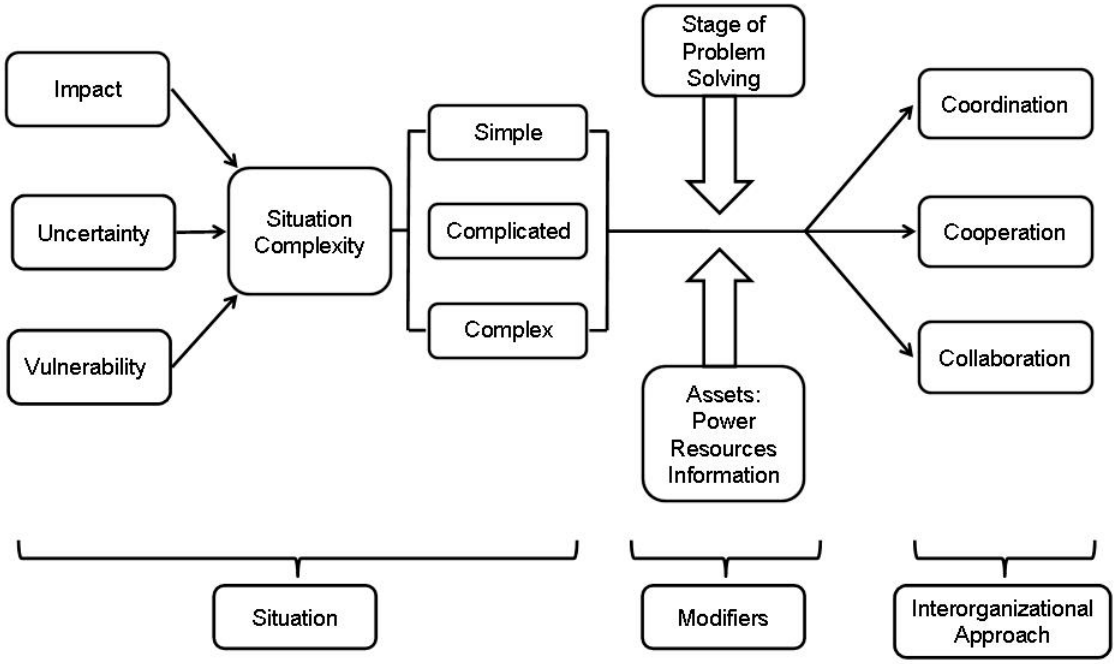
Event	Key Findings
Ice Storm	• Communication difficulties contribute significantly to the complexity of a situation, particularly when communication methods are not pre-tested and rehearsed in training exercises
Red River Floods	• The absence of coordination and transparency between municipalities can inhibit effective decision-making in the impact and rescue phase; sharing emergency plans pre-event is essential • Integrating lessons learned post-event into emergency plans may result in a more agile response in the future
Kelowna Fires	• Establishing clear jurisdictional boundaries and corresponding roles and responsibility in the pre-event phase can decrease the level of complexity during the event • The inter-organizational adoption of a homogenous emergency preparedness and management plan in the pre-event phase facilitates problem-solving • Transparent communication with the public can improve public trust, reducing anxiety levels and uncertainty
SARS	• Emergency plans and emergency infrastructure must be in place during the pre-event phase • A lack of inter-organizational communication during the event can increase the level of uncertainty and amplify complexity

Operation Sleepover	• Established inter-organizational networks notably diminish the complexity of the situation during the event phase • Decision-making both during the event and post-event can be facilitated by developing flexible preparedness and response plans as well as training programs in the pre-event phase
Blackout	• A lack of communication between organizations as well as between officials and the public increases both uncertainty and complexity
Hurricane Katrina	• Decision-making benefits from local knowledge and partnerships created during the pre-event stage with businesses and volunteer organizations when frontline members are given the authority to indentify how to best proceed with on-the-ground work • Lack of planning and anticipation of needs can contribute significantly to complexity • Private sector companies operating independently but working within pre-existing networks can contribute significantly to lessening the impacts of an extreme event
London Transit Bombings	• The provision of accurate, timely information to a wide-range of organizations and individuals contributes to decreasing the overall complexity of an event • Joint exercises involving multiple agencies provide the opportunity for multiple agencies to practice working together, contributing to a more effective, coordinated response
Indian Tsunami	• Post-event recovery and reconstruction periods allow opportunities for different types of organizations to cooperate and collaborate, building resilience • Informal networks involving local organizations within villages can provide significant, timely information for the population to prepare for an extreme event
Multiple Events	• Emergency planning can suffer from the recency effect bias, limiting planning to the mitigation of events similar in severity and scope to events that have previously occurred

Model of Inter-organizational Problem-Solving

Based on the findings from the literature review and case studies, a model of inter-organizational problem-solving was developed that consists of two main components: 1) situational complexity; and 2) inter-organizational approach to problem-solving. As illustrated in Figure 1, the relationship between these two components is modified by the specific stage of problem-solving involved, and the various assets available such as power, resources, and information.

