Defence Research and Development Canada
Recherche et développement pour la défense Canada

DEFENCE R&D DÉFENSE

Meta- Analysis of Hurricane Katrina
Lessons Learned

Doug Hales
Jordan Miller

Defence R&D Canada – Centre for Security Science

DRDC CSS CR 2008-07

March 2008

Canada

Principal Author

Doug Hales, Jordan Miller

CAE

[Principal Author Title]

Approved by

Paul Chouinard

DRDC Centre for Security Science Operational Research Analysis

Approved for release by

Dr. Andrew Vallerand

Chair – Centre for Security Science Document Review Panel

Abstract

This work provides analysis of the meta-organizational factors that contributed to the catastrophic results of Hurricane Katrina in New Orleans in August 2005. Organizational, cultural, sociological and technical issues were examined, and interactions between them, to underline the conditions that allowed New Orleans to be so significantly flooded. Research began with White House documents, and quickly branched out into varied collateral sources including the US Senate, the US Army Corps of Engineers, the Government Accountability Office, State and Local government documents and interviews with officials, the Public Broadcasting Service, and academia. The research was performed in support of a Defence Research and Development Canada (DRDC) Technology Investment Fund (TIF) supported by the Centre for Security Science (CSS).

The research sought to identify capability gaps, organizational and institutional limitations that allowed Katrina to manifest catastrophe on the scale observed, and to draw comparisons to the Canadian context where applicable. Identified gaps were mapped to the Defence S&T Strategy to identify where lessons are applicable in the Canadian all-hazards Emergency Response context.

Résumé

Ce document a fourni une méta-analyse de tous les facteurs qui ont contribué à faire en sorte que l'ouragan Katrina devienne une telle catastrophe en Nouvelle-Orléans en août 2005. La recherche a commencé à partir de documents du gouvernement américain et s'est rapidement étendue à différentes sources parallèles, notamment de documents du Sénat américain, du corps des ingénieurs de l'armée américaine, des gouvernements des États et des administrations locales, d'entrevues avec des fonctionnaires, de la Public Broadcasting Service et de représentants du monde universitaire. La recherche a été effectuée grâce à un Fonds d'investissement technologique (FIT) de Recherche et développement pour la défense Canada, lui-même financé par le Centre des sciences pour la sécurité (CSS).

La recherche visait à déterminer les lacunes et les faiblesses structurelles qui ont permis à Katrina de devenir une catastrophe à l'échelle observée; cette recherche avait aussi pour but d'établir une comparaison entre le contexte canadien lorsqu'il y avait lieu. À partir des lacunes relevées, on a tenté d'établir des correspondances dans la Stratégie S&T pour la Défense afin de déterminer les endroits où ces leçons peuvent d'appliquer au contexte canadien des interventions d'urgence tous risques.

This page intentionally left blank.

Executive summary

Hurricane Katrina was the most devastating natural disaster in American history, according to some sources causing as much as $160 billion dollars in aggregate damage. This did not happen on its own, and was the culminating effect of inadequate risk assessment, insufficient resources and planning to adequately address the vulnerabilities in the risk assessment, and institutions organized in such a fashion as to hamper coordinated efforts throughout the emeregency management (EM) cycle.

This work attempts to identify the capability gaps and limitations in the US EM cycle that permitted a catastrophe of this scale to occur. The research was performed in support of a DRDC Technology Investment Fund (TIF) to identify gaps in the Canadian Emergency Management (EM) mechanism. All lessons learned from Katrina were mapped against the Department of Homeland Security (DHS) Target Capability List (TCL); the full cycle is examined in this work, with issues emphasized as appropriate.

This work contains a concise narrative of events in New Orleans, and of the history of Federal Emergency Management Agency (FEMA), the agencies most commonly pilloried in the media for the failures during Katrina. The myth surrounding the perception of ineptitude is addressed through the history and bureaucratic shuffle of the post-9/11 US political landscape. This portion of the research will indicate there were significant structural factors preventing FEMA from responding as expected. Canadian plans are examined to determine if there are similar structural issues that could inhibit a Canadian response to a disaster.

Prevention is investigated to show how Canada's vulnerabilities to natural disasters and the driving factors. Hurricane Katrina underlined the significance of the loss of wetlands and marshes, New Orleans' key defences against a storm surge. Areas vulnerable to flooding, tidal and freshwater, in Canada are examined in terms of how the threat is defined and what measures are being taken to prevent a disaster before one occurs. The impacts of urban growth and social vulnerabilities are also examined.

The Response aspects of Hurricane Katrina and Canada are not examined thoroughly. Due to the gravity of the impact on New Orleans an assessment of response consistently returns to the same factors: lack of communication, and the flooding of routes in and out. Suffice it to say that in either context responders cannot perform their duties when they become casualties themselves. The Recovery measures enacted after Katrina are also analyzed for their effectiveness, and the potential future dangers of some measures taken.

All of the capabilities identified in the course of the research are mapped to the DHS TCL and/or the Defence S&T Strategy as appropriate. This work provides recommendations and conclusions based on the documents examined.

This page intentionally left blank.

Sommaire

This page intentionally left blank.

Table of contents

List of figures

1. Introduction

1.1 Project Objectives

This study is intended to support a broader Advanced Research Project aimed at modelling meta-organizational collaboration and decision making. This is a timely/topical issue given the complexity of the modern security challenges and the requirement for cross-agency coordination and multidisciplinary collaboration. The objective of the project is to develop a modelling capability that captures psychological, informational and physical factors allowing exploration and evaluation of decision-making structures, practices and tools. This particular study supports the objectives of the project.

1.2 Study Objectives

This study began with existing after action reports and lessons learned documents to understand how Hurricane Katrina became a catastrophe on the scale that it did. Particular focus was placed on the command & control, and its supporting functions like communications, intelligence and risk management. This study will be used to support a broader Technology Investment Fund (TIF) initiative to model meta-organization structure and relationships. It may also be used to inform S&T investment planning.

This study provides a narrative of the factors that allowed this catastrophe to manifest, and the organizational weakness and lack of clarity for emergency management in the United States: The Department of Homeland Security, The Federal Emergency Management Agency, the National Guard, State police, Local Police, etc, did not have common goals, practices or organizational cultures to facilitate interoperability. Their linkages to a meta-organizational command structure were unclear, and mostly ineffective.

Capability deficiencies identified in the research are characterized using the DHS taxonomy. Deficiencies will be compared (generalized where necessary) to the Canadian context. The start point is to establish familiarity with the DHS taxonomy. Command and control gaps identified in the research will be categorized. Some may fall into multiple categories; the focus is not on specific response component (e.g. fire trucks, buses, dredgers, boats, etc) but on mission areas and capabilities. Specific response capabilities will be included only where they are crucial for the situational awareness/decision making systems to function.

The initial research of US documents is stored in an .xls spreadsheet for the sake of simplicity and exportability. In summary, the initial priorities are to:

- Map lessons to the DHS taxonomy;
- Identify capability gaps, focusing on C2;
- Generalize for the Canadian context; and
- Relate capability gaps to DRDC S&T expertise areas.

Copies of the DHS framework and some action-after reports were provided for the kick-off meeting

1.3 Scope

The timeframe allotted allowed the final product to develop with some constraints. This work will highlight failures in the response to Hurricane Katrina, and provide recommendations for further research into possible gaps in the Canadian response mechanism. The US government published many official lessons learned, though does not provide a comprehensive analysis of all the issues surrounding the catastrophe. Collateral material from academia, the Public Broadcasting Service (PBS), and civil society organization supplements the initial documentation to provide a more robust, nuanced assessment of the incident. The lessons learned are mapped to the US Department of Homeland Security (DHS) target capability list, and also mapped to the Canadian Defence S&T Strategy document.

This project emerged to satisfy components of the Technology Information Fund: “Modelling Meta-Organisational Collaboration and Decision Making”. Successful modeling must consider human and organisational factors, which are currently not adequately addressed, and certainly not at a meta-organisational level. The aim of this project is to develop a modeling capability that captures pertinent conceptual and psycho-sociological as well as informational and physical factors for the purpose of assessing meta-organisational decision-making structures, practices and processes. The persistence of “coordination” as a problem in operations indicates a deeper issue than merely the need to “coordinate” tasks, which relates to the nature of the relationships amongst entities within a meta-organisation and whether or not the set of relationships and consequent meta-organisational form promotes or hinders collective decision-making. The research and findings of this project seek to support modelling the structure and dynamic relationships within a meta-organisation and understand how the different forms affect success in achieving individual and collective goals.