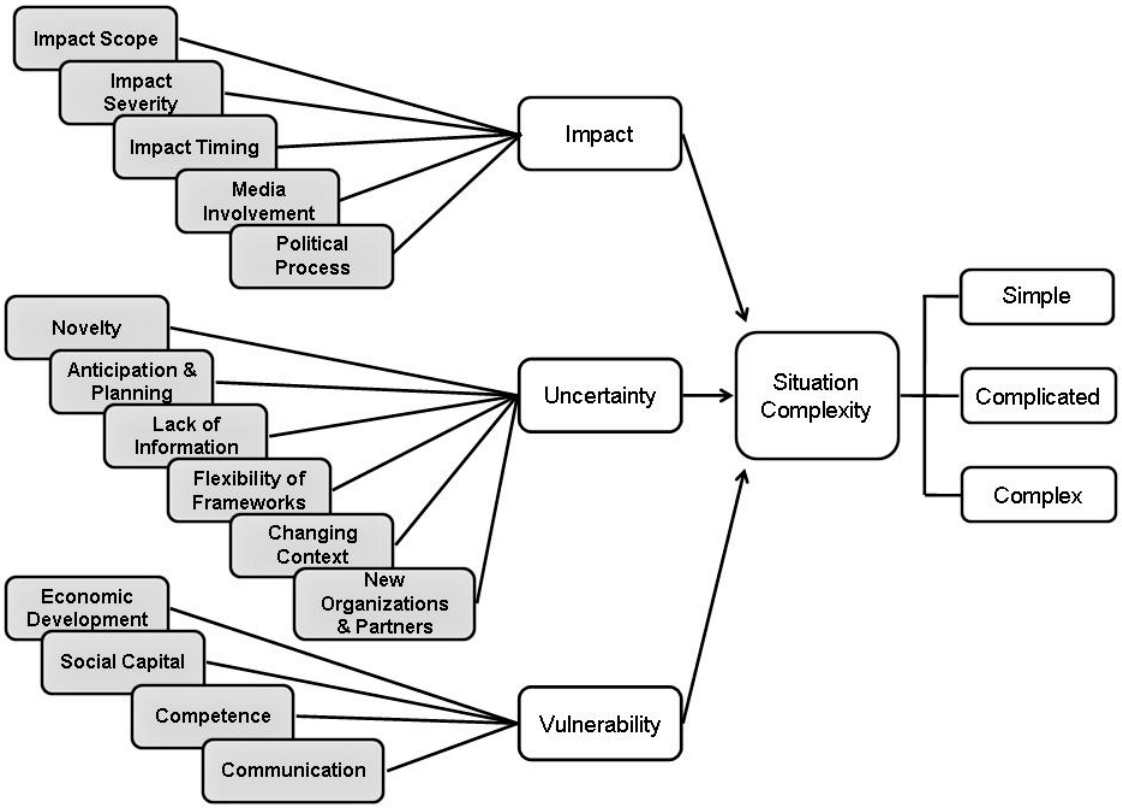
Figure 1 Model of inter-organizational problem-solving



Model Component: Situation

Situational complexity can be broken down into three main factors: the impact of the event, including actual, perceived and potential impacts; the uncertainty of the situation; and the vulnerability, or conversely, the resiliency of those who may be impacted, which includes the organizations themselves. As illustrated in Figure 2, these three factors combined determine the overall complexity of the situation. Each factor is composed of multiple elements of varying magnitudes that contribute to the factor, and ultimately to the complexity of the situation. Even though they are graphically depicted in the diagram in a linear fashion, each element could potentially either contribute to or detract from the complexity of the situation. Rather than independent and unidirectional, the element should be conceptualized as dynamic, changing frequently depending on the interplay of the multiple elements and factors present in the situation. Additionally, it is important to note that within overall situation complexity there are smaller "kernels" that may be simple, complicated and complex. For example, while a situation may be assessed as predominantly simple, it is likely to also have some complicated and complex aspects, however small. Similarly, even the most complex situations are likely to have some aspects that are relatively simple. Aspects of these three factors as they relate to complexity have been highlighted in diverse fields such as determinants of stress levels in individuals (Lemyre & Tessier, 1988; Lemyre & Tessier, 2003), challenges in managerial decision-making and leadership (Youssef & Luthans, 2005), military strategy (Albert & Hayes, 2007; Pfeifer, 2005), environmental and ecological systems (Adger, 2000; Folke, 2006; Gallopin, 2006), community development (Paton & Johnston, 2006), and risk perception (Lee & Lemyre, 2009; Lee, Dallaire & Lemyre, 2009; Lemyre et al., 2009b).

Figure 2 Three factors contributing to situation complexity



As illustrated in Figure 2, there are a number of elements within each factor (depicted by vectors in the diagram) that contribute to the factor's overall impact on the complexity of the situation. While some elements contribute to the complexity of the situation, others detract from the complexity. This represents the dynamic nature of the interplay of these elements, and the potential speed at which the complexity of a situation can change.

Situation Complexity – Event Impacts

More than just the actual impacts of the events, this factor also refers to potential impacts as well as perceived impacts. Often the potential impacts can contribute as much to the complexity of a situation as the actual impacts (Lemyre et al., 2005). Similarly, perceptions of impacts can also contribute significantly to the complexity of the situation (Ibitayoa, Mushkatelb, & Pijawkac, 2004). For example, in the case of SARS, much of the complexity of the situation was due to the public's perception of impacts, rather than the actual impacts that had occurred directly from the disease. Each type of impact (actual, potential, and perceived) is important in determining the extent to which impacts are contributing to the complexity of the problem.

Some key elements that contribute to the impact factor are:

1. *Scope of impacts* – The scope of impacts can be defined according to various levels or tiers. First tier impacts are generally defined as direct effects sustained by the event itself: the direct damage. Second tier impacts are those that impact on essential societal functions, services and utilities such as food

and water delivery, shelter, primary healthcare, electrical power. Critical infrastructure and vital functions may be interrupted. Finally, third tier impacts are those that are generally measured in political and longer-term economic costs associated with an event: social order and trust in institutions.

2. *Severity of impacts* – The severity of impacts is related somewhat to the scope. The severity of impacts are measured in part by the "ripple effect" that occurs as a result of the major event. The ripple effect can be quite extensive, impacting individuals, families, organizations, communities and society in a variety of ways. As the severity of the impacts increase or decrease, so will the level of complexity of the situation.
3. *Timing of impacts* – The time parameters involved often increase the complexity of the situation. Given the urgency of responding in many of these events, there are often considerable time pressures adding to the perceived complexity of issues and decisions.
4. *Involvement of media* – The media can add to the complexity of the situation, often by amplifying the perception of risk or perceived impacts, by creating greater confusion, misinforming, and by contributing to some organizations' decision to not openly communicate information about the event or actual risks associated with the event.
5. *Political processes* – If there are political considerations at play between and within organizations involved in the event, then this may contribute to additional complexity. For example, there may be competition between organizations, or political pressures to minimize the impacts, to maintain existing power structures, or to showcase more control of the situation than there actually is.

Situation Complexity - Uncertainty

The second factor identified as contributing to the complexity of the situation is uncertainty. As the level of uncertainty rises, so does situation complexity (Alberts & Hayes, 2007; Moffat, 2003; Rosenau, 1997). Conversely, as more becomes known about a situation, and useful information becomes available, the complexity of the situation decreases. There are a number of key elements that contribute to the uncertainty factor by either increasing or decreasing the overall complexity of the situation. These elements are:

1. *Novelty of situation* – If a situation is new, then it has the potential to be more complex. Experience with similar situations that have occurred in the past can decrease uncertainty.
2. *Anticipation and planning* – In most situations, it is likely that anticipation and planning will decrease the level of uncertainty. This will in turn decrease the potential complexity of situations.
3. *Lack of data/information* – Directly linked to uncertainty is the availability of data or information. Availability hinges on information sharing between and within groups and organization. An absence of accurate information or data overload is also likely to increase complexity. The availability of feedback information is also important in determining whether or not interventions or actions are effective.
4. *New organizations and partners* – The presence of new organizations and partners in multi-organizational response can impact the number of "unknowns" and thus the uncertainty factor (both positively and negatively). There is likely to be a certain level of uncertainty that results with the inclusion of new organizations with respect to the coordination of tasks and areas of responsibility. In other cases, the presence of new organizations may decrease the level of uncertainty and complexity of a situation by providing new services, and contributing new knowledge and experience about the situation.
5. *Rapidly changing context* – There are certain aspects of a situation that can change quite quickly, contributing to a rapid change in the overall context of the situation. The interactions between hazards, populations, and organizations involved, and impacts can produce a quickly evolving, changing context for the situation that creates uncertainty and contributes to complexity.