This work does not attempt to assign personal blame for the catastrophe: it does attempt to identify the specific flow of information, warnings, bulletins, and requests for assistance of any kind five days fore landfall. It does attempt to uncover long-standing risk assessment and risk management issues in the years leading up to the catastrophe, and the effects this had on the organizational culture of emergency management at the local, state and federal levels. The narrative section of this work seeks to provide a history spanning the creation of FEMA in 1979, to the response in 2005.

2. Narrative

2.1 Brief Summary of the Events

Hurricane Katrina made landfall on New Orleans at approximately 0600, 29 August 2005. That Katrina was an active, volatile storm in the area was not unknown; the storm was being tracked by the FEMA National Situation Update in the days leading up to Katrina. New Orleans was the second landfall, after 25 August 2005 at 1900, north of Miami as a category 1 hurricane with 75 mph maximum sustained winds. [1] The following day the FEMA National Situation Update read: "Katrina will regenerate on Friday over the Gulf of Mexico and head west northwest and then turn northward up into the northern Gulf of Mexico. Hurricane winds and flooding rain is a threat late Sunday into early next week in the northern Gulf and up into the Southeast."[2]

Anticipating that the hurricane could strike New Orleans with disastrous consequences, at approximately 4pm State officials decided that the Louisiana Emergency Operations Centre would be activated the following morning; one hour later all the organizations comprising the EOC were on a conference call of the plan, and agreed that contra-flow traffic measures would be enacted the following afternoon.[3] Contra-flow traffic means one side of the highway is converted to heading the other direction. These measures double the volume of traffic that can evacuate the city. With a category 3 hurricane bearing down on the city, possibly stronger by the time it makes landfall, the more people that can be effectively evacuated, the fewer remain vulnerable within the city.

Contra-flow allowed those with personal vehicles to evacuate the potentially dangerous area quickly, but what of those without cars? The vast majority of those who remained in the city did so for lack of personal vehicles. Buses were slated to provide evacuation, however according to the mayor, the drivers and buses were insufficient to handle the job of evacuation: 'Everybody was evacuated at that time. We did not have the drivers. We had the buses, but there were no drivers. We had to scrounge around to find enough buses'.[4] The degree to which people in general were notified of the disaster is unclear. The message was disseminated on the radio, television, and by word of mouth using church-based groups: "We [New Orleans leadership] communicated with all of the people in the city, especially the churches, to say, "Look, this thing is coming." We faxed out to every one. We had talked about the buddy system. And for the most part, a lot of churches participated and got people out."[5] Those who remained in the city were largely the elderly, infirmed, poor, and the vast majority African-American. Those with cars presumably had radios in them, and would hear the announcement as part of their daily activities involving cars.

---

[1] PBS Frontline – 14 days: A Timeline. http://www.pbs.org/wgbh/pages/frontline/storm/etc/cron.html
[2] FEMA – National Situation Report. "*as of 5:30 am Friday, August 26, 2005"*.
http://www.dhs.gov/xlibrary/assets/2005Aug26_FEMA_Natl_sitrep.pdf
[3] Bradberry, Johnny B. (Secretary; Louisiana Department of Transportation and Development) *Written Testimony Of:*. http://hsgac.senate.gov/_files/013106Bradberry.pdf.
[4] PBS Frontline – Interview: Ray Nagin.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/nagin.html#4
[5] Ibid.

On August 27th FEMA announced that Katrina had grown to a category 3 storm, and based on readings from reconnaissance aircraft the storm was likely to grow more still.[6] The graphics published in the report clearly indicated the storm was projected to make landfall just east of the mouth to Lake Ponchartrain. National Hurricane Center director Max Mayfield tells the *Times-Picayune* newspaper, "This is scary … this is the real thing."[7]

On the morning of the 29 August 2005 Hurricane Katrina struck New Orleans. The storm passed without flooding the city with rainwater; the flooding began on a wide scale in the hours after the hurricane passed New Orleans city officials realized that the levees had failed along the 17th Street Canal.[8] The sheer volume of water within the city hampered an effective response. Cellular telephone towers were downed, electricity delivery failed, landline telephone lines were destroyed: communications were blinded in many areas. Further limiting response, a number of 9-1-1 call centres were flooded, police stations were flooded, Jackson barracks (home station of the National Guard in New Orleans) was also flooded. Members of the response mechanism became victims of the hurricane, negating assistance to the rest of the population.

By day two (Tuesday, August 30) the Army Corps of Engineers attempted to plug breaches in the 17th Street Canal and Industrial Canal levees. Their efforts unfortunately fail and the city continues to flood. Rescue efforts begin, with helicopters dropping people at the Superdome or convention centre; there are also reports of looting at this time.[9] All of this underlines the lack of preparedness for a disaster of this magnitude. The evacuation efforts were incomplete due to poor planning, first responders became victims, State (National Guard) and Federal (FEMA) responders could not organize an effective response, all compounded by communications failures. The flooding on the roads negated any vehicle movement, meaning FEMA could not get the available supplies from forward positions into the city to those who needed them. Most of the New Orleans support facilities were insufficiently stocked also.

On days three through five (31 August – 2 September 2005) it becomes obvious that state and federal assistance should have been requested earlier. Without a military presence equipped for the magnitude of response the situation demanded thousands remained stranded. Despite statements from FEMA to the contrary, thousands remained without food, water or rescue at the Superdome on Convention centre in New Orleans. On the sixth day federal troops enter the city to restore order and provide as much relief as possible. On day six (3 September) federal troops arrived in the city with the appropriate resources to address the catastrophe, and began aggressively providing assistance to those still in the city. FEMA director Michael Brown admitted his greatest error in the response was to not have asked for federal troops sooner.

2.2 History of Hurricanes on the Gulf Coast

Andrew

[6] FEMA – National Situation Report. *"as of 5:30 am Saturday, August 27, 2005"*.
[7] PBS Frontline – 14 Days: A Timeline.
[8] PBS Frontline – Interview Walter Maestri.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/maestri.html
[9] PBS Frontline - 14 Days: A Timeline.

FEMA's response to Hurricane Andrew was poorly planned, and was a major reason for the organizational and cultural overhaul lead by Bill Clinton. Damage from hurricane Andrew was estimated at $25 billion. Andrew's impact on southern Florida was extreme, from Dade County to near Key Largo. Andrew reportedly destroyed 25,524 homes and damaged 101,241 others. The Dade County Grand Jury reported that ninety percent of all mobile homes in south Dade County were totally destroyed. In Homestead, more than 99% (1167 of 1176) of all mobile homes were completely destroyed.[10] As a result of this disaster thousands become stranded without food and water. Overwhelmed local emergency managers wait in vain for FEMA. It takes five days for federal troops to arrive.[11] Hurricane Andrew was, up to that point, the largest response operation FEMA had undertaken, and not surprisingly had significant difficulty addressing it effectively and within a reasonable time frame.[12] Similar to Hurricane Katrina, many communications systems were down and destroyed, and many of the first responders meant to help those in need were casualties themselves.[13] The impact of the disaster was more spread out during Andrew than during Katrina, but a devastating incident nonetheless.

Ivan

Hurricane Ivan represents the disaster that never was. Hurricane Ivan made landfall as a Category 3 storm on September 16, 2004, passing between the cities of Mobile, Alabama and Pensacola, Florida with the eye located just west of the Alabama-Florida line.[14] Though it was headed for landfall in New Orleans, it totally missed veering east as it approached the coast, causing minimal damage. Walter Maestri, an emergency planner for Jefferson Parish indicated that if New Orleans was hit the city could have flooded with as much as 22 feet of water[15] in some places. Nonetheless Mayor Ray Nagin called for an evacuation of the city as the hurricane bore down closer on New Orleans. There were concerns expressed that evacuating the city without any damage was tantamount to crying wolf. These claims could not be confirmed by survey research conducted in the New Orleans parishes. "Ivan was the largest evacuation experienced by south-eastern Louisiana, but from our research, there does not appear to be either a positive or negative effect on willingness to evacuate in the future. Willingness to evacuate in the hypothetical evacuation scenario is nearly identical in the pre- and post-Ivan parishes."[16] This was confirmed later; approximately 13 of 14 people evacuated New Orleans as Katrina approached. The inference being that despite the seemingly ambivalent respondents, when evacuation measures are enacted, most take them seriously. What remains unclear is how many stayed in New Orleans out of will, and how many stayed because they lacked the means to evacuate.

---

[10] National Oceanic and Atmospheric Administration. *Hurricane Andrew: 16-28 August 1992 – Preliminary Report.* http://www.publicaffairs.noaa.gov/andrew92.html

[11] PBS Frontline - A Short History of FEMA.

[12] Morrow, B.H., Peacock, W.G. *Hurricane Andrew: Ethnicity, Gender and the Sociology of Disasters.* Routledge – 1997. pp 227.

[13] Quarantelli, E.L. *Catastrophes are Different From Disasters: Some Implications for Crisis Planning and Managing Drawn From Katrina.* Disaster Research Centre – University of Delaware.

[14] Mittiga, Mary., Sharpe, Vicki. *The Aftermath of Hurricane Ivan: reconstructing roadways while recovering species.* John Muir Institute of the Environment – University of California. 2006.

[15] PBS Nova Science Now – Hurricanes. Aired: Jan 25, 2005 http://www.pbs.org/wgbh/nova/sciencenow/dispatches/050901.html

[16] Howell, S.E., Bonner, D.E. *Citizen Hurricane Evacuation Behaviour in Southeastern Louisiana: A Twelve Parish Survey.* Survey Research Centre – University of New Orleans. July 2005.

Pam (exercise)

Ivan was a very near miss in New Orleans in 2004, and prompted concerns at FEMA over the readiness of the city should the next Ivan make landfall in or around New Orleans. Hurricane Pam was an exercise run by FEMA by creating the worst case scenario possible. Ivan was a category 3 hurricane that missed New Orleans. Pam represented a category 2 or 3 storm not heading directly toward New Orleans that would suddenly veer toward the city while gaining force to a category 4 or 5. This scenario was so severe because the initial category 2 or 3 would not necessitate and immediate evacuation of the city. The city would be full of people when the category 4 or 5 hurricane struck, inevitably running the casualty rate many times higher than seen during Katrina. This scenario would have breeched much of the Lake Pontchartrain sea wall and flooded most of the city under 20+ feet of water. The exercise used realistic weather and damage information developed by the National Weather Service, the U.S. Army Corps of Engineers, the LSU Hurricane Center and other state and federal agencies to help officials develop joint response plans for a catastrophic hurricane in Louisiana.[17] The intention was to create the worst possible response scenario, and from the exercise identify the shortcomings in the response mechanism. Tragically however, many of the sections with respect to search and rescue, communication, and the associated tasks and staffing remained as 'to be determined' (TBD) when exercise funding was cut. These areas left undetermined were notably lacking in preparedness when Katrina struck. Tragically, a former FEMA official said that "funding dried up" for follow-up to the 2004 Hurricane Pam exercise, cutting off work on plans to shelter thousands of survivors.[18] This means that whatever conclusions came from the Hurricane Pam exercise were never explored or validated, particularly measure to help the most vulnerable, who ended up shouldering the brunt of hardship levelled by Hurricane Katrina.

2.3 The Federal Emergency Management Agency (FEMA)

2.3.1 Organizational History

Currently, 'the primary mission of the Federal Emergency Management Agency is to reduce the loss of life and property and protect the Nation from all hazards, including natural disasters, acts of terrorism, and other man-made disasters, by leading and supporting the Nation in a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery, and mitigation.'[19] This is all in support of DHS's broader mission to 'lead the unified national effort to secure America. We will prevent and deter terrorist attacks and protect against and respond to threats and hazards to the nation. We will ensure safe and secure borders, welcome lawful immigrants and visitors, and promote the free-flow of commerce.'[20] As an agency of DHS, FEMA is responsible for supporting the overall DHS mission by executing its responsibilities within its area of responsibility. It is worth examining the history of the organization to understand how it ended up as an agency of DHS.

---

[17] FEMA Press Release. *Hurricane Pam Exercise Concludes.* 23 July, 2004. Release Number: R6-04-093
[18] Shane, Scott., Lipton, Eric. *Government Saw Flood Risk, but not Levee.* New York Times – 2 September 2005.
[19] FEMA Website – *What We Do*. http://www.fema.gov/about/index.shtm
[20] Department of Homeland Security. *Securing the Homeland.* http://www.dhs.gov/xabout/strategicplan/index.shtm

In the 1960s and 1970s America experienced a number of serious natural disasters requiring significant federal response and recovery operations oversight from the Federal Disaster Assistance Administration, a cell established within the Department of Housing and Urban Development (HUD). The National Flood Insurance Act passed in 1968 offered new flood protection to homeowners, and the 1974 Disaster Relief Act even more firmly established the process of Presidential disaster declarations.[21] To create a durable, responsive instrument the US Federal Emergency Management Agency was created in 1979 by then President Jimmy Carter after state governors pressed the federal government for a more effective means to coordinate disaster relief.[22] During the 1980s America experienced few national disasters and the agency's senior positions were staffed largely with political appointees with limited or no experience in emergency management. FEMA has been described at its worst as a 'backwater and a parking lot for political appointees'[23] during the 1980s. Unfortunately this contributed to a culture of complacency pervasive within the organization that, in turn, inhibited responding effectively to Hurricane Andrew in 1992.

Hurricane Andrew shocked FEMA and challenged the existing patronage ethos. Mid-disaster, the FEMA director, Wallace Stickney, was dismissed in favour of Andrew Card (later to re-emerge as current President Bush's Chief of Staff). That the organization was unable to address the disaster effectively should not be so surprising because FEMA had 10 times the proportion of political appointees of most other government agencies; the poorly chosen Bush appointees had a profound effect on the performance of the agency.[24] Hurricane Andrew was the most expensive natural disaster in U.S. history [to that point] with insured losses topping $15.5 billion in nominal terms and total property losses exceeding $26 billion.[25] Whether FEMA could have mitigated this will never be known, but it is certain that an effective response took a week to deploy to the affected area, too long by any measure, and quite unacceptable in a disaster of that magnitude.

One of Bill Clinton's first acts after winning the Presidential election was to appoint James Lee Witt, a professional emergency manager from his home state of Arkansas. This was the first time an individual was appointed director who had emergency management experience. FEMA was also elevated to cabinet-level status, with much shorter lines of communication to the White House. According to Witt "we had the responsibility of coordinating 22 federal agencies as part of the Federal Response Plan. We also had a role in the national security side that we had to fulfill, and we also were dealing with a tremendous amount of money that affected budgets."[26] During Witt's tenure 'Project Impact' was established as a prevention and protection measure: "Through its four-pronged program, Project Impact builds safe communities when individuals, businesses, and community leaders take the following steps:

---

[21] FEMA History. http://www.fema.gov/about/history.shtm
[22] PBS Frontline – The FEMA Story. http://www.pbs.org/wgbh/pages/frontline/storm/themes/fema.html
[23] PBS Frontline – A short history of FEMA.
http://www.pbs.org/wgbh/pages/frontline/storm/etc/femahist.html
[24] Franklin, Daniel. *The FEAM Phoenix: The Reform of the Federal Emergency Management Agency.* Washington Monthly. July/August 1995.
http://www.washingtonmonthly.com/features/2005/0509.franklin.html
[25] National Hurricane Center, (2005), "Costliest U.S. Hurricanes 1900-2004 (unadjusted), http://www.nhc.noaa.gov/pastcost.shtml.
[26] PBS Frontline – Interview James Lee Witt.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/witt.html

- Identify and recruit Project Impact partners in the community such as local government leaders, civic and volunteer groups, businesses, and individual citizens.
- Determine the community's risk for falling victim to natural disasters.
- Set priorities and target resources to reduce impact of future disasters.
- Keep the entire community informed and focused on Project Impact's ability to reduce damage and costs of future disasters."[27]

This reflects a significant institutional culture shift in a five year period. The organization had a reputation as being a place where political appointees were placed as a reward, to an organization that was spending money on preventative and protective measure to mitigate the damage of future disasters. It is the difference between passive maintenance of the organization vice active promotion of effective EM procedures. It is reasonable to conclude these changes were largely the result of personality in the form of Witt's leadership. The Department of Homeland Security (DHS) would face similarly significant challenges (integrating many organizations into one) when it was established post 9/11.