6. *Flexibility of interpretive frameworks* – The frameworks used to identify and understand the situation may have an impact on complexity. Looking at the situation with an inflexible framework may limit the understanding of events as multiple perspectives are not explored. Thus a rigid framework may lead to increased uncertainty, while an exploration of the situation from multiple perspectives may decrease uncertainty, thereby decreasing the level of complexity as well.

Situation Complexity – Vulnerability (Resilience)

The third factor that has been identified as contributing to situational complexity is vulnerability. There is a growing literature on vulnerability and resiliency in various domains, often with each concept being positioned as the converse of the other (e.g., Smith, Smoll, & Ptacek, 1990). For the purposes of this framework, it is assumed that people or groups that are high in resiliency can be considered less vulnerable. Conversely, those who are more vulnerable likely have lower resiliency to the impacts of the situation. *Vulnerability* is strongly associated with susceptibility to certain impacts (Lemyre et al., 2009a). Originally presented as an individual characteristic within the child development literature (Masten, Best, & Garmezy, 1990), and as a characteristic of ecological systems (Holling, 1973) the concept of resiliency has more recently been applied in a broader context to various collectives such as organizations (Hind, Frost & Rowley, 1996), communities (Norris, Stevens, Pfefferbaum, Wyche & Pfefferbaum, 2008; Red Cross, 2004), and societies (Paton & Johnston, 2006). At an individual level, resilience has been defined as "the capacity to rebound from adversity, strengthened and more resourceful…it is an active process of endurance, self-righting and growth in response to crisis and challenge" (Walsh, 2003, p. 4). At a collective level, resilience has been defined as: "The ability of community members to take meaningful, deliberate, collective action to remedy the impact of a problem, including the ability to interpret the environment, intervene, and move on" (Pfefferbaum, Reissman, Pfefferbaum, Klomp, & Gurwitch, 2005).

The elements that can modify levels of the vulnerability or resiliency of those who are likely to be impacted by an event are numerous (Norris et al., 2008). Some of the key elements that would modify levels of resiliency, and thus contribute to the complexity of the situation include:

1. *Economic development* – Economic development can include elements such as equity of resource distribution among organizations and individuals within the area being impacted by the event, as well as the actual level and diversity of economic resources available.
2. *Social capital* – Social capital consists of many different elements including social support, social embeddedness, organizational linkages and cooperation, citizen participation, sense of community, and attachment to place.
3. *Community competence* – Community competency refers to the collective capacity to undertake various activities such as community action, critical reflection and problem-solving skills, flexibility and creativity, collective efficacy, and political partnerships.
4. *Information and communication* – Key to the concept of vulnerability is information and communication, characterized often as available narratives, responsible media, skills and infrastructure, and availability of trusted sources of information.

Model Component: Inter-organizational Approach to Problem-Solving

The other main component of the model is the type of inter-organizational approach used to problem-solve. For the purposes of the model, three overall approaches to problem-solving were identified: Coordination, Cooperation and Collaboration. Keeping with the assumption outlined previously that there is no "best" approach to inter-organizational problem-solving, the model assumes that aspects of all three approaches will likely be used during the problem-solving process either concurrently or consecutively,

depending on the problem requirements. To describe these approaches to problem-solving as strictly trichotomous would be an oversimplification of the problem-solving process.

Given the wide diversity of fields in which the concepts of coordination, cooperation and collaboration are used, definitions and conceptualizations are numerous. For the purposes of the current model, a set of definitions commonly used in community planning have been adapted. This set of definitions emphasizes the unique characteristics of each approach, and has previously been used to evaluate the collaborative nature of various inter-organizational structures (Taylor-Powell, Rossing & Geran, 1998).

Coordination can be defined as a process of communication, planning and sharing of resources, risk and rewards for the purposes of efficiency and effectiveness in achieving the complementary goals of the parties involved (Taylor-Powell et al., 1998). With coordination, there is an emphasis on ensuring that use of similar resources does not overlap, and that resources are used efficiently. With this approach information is shared and organizations are likely to be relatively independent, with each organization engaging in independent decision-making. Moreover, activities occur within organizational silos in parallel with other organizations. Coordination is effective once a plan of action has been determined.