The effectiveness of Witt's leadership can be concluded with confidence because when he stepped down as FEMA director at the end of President Clinton's tenure the organizational culture shifted back toward the inertia characteristic of the 1980s. Joe Allbaugh, President George W. Bush's appointee as FEMA director was intent on cutting the funding to FEMA believing it to be an 'entitlement program'. Warren Rudman (Republican Senator), a co-chair of the Hart/Rudman Commission, created in 1998 to evaluate and reassess U.S. national security policies described Allbaugh's leadership as being detrimental to the changes led by Witt: "He might have been right in some of those things, but in some of the authorities that they took away and some of the people they lost, it probably was a mistake".[28]

Making matters worse for FEMA it was amalgamated into DHS after 9/11, losing its cabinet status and access to the White House and the President. FEMA was a coordination organization in the first place, with very few resources of its own. Equally, DHS has very few resources, serving as a coordination body for all the functions of government related to homeland security, with a specific focus on terrorism prevention and response. The effectiveness with which FEMA was integrated into DHS, and indeed DHS's effectiveness in integrating all its constituent parts into a functioning mechanism is highly suspect. The US Comptroller General testified in February 2007 that with respect to disaster preparedness and response "DHS must overcome continuing challenges, including those related to clearly defining leadership roles and responsibilities, developing necessary disaster response capabilities, and establishing accountability systems to provide effective services while protecting against waste, fraud, and abuse."[29]

FEMA was sidelined in terms of importance under DHS, whose focus was primarily on preventing and responding to terrorist attacks on the United States. This joining of FEMA into DHS was not taken well by FEMA, not was it a priority of DHS: "The idea was never

[27] FEMA. *Project Impact: Building a Disaster Resilient Community.* Release Date: November 22, 1999. Release Number: 1293-71. http://www.fema.gov/news/newsrelease.fema?id=8895

[28] PBS Frontline – Interview Walter Rudman. http://www.pbs.org/wgbh/pages/frontline/storm/interviews/rudman.html

[29] General Accounting Office. *Homeland Security: Management and Programmatic Challenges Facing the Department of Homeland Security*, GAO-07-452T (Washington, D.C: Feb. 7, 2007).

fully embraced by then-Director of FEMA Mike Brown, or even by the secretary of homeland security. They had a lot of other things to do on their plate, and Tom Ridge (first Secretary of Homeland Security) in particular, as I said, had one of the biggest managerial challenges that any government official has ever faced. And this issue of response and building FEMA into something more than it was and integrating it into the department was sort of a second- or third-order priority. I think that's too bad, but that's how I saw it develop."[30] This creates a very unfortunate organizational environment in which the junior partner is hesitant and resistant to join the senior organization, and the senior organization does not consider the junior a priority. This does not create an environment conducive to successful cooperation or trust.

This is one of the many explanations as to how FEMA returned to being perceived as a second-rate organization, and not a priority of the Federal government. The result was a failure to conduct exercises, and an erosion of response capability to a lack of clarity and understanding as to how the organization would manage emergencies: "A key issue in the response to Hurricane Katrina was the lack of clearly understood roles and responsibilities. An aspect that continues to be a subject of discussion is the roles and responsibilities of the Federal Coordinating Officer (FCO), who has the authority to make mission assignments to federal agencies for response and recovery, and the Principal Federal Official (PFO), whose role was to provide situational awareness to the Secretary of Homeland Security."[31]

In the wake of Hurricane Katrina FEMA had preparedness removed from its mandate, a disastrous mistake according to then Director Michael Brown in an email to Michael Jackson, the second-in-command at DHS. In the email he pleads that emergency management is a cycle, and that to remove a link is to break the cycle and limit the effectiveness of managing any emergency.[32] This, in addition to an organization that has yet to regain its effectiveness since being amalgamated into DHS, represents a decline in the organizational responsibilities of FEMA, and with it a decline in the organization's effectiveness to respond, let alone manage, emergencies.

2.3.2 Institutional Theory

Institutional theorists contend that the institutional environment strongly influences the development of organizational structure and organizational performance, i.e. while individuals come and go, institutions persist and inform behaviour. Throughout its existence FEMA has struggled to establish its political mandate and authority. In such cases there is a danger that organizations will decouple their technical core from these "legitimizing" structures and they will minimize or ceremonialize evaluation and implementation programs to sustain confidence in formal structures.[33] Institutionalization can be defined as the development of stable patterns of

[30] PBS Frontline – Interview Richard Falkenrath.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/falkenrath.html
[31] General Accounting Office. *Homeland Security: Observations on FEMA and DHS Efforts to Prepare for and Response to Major and Catastrophic Disasters and Address Related Recommendations and Legislation*, GAO-07-1142T. (Washington, D.C: July 31, 2007).
[32] PBS Frontline – Brown's 2005 Memo of Concern.
http://www.pbs.org/wgbh/pages/frontline/storm/etc/brownconcern.html
[33] Institutional Theory: Meyer & Rowan, DiMaggio & Powell,
http://faculty.babson.edu/krollag/org_site/org_theory/Scott_articles/rs...

behaviour and understanding. While frequently critical, post-Katrina analysis does not appear to have included an assessment of FEMA's institutional strength. Peters has identified four dimensions/criteria which might be used to evaluate the extent of institutionalization:[34]

- Autonomy: the capacity of an institution to both make and implement decisions. Cursory research suggests that FEMA's mandate was/is (along with Public Safety Canada's) centred on policy development and program coordination. The Post-Katrina Reform Act keeps FEMA within DHS; the act enhanced FEMA's responsibilities and its autonomy within DHS, and will lead and support the nation in a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery, and mitigation.[35] However, without a corresponding increase in assets, it is difficult to know for sure if FEMA will be any more autonomous in practice in the future.

- Adaptability: the extent to which an organization is capable of both adapting to changes and shaping its environment. FEMA's history and the nature of emergency management indicate it was largely reactive; institutionally weak. The Post-Katrina Act recommends FEMA be more flexible, yet paradoxically emphasizing balancing 'the need for fast and flexible response against the need to prevent waste, fraud, and abuse'[36] giving the impression that more rules and regulations must accompany a rapid, effective response. FEMA was self-declaredly an organization with almost no resources, and could only coordinate the delivery of resources. This is changing by allowing FEMA to 'lean forward and provide immediate support to a disaster site mainly through FEMA-owned goods and assets, and later on to establish sustained supply chains with the private vendors.'[37] The ability to use owned resources and coordinate with external agencies indicates a willingness to adapt more effective methods of emergency service delivery.

- Complexity: the capacity of an organization to configure internal structures. Whether the autonomy and adaptability FEMA is striving for can be maintained will partially depend on how well it can coordinate all its assets and delivery agents.

- Coherence: the capacity of an organization to manage its workload and develop internally consistent and effective processes, not least to decide on core tasks and filter out diversions. Readings suggest this is an inherent challenge exacerbated by externally imposed changes in emphasis. The complexity of the task at hand will in part dictate how coherently the challenges can be met.

---

[34] B. Guy Peters, Institutional Theory: Problems and Prospects, Institute for Advanced Studies, Vienna

[35] General Accounting Office. *Homeland Security: Observations on FEMA and DHS Efforts to Prepare for and Response to Major and Catastrophic Disasters and Address Related Recommendations and Legislation*

[36] General Accounting Office. *Catastrophic Disasters: Enhanced Leadership, Capabilities and Accountability Controls Will Improve the Effectiveness of the Nation's Preparedness, Response and Recovery System.* September 2006 - GAO-06-618.