Cooperation is conceptualized as a process where parties with similar interests plan together, negotiate mutual roles, and share resources to achieve joint goals, but maintain separate identities (Taylor-Powell et al., 1998). Cooperation involves not only coordinating existing resources, but also ensuring that additional organizations are brought in to fill resource gaps. With cooperation, information is shared along with activities and resources. Organizations are likely to be more interdependent in some key stages of the problem-solving process (particularly around the problem definition stage and solution implementation stage, with more joint decision-making occurring). A key feature is the sharing of resources in view of a joint outcome.

Collaboration is defined as a process through which parties who see different aspects of the problem can constructively identify a common goal and explore within their differences how to implement solutions that go beyond their own limited vision of what is possible (Taylor-Powell et al., 1998). Collaboration emphasizes the ability to develop a conceptualization or definition of the problem as well as to develop innovative solutions. Decision-making can be characterized as "shared" or 'networked''. In addition to information, activities, resources, power and authority are also shared. As well, the organizations, while maintaining their individual organizational identity, in collaborating with one another may be required to alter their approach to accommodate different visions. By working together, organizations may become slightly transformed through such compromises (Taylor-Powell & Rossing, 2009).

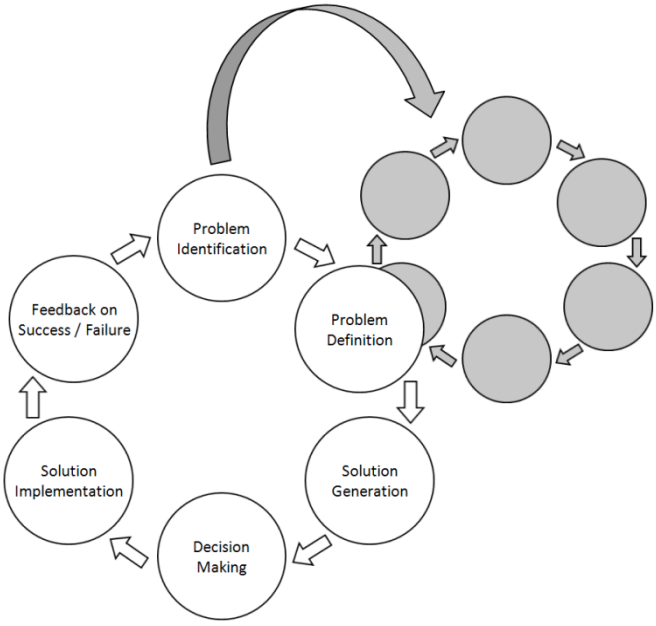
Model Component: Modifier – Stage of Problem-solving

As the model indicates a variable that will modify the relationship between situation complexity and inter-organizational approaches to problem-solving is the particular stage of problem-solving in which organizations are engaged at various points in time. As illustrated in Figure 3, the generic logical stages in problem-solving[1] can be characterized in a manner similar to the following six recursive steps: 1) problem identification; 2) problem definition; 3) solution generation; 4) decision-making; 5) solution implementation; and 6) monitoring/feedback on success/failure of solutions. The process is recursive to the extent that the monitoring and feedback on success or failure of solutions will lead problem-solvers to

[1] It is noted that this is the "normative" approach to understanding problem-solving. In many instances, this does not accurately reflect how decision-making is carried out; however, it is often viewed as the desired approach, and what decision analysis strives to replicate in determining how best to assist people and organizations make "good" decisions.

often revisit problem identification, and if necessary, continue through the stage until resolution is achieved.

Figure 3 Generic stages of problem-solving



The stages of problem-solving modify the inter-organizational approaches used to problem solve according to the various levels of situation complexity. As illustrated in Table 4, the different stages of problem-solving require different approaches depending on the complexity of the situation. For example, the need for collaborative efforts in simple situations is likely limited. The emphasis would be primarily on cooperative efforts at the problem identification, problem definition, and feedback stages, with coordinated efforts required for the remaining stages. Conversely, in complex situations, the emphasis on collaboration would be higher, with collaboration occurring (likely along with cooperation and coordination) at most of the stages.