[37] General Accounting Office. *Homeland Security: Observations on FEMA and DHS Efforts to Prepare for and Response to Major and Catastrophic Disasters and Address Related Recommendations and Legislation,* GAO-07-1142T. (Washington, D.C: July 31, 2007).

Although implicit there is an assumption that institutionalization is desirable. A sobering, countervailing hypothesis is offered by Carroll in his study of the Pentagon and American attitudes towards war. He suggests that organizational consolidation and expansion of the US military during World War II had cultural implications. "Bureaucracy replaced battle order as the defining social structure" and institutional momentum supplanted personal decisiveness.[38]

The assumption is that governments will develop policy in such a manner as to maximize the 'social welfare function' by providing programs for the greatest societal good; economists increasingly felt this duality assumption – where participants in private markets are assumed to be self-interested utility maximizers while political players are publicly-interested welfare maximizers – was a highly questionable proposition in real life.[39] Upgrading the protection to New Orleans by building levees to an appropriate standard, in retrospect, would have been preferable to the consequences of the catastrophic hurricane. Though evidence existed to indicate that a storm of Katrina's magnitude would eventually hit New Orleans, nothing was done. As indicated above, the availability of information and awareness that social welfare would be best served by certain decisions does not guarantee their implementation.

Prior to a disaster the potential consequences remain somewhat intangible. Without having the immediate task of treating and evacuating the injured, stopping the water, and planning the reconstruction of the city, bureaucrats remain engaged in daily function. Political actors, both executive and legislative, are assigning functions with a public character largely without criteria and with consequences that are expensive to both the public and private sectors.[40] However, as these consequences are not tangible until disaster or catastrophe strikes, little is done to make the issue of insufficient protection to city important to the public discourse.

It is not as though the citizens of New Orleans were ignorant of the threats posed by the levees and their geographic location in an area prone to tropical storms, including hurricanes. Long-term residents have lived through many hurricane threats, and since most of those hurricanes have not directly hit southern Louisiana, these residents are less likely to feel that they should leave their homes. On average, 74% of the residents in these six parishes of New Orleans have lived in southern Louisiana more than thirty years: in no parish were long-term residents significantly more likely to evacuate.[41] Furthermore, an average of 40% of residents in these parishes have both lived in southern Louisiana more than thirty years and have never had hurricane damage to their home.[42] They all remember Ivan, and many likely remember Betsy in 1965. The vast majority indicated they would evacuate the city if recommended to do so by the authorities, but this is a purely reactive behaviour: no demands to reinforce the levees, negating evacuation measures, are forthcoming. This sense of acceptance at the threat of hurricanes, and what appears to be an underlying assumption that all will work out in the end is consistent with a lack of grassroots political organization to demand better protection for the city.

---

[38] Carroll, James. House of War: The Pentagon and the Disastrous Rise of American Power, Boston, Houghton Mifflin, 2006, pp. 28.
[39] Novak, Julie. *Public Choice Theory; An Introduction*. Centre for Independent Studies: Autumn 1998. www.cis.org.au/Policy/autumn98/aut9810.htm
[40] Roe, Ronald C. *Exploring the Limits of Privatization.* Public Administration Review. No 47: Nov/Dec 1987.
[41] Howell, Susan E; Bonner, Dean E. *Citizen Evacuation Behavior in Southeastern Louisiana: A Twelve Parish Study*. University of New Orleans: July 2005
[42] Ibid.

It is possible that the effort required to organize grassroots political action for the purposes of greater protection of New Orleans was deemed not worthwhile, or unlikely to succeed. Forming a coherent position on the issue does not necessarily mean voters will be more engaged on the topic of levees and flooding. "Even though the results of an election may be very important and individual's vote rarely decides an election. Thus, the direct impact of casting a well-informed vote is almost nil: the voter has virtually no chance to determine the outcome of the election. So spending time following the issues is not personally worthwhile for the voter."[43] Even if a minority of citizens was strongly in favour, presumably those living in the lowest-lying areas of New Orleans, there is no assurance that they could influence the broader population. Though individuals may demand better mitigation measures, "the choice calculus of the single individual is constrained by the knowledge that other individuals in the group must agree before the ultimate action can be taken"[44] If the targeted audience will not engage on the issue, and better information will not foster engagement either, the incentive to mobilize political action is absent. Given the sociological division in New Orleans this is certainly a possibility.

When voters refuse to engage change in the priority of service delivery it is unlikely to be delivered: politicians act in rational self-interest in the sense that if they attempt to formulate policies to maximise votes, rather than win an election to formulate important policies later.[45] If the voter seeks to maximize the excess benefits which he/she derives from government expenditure,[46] and given the self-interest of the politician and the absence of demands for better levees based on the assumption that the damage won't be critical or that there will be sufficient time for evacuation, it is not surprising that the levees were not fortified: there would be not electoral benefit for politicians in making levees the issue. Conversely at the US federal level, the fear and vulnerability felt in the United States after September 11, 2001 negated demands for the American people that FEMA remain its own organization; the desire to have a meta-organization to keep the homeland safe (DHS) satisfied the desire for protection more so that did the continuation of a separate emergency management agency. The invasion of Afghanistan, strengthening of the military, etc, all played to a very prominent security agenda, negating emergency management. Twelve of the fifteen DHS Target Capability Areas deal with NBC attacks: this shows a public engaged in the issue of an NBC attack on their shores, and willingness, even if tacit, to accept NBCD as a federal priority at the cost of emergency management. In short because the demand for a public choice to fortify the levees never came politicians never engaged.

The organizations involved in New Orleans ranged from the local, to the State of Louisiana and its agencies and departments, and the Federal government. The lack of cooperation between these large bureaucracies is consistent with the theoretical constructs of organizations. The bureaucracy is understood by formal structures or stipulations of functions and more by assessing the allocation pattern of the yearly budget. This is a somewhat different slant on the 'life cycle' of the bureaucracy, although the basic premise of perpetuating the precedent remains. Once an organization's core allocation pattern is established, securing and retaining the stability of resources became the predominant decision value. Moreover, this cyclical nature leads to

[43] Shaw, Jane S. *Public Choice Theory*. The Concise Encyclopedia of Economics. http://econlib.org/library/enc/publicchoicetheory.html.
[44] Buchanan, James M; Tullock, Gordon. *The Calculus of Consent: Logical Foundations of Constitutional Democracy*. The Library of Economics and Liberty. www.econlib.org/library/buchanan/buchCv3c1.html.
[45] Novak. 1998.
[46] Ibid.

retrenchment of priorities and practices. Decisions are made in increments, branching from the existing core allocation, and from routine. Incremental policy-making ties each nation to its own peculiar past.[47] This results in a bureaucracy 'muddling along' on an annual business cycle.[48]

Policy makers and analysts take as their starting point not the whole range of hypothetical possibilities, but on the here and now in which we live, and then move to consider how alteration might be made at the margin.[49] These points speak to the danger of bureaucratic inertia; if change will only be made slowly, an unwillingness to take the first steps in a series of many virtually ensures the objectives will never be realised. Levee fortification and other significant prevention and protection measures were never implemented, in part, due the significant investment and policy shift required to, first, mobilize the will for the project, and second, the implement it.

The organizational willingness to implement change faced many obstacles in New Orleans, and this was echoed by the organizational friction during the response phase. Complexity comes from the number of influential actors implicated in the decisional system. In this situation, a system of checks and balance favours the model of successive limited comparisons because a decision is distributed between many institutional actors who bargain power and influence.[50] Competing bureaucratic interests, objectives and cultures creates additional obstacles to multi-organizational decision making. For example, the US Army Corps of Engineers is responsible for maintaining, inspecting and fortify the levees, though have no direct bureaucratic connection to New Orleans and the State of Louisiana, the organizations who will be first charged with response should the levees fail. The decentralized nature of American federalism gives individual states considerable power internally, in contrast with the federal organization charged with near-total responsibility for the levees.