Table 4 Problem-Solving Stages and Emphasized Problem-Solving Approaches

Problem-solving Stage	Emphasized Approach for Simple Situation	Emphasized Approach for Complicated Situation	Emphasized Approach for Complex Situation
Problem Identification	Cooperation	Collaboration	Collaboration
Problem Definition	Cooperation	Collaboration	Collaboration
Solution Generation	Coordination	Coordination Cooperation	Collaboration
Decision-Making	Coordination	Coordination Cooperation	Collaboration
Solution Implementation	Coordination	Coordination Cooperation	Coordination Cooperation
Feedback on Success/Failure	Cooperation	Collaboration	Collaboration

Model Component: Modifier – Assets

Various authors have written about the modifying impacts that the distribution and sharing of power, resources and information can have on how organizations and people relate to one another (Crosby & Bryson, 2005; Crosby, Bryson, & Anderson, 2003; Hobfoll, 1989; 2001; 2004; Paquet, 1999; 2005; 2009). Based on this literature combined with findings from the case studies, the model was developed to account for the availability, distribution and willingness to share power, resources and information among organizations as a modifying effect on the extent to which coordination, cooperation and collaboration will occur. Table 5 outlines the different types of inter-organizational approaches to problem-solving that are likely to occur with the incremental sharing of different components. At one level, if there is no sharing, then organizations operate independently, without significant connection to other organizations. If basic information is shared across organizations, then coordination can occur. With coordination, the main concern is with efficiency and with avoiding overlaps and duplication. Once information, activities and resources start to be shared, then there is the possibility of cooperation to start occurring between different types of organizations. If in addition to these, power is starting to be shared, then there is a greater likelihood that true collaboration between organizations can occur. Crosby & Bryson (2005) outlined the concept of shared power as "actors jointly exercising their capabilities related to a problem in order to further their separate and joint aims…power sharing requires a common or mutual objective…shared power remains a mixed-motive situation in which participants reserve the right of 'exit'" (p. 18). This conceptualization also can move the relationship from inter-organizational to meta-organizational once there is the addition of sharing of authority. According to Crosby & Bryson (2005), once authority is shared, the organizations have, in essence, merged into a new entity.

Table 5 Modifying variables of power, resources and information (adapted from Crosby & Bryson, 2005)

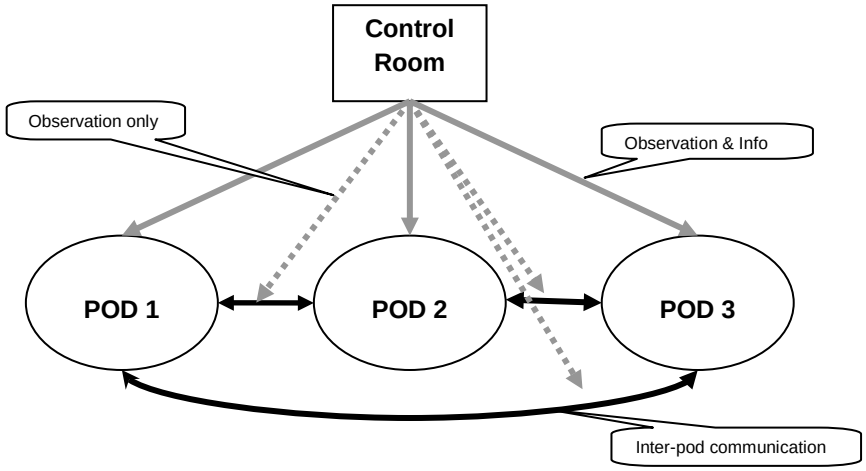
Inter-organizational approach	What is shared
Meta-organization	Authority
Collaborate	Power
Cooperate	Activities and Resources
Coordinate	Information
Independent	Nothing

Next Steps: Model Testing Via an *In Vivo* Simulation Experiment

In order to test various aspects of the model for inter-organizational problem-solving, an *in vivo* simulation experiment is currently underway. This simulation experiment uses the *Inter-GAP In Vivo System* developed by Lemyre et al. (2010) that is able to examine both intra- and inter-organizational problem-solving processes and outcomes. The *in vivo* simulation design includes two independent variables – type of multi-organizational problem-solving (i.e., coordination, collaboration); and, multi-organization environment. Participants are drawn from three types of organizations (military, ICS non-military such as emergency services, and non-ICS such as non-governmental organizations) and grouped in pods (rooms) in both homogeneous and heterogeneous session configurations of the experiment. Each session typically holds nine participants grouped three to a pod (see Figure 4 for the overall session composition of the *in vivo* experiment). A complex scenario is delivered to each pod via multi-media injects from a control room. The inter-pod and intra-pod interactions for each session of the experiment, prompted by task instructions, are video and audio recorded. This provides the source data for measurement of problem-solving outcomes. The research design includes two sets of dependent variables – one focusing on problem-solving processes and task or group cohesion, including individual, collective and panel satisfaction with the problem-solving process; another focusing on problem-solving outcomes

such as decision quality and level of agreement on outcome. Various measures have been developed for each dependent variable (e.g., self reports, participant ratings, panel assessment, etc.).

Figure 4 Overall Session Composition for *In Vivo* Experiment



Conclusion

The model for inter-organizational problem-solving incorporates a wide breadth of literature, as well as empirical evidence from recent case studies. The framework highlights two main components including the approach to inter-organizational problem-solving, as well as situation complexity. Analysis of the results from an *in vivo* simulation experiment will be incorporated into the model. Not only will this model be relevant for responder and planning agencies as they make efforts to improve their understanding and development of inter-organizational relationships during extreme events, but also for planners and policy makers who may use the elements and sub-elements of the model as areas that need to be addressed and practiced in the pre-event planning stage of disaster prevention.

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References

Adger, W.N. (2000). Social and ecological resilience: are they related? *Progress in Human Geography,24*(3), 347–364.

Ahrne, G., &Brunsson, N. (2005). Organizations and meta-organizations. *Scandinavian Journal of Management, 21,* 429-449.

Ahrne, G., &Brunsson, N. (2008). *Meta-organizations*. Northampton, MA: Edward Elgar.

Alberts, D. S., & Hayes, R. E. (2007). Planning: Complex Endeavours. The Command and Control Research Program. Retrieved August 15th, 2009, from http://www.dodccrp.org/files/Alberts_Planning.pdf.

Brunsson, N., & Jacobson, B. (2000). *A world of standards*. Oxford, England: Oxford University Press.

Chouinard, P. (2009). *TIF Meta-Organizational Project Overview.* Unpublished document.

Cray, D., Mallory, G. R., Butler, R. J., Hickson, D. J., & Wilson, D. C. (1988). Sporadic, fluid and constricted processes: Three types of strategic decision making in organizations. *Journal of Management Studies, 25* (1), 13-39.

Crosby, B.C., & Bryson, J.M. (2005). *Leadership for the Common Good: Tackling Public Problems in a Shared-Power World* (2nd Edition). San Francisco, CA: Jossey-Bass.

Crosby, B.C., Bryson, J.M., & Anderson, S.R. (2003). *Leadership for the Common Good Fieldbook.* St. Paul, MN: University of Minnesota Extension Service.

Folke, C. (2006). Resilience: The emergence of a perspective for social-ecological systems analyses, *Global Environmental Change,16*(3),253–267.

Gallopín, G. (2006). Resilience, vulnerability, and adaptation: A cross-cutting theme of the International Human Dimensions Programme on Global Environmental Change. *Global Environmental Change, 16*(3), 293-303.

Gaudine, A., & Thorne, L. (2001). Emotion and ethical decision-making in organizations. *Journal of Business Ethics, 31,* 175-187.

Hind, P., Frost, M., & Rowley, S. (1996). The resilience audit and the psychological contract. *Journal of Managerial Psychology, 11*(7), 18-29.

Hobfoll, S.E., (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist*. *44*(3), 513-524.

Hobfoll, S.E. (2001). The influence of culture, community, and the nested self in the stress process: Advancing conservation of resources theory. *Applied Psychology, 50*(3), 337 – 421.

Hobfoll, S.E. (2004). *Stress, Culture, and Community: The Psychology And Philosophy Of Stress.* New York: Plenum Press.

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics, 4,* 1-23.

Ibitayoa, O.O., Mushkatelb, A., &Pijawkac, K. D. (2004). Social and political amplification of technological hazards: The case of the PEPCON explosion. *Journal of Hazardous Materials, 114*(1-3), 15-25.

Lee, J., &Lemyre, L. (2009). A social-cognitive perspective of terrorism risk perception and individual response in Canada. *Risk Analysis*, *29*(9), 1265-1280.

Lee, J., Dallaire, C., &Lemyre, L. (2009). Qualitative analysis of cognitive and contextual determinants of Canadians' individual response to terrorism. *Health, Risk & Society, 11*(5), 431-450.