The failure to agree on priorities further hampers the development of effective policy. It follows from all that has just been highlighted that for effective policy such a means-end relationship is possible only to the extent that values are agreed upon, are reconcilable, and are stable at the margin.[51]

In summary, structural complexity is a function not only of the number of influential actors within an organization, but also the variable involved, resource constraints and institutional and informational barriers. Coherence within an institutional system is inhibited as structural complexity increases. Resulting from the competing priority within a complex structure changes tend to be incrementally conceived and implemented, with each element of an organization taking a small part of the collective responsibility. The myth that more information within complex systems will lead to better decision-making bears little relation to reality; competing interests hamper decision-making and more information will not lead all parties to the same perspective, or

---

[47] Lindblom, Charles E. *The Science of 'Muddling Through'*. Institution for Social and Policy Studies: Yale University. 1983.
[48] Wiles, Don. *Bureau 'Life Cycle' and Budget 'Muddling'*. www.albany.edu/~dkw32/s3_cycle&muddle.html.
[49] Lindblom, Charles E; Barybrooke, David. *A Strategy of Decision: Policy Evaluation as a Social Process*. Free Press: New York. 1970.
[50] Teisanu, Radu. *Evolution and Institutionalized Intertia.Rethinking the European Decision-Making Process.* July 2006
[51] Lindblom, *The Science of 'Muddling Through'*. 1983

rank priorities in the same way. The challenge is to identify the interdependencies of actions and the social choices that influence decision making.

3. DHS Framework – Recurring Themes

3.1 Mission Areas

In December 2003 Homeland Security Presidential Directive (HSPD)-8 established the US Department of Homeland Security (DHS). Four mission areas were identified – Prevent, Protect, Respond & Recover corresponding to a time sequenced, all-hazards approach to emergency management. This provides a useful framework for an overview of recurrent themes – initial characterization of the broader lessons learned.

3.2 Backdrop

Hurricane Katrina has particular resonance. It is striking for both the severity of the impact and seeming inadequacy of the response. Initial media attention focused on response efforts. Stepping back, and with the advantage of hindsight, it is clear that prevent and protect deficiencies were equally liable and recovery remains a challenge. Two facts stand out; first, the disaster had been anticipated. This was far from a "black swan", an outlying event lying beyond the realm of reasonable expectations. The devastating consequences of a hurricane striking the Gulf Coast and breaching the levees were foreseen and had been predicted. The "Hurricane Pam" exercise was based such a scenario. Second, pre-existing social conditions and known patterns of differential vulnerability resulted in the communal triage which challenged our image of a just society. In short the catastrophic effects stemmed from both failures in protective systems and a reluctance to acknowledge socio-economic structure.[52]

Prevention/Mitigation – Actions taken to reduce or eliminate the effects of an emergency or disaster
Preparedness – Actions taken prior to an emergency or disaster to ensure an effective response
Response – Actions taken to respond to an emergency or disaster
Recovery – Actions taken to recover from an emergency or disaster

[52] Tierney, Katherine. Foreshadowing Katrina: Recent Sociological Contributions to Vulnerability Science, Contemporary Sociology 35, 3.

3.3 Recurring Themes

3.3.1 Prevent

Disaster is the tangible realization of risk[53]

Katrina served to underscore the importance of risk characterization and presentation.

A rigorous risk assessment methodology is required to take the necessary measures to prevent catastrophe. Risk is conventionally viewed as a product of event probability and related consequences; the sum of threat and likelihood There is a subjective element, a danger that given the episodic nature of disasters their probability may not be fully appreciated. More importantly, in the aftermath of Katrina a consensus emerged that too much attention had been paid to probability to the neglect of consequences. Random, unavoidable natural events will continue to put us at risk periodically. Human choices will determine vulnerability to these risks, especially the human choices not to allocated an adequate level of resources to mitigate threats.

Risk will change over time and a continuous assessment process is required. The literature search highlighted the very real danger of risk ossification/homeostasis. The New York Times attributed the catastrophe to "the accumulation of 40 years of compromises"[54]. Underlying assumptions should be revisited regularly and vulnerability re-evaluated. Urbanization may increase vulnerability, as in the case of New Orleans where housing development on the flood plain continued unabated. In similar fashion the sheer complexity and growing interdependence and tightly coupling of sophisticated technology system of systems can pose risks. Although technology systems have built-in safety features, many worry that multiple, small failures can compromise if not overwhelm these. The literature is replete with concern that increasing vulnerability to catastrophic disasters is not well appreciated:

> Natural disasters cause ever greater destruction because of the increasing interdependence of the natural and constructed environments; industrial or technological disasters increase because of the proliferation of sophisticated and potentially dangerous technologies; terrorist and other deliberate disaster increase because of the power of non-state groups and greater lethality of their weapons. Attempts to reduce damage may be short-lived because of risk homeostasis, or the propensity for the degree of risk-taking and the magnitude of loss to remain the same over time.[55]

Underinvestment in maintenance of critical infrastructure can contribute to exacerbating consequences. Authors such as Lee Clarke have suggested more attention be paid to "possiblistic" thinking and exploration of 'worst case' scenarios. While worst case thinking can stretch imaginations and encourage innovation there is a danger that overemphasis can divert attention from investment in mitigating the consequences of more routine "disaster". As Eugene Rosa indicates the much deeper challenge relates to balancing if not reconciling a Cartesian worldview

[53] Rosa, Eugene A. The Sky is Falling; The Sky is Falling… It Really is Falling! Contemporary Sociology, 35,3
[54] Revkin, Andrew. Gazing at Breached Levees, New York Times 2 September 2005.
[55] Roberts, Patrick S. *What Katrina Means for Emergency Management,* The Forum Volume 3 Issue 3 2005 Article 2

and reductionist approach with a holist view and synthesis. "The devil here is not so much in the details as it is in the resistance of cultures and a wide range of powerful institutional actors"[56]. Katrina provides an apt stimulus to review our understanding of risk and dependence on pervasive technologies.

The treatment of risk may be equally important. In a seminal paper, Martin Landau and Donald Chisholm discuss the "arrogance of optimism" and advocate adoption of "failure avoidance management". They note the inherent tension between efficiency (homogeneity, commonality, and standardization) and effectiveness (diversity, duplication, overlap) and argue that organizational culture seeks to adopt synoptic and deterministic certainties of engineering and, in doing so, can promote self-deception. "Optimism restricts anticipation of error, minimizes its probability and leads to the concealment of both its occurrence and the severity of its effects."[57] Martin Guillen extends this argument contending that this can result in attempts to translate uncertainties into risks, establish affinities between emergency response to localized incidents and reaction to much larger emergencies whose consequences are much harder to predict and difficult to deal with.[58] This drive for optimism is pervasive in military culture as well: "we were taken by surprise…Why?-Because we live in hope. Commanders feel relentless pressure to be optimistic."[59]

This may seem some distance from Katrina but one the author cites as an example the assumption that emergency and relief workers will remain at their posts rather than taking care of their families. A case could be made for the value added a "Red Team" could contribute, identifying risks from a perspective not tied to implementation or management of the outcome. Ideally such an initiative would underscore the cultural challenge. A number of scholars have suggested that organizational determinants can distort risk assessments. When people run into incomprehensible scenarios they seek plausible parallels, driven by managerial coercion to demonstrate/exercise control over confusion and a tendency to conflate uncertainty and ambiguity. Accordingly risks are defined, risk managers created and risk acceptability agreed.[60]

In his analysis of the import of Katrina, Patrick Roberts notes that "disaster relief is targeted toward compensating property owners, not to addressing the needs of those without much property to begin with".[61] This suggests that in developing a methodology for assessing systemic risk - integrating risk across scenarios – provisions are necessary for assessing social and psychological impact and challenge to existing authority and legitimacy.

---

[56] Rosa, Ibid.
[57] Landau, Martin and Donald Chisholm, The Arrogance of Optimism: Notes on Failure-Avoidance Management, Journal of Contingencies and Crisis Management, Vol 3 No 2, June 1995, p 69.
[58] Martin F. Guillen's review of Mission Impossible: Using Fantasy Documents to Tame Disaster (lee Clarke, Chicago, University of Chicago, 1999) Administrative Science Quarterly, March 2001., pp 151-153
[59] Gross Stein, Janice; Lang, Eugene. Unexpected War. Canada in Kandahar. Viking Canada. 2007. pp 187.
[60] Book Review Vol 9 No 1 March 2001
[61] Roberts, Patrick S. *What Katrina Means for Emergency Management*, The Forum Vol. 3 Issue 3 2005, p 3.