Lemyre, L., Clement, M., Corneil, W., Craig, L., Boutette, P., Tyshenko, M., Karyakina, N., Clarke, R. &Krewski, D. (2005). A psychosocial risk assessment and management framework to enhance response to CBRN terrorism threats and attacks. *Biosecurity and bioterrorism: Biodefense Strategy, Practice, and Science, 3*(4), 316-330.

Lemyre, L., Gibson, S., Markon, M.P.L., Lee, J., Brazeau, I., Carroll, A., Boutette, P., &Krewski, D. (2009a). Survey of public perceptions of prion disease risks in Canada: What does the public care about? *Journal of Toxicology and Environmental Health (Part A), 72*, 1–9.

Lemyre, L., Gibson, S., Zlepnig, J., Meyer-MacLeod, R., &Boutette, P. (2009b). Emergency preparedness for higher risk populations: Psychosocial considerations. *Radiation Protection Dosimetry,134*(3-4), 207-214.

Lemyre, L., & Tessier, R. (1988). Mesure de Stress Psychologique (MSP): Se sentir stressée [Psychological Stress Measure (PSM): Feeling stressed]. *Canadian Journal of Behavioural Science, 20,* 302-321.

Lemyre, L., &Tessier, R. (2003). Measuring psychological stress: Concept, model, and measurement instrument in primary care research. *Canadian Family Physician, 49,* 1159-1160.

Masten, A.S., Best, K.M., &Garmezy, N. (1990). Resilience and development: Contributions from the study of children who overcome adversity. *Development and Psychopathology, 2,* 425-444.

Moffat, J. (2003). *Complexity Theory and Network Centric Warfare*. Washington, DC: CCRP.

Norris, F. H., Stevens, S. P., Pfefferbaum, B., Wyche, K. F. &Pfefferbaum, R. L. (2008). Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology, 41*, 127-150.

Nutt, P. C. (1976). Models for decision making in organizations and some contextual variables which stipulate optimal use. *The Academy of Management Journals, 1*(1), 84-98.

Paton, D., & Johnston, D. (2006). *Disaster Resilience: An Integrated Approach*. Springfield, IL: Charles C Thomas Publisher Ltd.

Paquet, G. (1999). *Governance Through Social Learning*. Ottawa, ON: University of Ottawa Press.

Paquet, G. (2005). *Gouvernance: Une invitation a la subversion*. Montreal, QC: Liber.

Paquet, G. (2009). *Scheming Virtuously: The Road to Collaborative Governance*. Ottawa, ON: Invenire Books.

Pfefferbaum, B., Reissman, D. B., Pfefferbaum, R.L., Klomp, R. W., &Gurwitch, R. H. (2005). Building Resilience to Mass Trauma Events. In L. S. Doll, S. E. Bonzo, D. A. Sleet, & J. A. Mercy (Eds.), *Handbook of Injury and Violence Prevention* (pp. 347-358). Atlanta, GA: Springer Science.

Pfeifer, J. W. (2005). *Command resiliency: An adaptive response strategy for complex incidents* (Unpublished Master's thesis). Naval Postgraduate School, Monterey, California, United States.

Red Cross. (2004). *World Disasters Report: Focus on Community Resilience*. London: International Federation of Red Cross and Red Crescent Societies.

Rosenau, J.N. (1997). Many damned things simultaneously: Complexity theory and world affairs. In D.S. Alberts, & T.J. Czerwinski (Eds.), *Complexity Global Politics and National Security* (pp. 107-119). Washington, DC: National Defense University.

Smith, R.E., Smoll, F.L., & Ptacek, J.T. (1990). Conjunctive moderator variables in vulnerability and resiliency research: Life stress, social support and coping skills, and adolescent sport injuries. *Journal of personality and social psychology, 58*(2), 360-370.

Taylor-Powell, E., Rossing, B., & Geran, J. (1998). *Evaluating collaboratives: Reaching the potential.* Madison, WI: University of Wisconsin-Extension.

Taylor-Powell, E., & Rossing, B. (2009). *Evaluating Collaborations: Challenges and Methods.* Retrieved October 1st, 2009 from http://danr.ucop.edu/eee-aea/rossing.html

Youssef, C.M., & Luthans, F. (2005). Resiliency development of organizations, leaders and employees: Multi-level theory building for sustained performance. In W.L. Garder, B.J. Avolio, & F.O. Walumbwa (Eds.), *Monographs in Leadership and Management (Volume 3). Authentic Leadership, Theory and Practice: Origins, Effects and Development* (pp. 303-344).

Walsh, F. (2003). *Strengthening Family Resilience* (Second edition). New York: The Guilford Press.