3.3.2 Protect

As the NATO SAS 065 Panel observed, there is a marked difference between deciding and doing and implementation – the best laid plans – is swayed if not deflected by contingencies. Lieutenant General Strock, US Army Corps of Engineers said "tradeoffs between costs and protection levels were a result of a 'complex process involving the intersection of lot of people from the local, state and national level'". [62] Adam Hughes, an OMB analyst, observed that "such tradeoffs erred far too often on the side of serving short-term needs and discounting long-term risk".[63]

The US Army Corps of Engineers (USACE) is responsible for the monitoring and maintenance of the New Orleans flood protection system, comprising a sea wall, levees, canals and pumping stations. The annual assessments between 2002 and 2004 with respect to the London and 17th St. canals only differed in the timeline of when they expected the upgrades to be complete. There was significant overtopping at both these locations when Katrina made landfall; this is where most of the flooding in the city originated. Over two full years, no work was done on the levees; all that changed was the expected data of completion[64]. This is the most striking example of long-term need overshadowed by short-term convenience.

3.3.3 Respond

Quarantelli supports the view that contends "behaviors in community disasters and everyday emergencies are qualitatively and quantitatively different".[65] He draws a further distinction between disasters and catastrophes. In a typical disaster the homeless seek shelter with friends and relatives; in a catastrophe the facilities and operational bases of almost all emergency management organizations are crippled.

The response yardstick in a catastrophe is fundamentally different from that of a disaster. The history of North American disasters (hurricanes, ice storms, flooding, power outages) is one of resources being stretched to restore order, though by and large order is restored rather quickly. Catastrophes are different in that they are of such a magnitude that no level of planning will ever be sufficient to muster a response as effectively as during a disaster event. When responders become victims, as was the case with the National Guard, the police, 9-1-1 exchanges and hospitals the event has passed from disaster to catastrophe. Red Cross not permitted to deliver aid, because it would 'encourage people to stay'. This list of reasons provided by the Red Cross range from not wanting to disobey National Guard orders, to not having a search and rescue capability; their plan was to provide care *once* survivors were evacuated from New Orleans.[66] There are a number of problems with this reasoning. Firstly, the National Guard was not responsible for commanding a civilian organization, and was not permitted to act as a law enforcement agency, which they essentially were in this case by securing a perimeter, and distributing limited supplies.

---

[62] Revkin, Andrew. Gazing at Breached Leveees, New York Times 2 September 2005
[63] Ibid.
[64] Department of the Army. *Annual Inspection of Completed Works Program: 2004 Annual Inspection for Maintenance of Completed Flood Control Works in the New Orleans District.* Prepared for the Commander of the Mississippi Valley division. 20 December 2004
[65] Quarantelli, E.L. Disaster Related Social Behavior: Summary of 50 yeard of Research Findings
[66] American Red Cross – Frequently Asked Questions.
http://www.redcross.org/faq/0,1096,0_682_4524,00.html

Second, this assumes that those still in the city want to stay there and not evacuate; as we shall see nothing could be further from the truth.

The disproportionate burden borne by the poor in the wake of Katrina is partly the result of evacuation plans being contingent on vehicle ownership. The University of New Orleans produced a report after Hurricane Ivan (2004) indicating the likelihood to evacuate from the path of a hurricane was not linked specifically to income across the parishes. However, this analysis did not treat all parishes equally: 'low income' was a dichotomous function of earning below $25,000 a year. [67] The after-action reports after Hurricane Katrina indicated that Orleans Parish was the most economically depressed of the twelve, indicating a structural bias in this study: more people are eligible for the 'under 25k' segment in this study. The report stated that those listed a poor who did evacuate were more likely to go 'to friends' or relatives homes, or to a place of employment, where they felt safer than in their own homes.'[68] None of these options require a vehicle; more likely a pair of shoes and knowledge of where you are going. Nevertheless, this report concludes, with respect to income as a determinant of the likelihood to evacuate, that 'the number of low income residents who remain in harm's way illustrates the need for both education about the need to travel far enough and providing evacuation assistance to those without means.'[69] For 'means' we can safely assume they are referring to those without vehicles to exit the city on their own.

Though there is an acknowledgement that alternate evacuation plans for those without cars is necessary, there is little done to ensure this happens. The Mayor of New Orleans (Ray Nagin) preferred to download that responsibility to faith-based groups (churches) in the city to arrange transport or shelter for those without the option to leave.[70] Much of the conversation about public transit to evacuate people from New Orleans focuses on how a yard full of city-owned buses were flooded, thus a wasted resource incapable of evacuating survivors. However, what of using the buses before hand to evacuate those without cars prior to landfall? The issue of 'unavailability of drivers'[71]for the buses re-appears consistently in the Mayor's testimony; this claim is difficult to confirm one way or the other. Some of the more blunt commentary indicates that the city and the state did not care about the poor, largely black segments of New Orleans: if they had, the argument goes, they would have based evacuation plans on the assumption that not everybody could self-evacuate[72] prior to landfall. The response to that segment of the population was not well planned, and was worst hit by Katrina, containing the Ninth Ward.

Many were provided no reasonable opportunity to leave the city, and were treated as criminal when they sought what food and water remained in the city. There remained one option: to self-evacuate on foot across a bridge to the South side of the Mississippi. When groups tried to do this they were fired upon, and verbally demeaned by the police guarding the bridge: the sheriff himself cited not wanting the other side of the river to become so crime ridden as Orleans Parish,

---

[67] Howell, Susan E., Bonner, Dean E. *Citizen Hurricane Evacuation Behaviour in Southern Louisiana: A Twelve Parish Study*. July 2005.
[68] Ibid.
[69] Ibid.
[70] PBS Frontline – Interview: Ray Nagin.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/nagin.html
[71] Ibid.
[72] Strolovitch,Dara., Warren, Dorian., Frymer, Paul. *Katrina's Political Roots and Divisions: Race, Class, and Federalism in American Politics*. 11 June 2006.

and thus was preventing people from evacuating to safety.[73] Many who returned, after being turned away at the bridge, tried to organize water and food, only to be broken up at gunpoint by National Guardsmen,[74] ostensibly there to protect those still stranded in the city. This put all those still left in the city in an unsolvable situation: unable to leave the city to save themselves, not allowed to organize the collection of goods, and without any alternate means to secure supplies from the State of Louisiana or FEMA. There were no amenable solutions to this problem without widespread distribution of essential goods and/or rescue from the mostly flooded city. When help finally did arrive from DHS it came in the form of anthrax vaccines,[75] a particularly useless remedy to the dehydrated and starving.

Medical teams were in place, coordinated by FEMA;[76] however, many of the doctors were not legally permitted to help people because medical licenses are issued by the state, and only license a doctor to practice in the state issuing the license[77]. Similar bureaucratic hurdles existed stopping bottled water from because they lacked 'tasker numbers', the refusal to allow the state of Arkansas to send buses and planes to evacuate people displaced by the flooding.[78] Similar bureaucratic hurdles hampered evacuation to those fortunate enough to leave the city to a crawl because FEMA said that post 9/11 security procedures required a (prolonged) search for more than 50 federal air marshals to ride the airplanes, and to find security screeners. At the gates, inadequate electric power for the detectors held things up until officials relented and allowed time consuming searches by hand of desperate and exhausted people.[79] This story illustrates a strange sequence of events where people like the Governor and FEMA director Michael Brown blame excessive and unclear bureaucracy for hampering the response to Katrina, yet FEMA, the lead organization is creating unnecessary bureaucratic hurdles in the most urgent time of catastrophe. More doctors, more water, higher turnover rate for evacuating flights departing New Orleans would have sped response, and alleviated more suffering in the city than was observed.

Even before Government could muster a response, private industry was reacting more quickly. Blackwater – the private security firm known best for protecting L. Paul Bremmer in Iraq after the American defeat of Iraq – was the first organization to arrive on the scene[80] after landfall of Hurricane Katrina. That is to say, they were in place before state police, the Coast Guard, EMS from outside the city; everybody was behind Blackwater in response time. They were not the only private security firm to arrive: dozens of others arrived, ostensibly providing security, though one company 'Bodyguard and Tactical Security' was implicated in an allegedly fatal firefight with hoods who opened fire on their convoy.[81] These firms provided security to the wealthiest elements of New Orleans society – those who could afford them – and provided no relief or recovery to those stranded in the city. This is indicative of a very slow, unresponsive federal mechanism when private security contractors can be in place protecting mansions before the

[73] Kauffman, Sarah. *The Criminalization of New Orleanians in Katrina's Wake.* 11 June 2006.
[74] Smith, Nell. *There's No Such Thing as a Natural Disaster.* 11 June 2006.
[75] Ibid.
[76] PBS Frontline – Interviews: Michael Brown.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/brown.html
[77] Tierney, John. 2005. "Going (Down) by the Book." New York Times.
[78] Lukes, Stephen. 11 June 2006.
[79] Block, Robert, et al. 2005. "Behind Poor Katrina Response, a Long Chain of Weak Links." Wall Street Journal, September 6, p. 1.
[80] Scahill, Jeremy. *Blackwater Down.* The Nation. 22 September 2005.
[81] Ibid.

federal government can deliver food and water to the homeless, destitute people who did not have cars with which to evacuate.

The willingness to use weapons to enforce order was not exclusive to the private security firms. The police were ostensibly in place to provide security from 'looters' and other alleged miscreants sowing disorder in the city. The fact of the matter is the vast majority of breaking and entering that occurred in the city was not for profit, but for sustenance. This was not limited to those stranded in the city; responders without the necessary supplies took the necessary measure to secure what they needed. Emergency Managers openly admit to having 'looted' – or more accurately committed a break and enter in a time of crisis to acquire necessary supplies – a pharmacy to distribute medication to those in need.[82] This is illustrative, as doctors and emergency managers looking for medical supplies were not met with gunfire as were similar actions by others raiding grocery stores for food and water after being stranded inside the city with no help forthcoming.

The concept of looting presupposes a context of assertable property rights,[83] which in a disaster of the scale of Katrina were meaningless. What is overlooked is the necessity for food and water that the city, State or Federal government failed to provide in a timely manner that drove people to fend for themselves. Nevertheless, police and military resources were used to prevent looting. "Again the preoccupation with preventing looting often leads to the allocation of security personnel to non-existent or trivial tasks. On the other hand, such an allocation is likely to be successful since prevention is quite possible when the problems do not exist."[84] The notion that disaster will lead to looting and lawlessness is unfortunately reinforced by the Target Capability List published by DHS, the document against which everyone is meant to measure their readiness assumes "Looting and/or damaging to unattended properties, especially shops and stores by armed hooligans and criminals should be considered."[85] The trend of using excessively forceful resources to mitigate a mostly fictitious threat is likely to continue.

Rescue efforts were poorly managed from the onset. The response from the police and the National Guard was unnecessarily heavy handed. The Red Cross would not directly deliver supplies into the city, preferring to help those who evacuated. The Red Cross however would not provide evacuation, and did nothing to facilitate it. FEMA failed in getting those stranded out of New Orleans, as did all the organizations it was responsible for. In short, the entire response was bungled from the start.

---

[82] PBS Frontline – Interview: Walter Maestri.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/maestri.html
[83] Lukes, Stephen. *Questions about Power: Lessons from Hurricane Katrina.* 11 June 2006
[84] Dynes, Russel R. *Social Capital: Dealing with Community Emergencies.* Homeland Security Affairs Journal.
[85] Department of Homeland Security. *Target Capabilities List: A companion to the National Preparedness Guidelines.* November 2007

3.3.4 Recovery

3.3.4.1 Debris Management

The Solid Waste Association of North America (SWANA) is a long-standing professional association of managers and practitioners. In the aftermath of Katrina and in response to a request by the Louisiana Department of Environment Quality, SWANA has summarized lessons observed. As might be expected, the initial focus is on clearance speed and priority given to recovery and collection activities consistent with minimal acceptable compromise to personnel safety and environmental consequence. The work falls into two phases. Phase 1 involves the removal of debris which could threaten public safety in the near term; a subsequent Phase allows for greater opportunities for diversion and recycling.

The SWANA report was very clear in highlighting that despite the prioritization of a quick clean up to allow the city to resume living as normal as possible there are still some goods that must be dealt with according to standard procedure. Propane tanks and white goods (Freon and mercury from HVAC units and thermostats respectively) were to be treated in accordance with standard procedures[86], notably time consuming. Any available wood and rock/cement was to be piled as best as possible to be recycled into mulch and gravel. This indicates a partial consciousness to recycling destroyed goods, or at least keeping them out of the dump where they would sit idle, like the huge volume of soft goods (mattresses, textiles, etc) to be evacuated.

Cars were to be towed to one location per neighbourhood where insurance companies could follow their procedures before shipping them off as scrap.[87] The debris removal plan was not comprehensive however, with admission that the worst affected areas would require strategic plan to thoroughly address.[88] There is a marked difference between how different types of goods were to be addressed. Regular waste that could be found in a normal landfill was to be evacuated as quickly as possible, with more time spent finding and safely disposing of harmful chemicals. Though this sounds reasonable, there is significant evidence to suggest the hurried nature of the debris clean up was not a smoothly run operation, and that environmental hazards were not sufficiently mitigated.

The National Academy of Science investigated the results of debris removal, and the results are quite alarming. The most striking thing is the choice of the cite for the landfill; it is located on Chef Menteur Highway in reclaimed swamplands next to Bayou Sauvage National Wildlife Refuge: largest urban refuge in America.[89] The site chosen will be permanent, and there are significant problems with the site, especially as pertains to the likely long-term effects. The water table in area one to four feet deep in the landfill, posing a significant threat to groundwater that will intermix with waste and migrate off site. When it does migrate it will be discharged to Maxent Canal, which backflows toward communities in New Orleans when the pumps are off..[90]

---

[86] S.W.A.N.A. *Hurricane Katrina Disaster Debris Management: Lessons Learned from State and Local Governments.* 21 September 2005.
[87] Ibid.
[88] Ibid.
[89] National Academy of Science. *Hurricane Debris Disposal in New Orleans.*
[90] Ibid.

Pump failure occurred in a number of areas during Hurricane Katrina, overloading the remaining pumping stations. Pump failure in the future is certainly possible.

With the chosen location for a landfill the threat has been created where there was previously none. Aside from the existing dangers – the city is below sea level, the levees are insufficiently built to withstand anything above category 3, etc – there is now the added danger of hazardous material mixing with ground water, and a significant likelihood that those materials will flow back into the city. The materials include (and are not limited to) paint cans, bottles of chlorine bleach, and drain cleaners. The following comments illustrate the severity of the glut of hazardous materials that now looms on the bayou:

- "We calculated that there's as much as 5 million gallons of that particular waste stream," - Chuck Brown with the Louisiana Department of Environmental Quality.
- "If we're *lucky*, we'll probably get maybe 20%, 30 %, somewhere right around there." - David Romero with the Environmental Protection Agency.

More worrisome, this indicates that 70 to 80% of the hazardous materials in the debris are now in the landfill, and will likely make their way into the groundwater. Or, considering both comments above, the city will be lucky to capture approximately 1 to 1.5 million gallons of the possible 5 milliong gallons of waste

- "Delivery of materials (to the landfill) containing lead based paint, asbestos, creosote, arsenic, petroleum products, household pesticides, cleaning chemicals - would be unavoidable." - U.S. Fish and Wildlife Service, Louisiana Field Office.
- "Liquid will be generated as waste breaks down and as rain falls. The liquid will contain hazardous materials that accidentally got into the landfill. That liquid becomes groundwater and can move off the site and contaminate the area around the landfill." - LSU Engineering Professor John Pardue.
- "Household furniture is treated with polybrominateddiphenylethers (PBDEs) as a fire retardant. PBDEs are carcinogens that are being found as widespread environmental pollutants that are accumulating in human breast milk and wildlife." - Dr. Fred Lee, Expert Report, 2/14/06
- "After Hurricane Betsy hit New Orleans in 1965, city officials dumped and burned storm-related debris atop the former landfill [at Agriculture Street Landfill]. It was later named a Superfund site, a designation reserved for the country's most contaminated areas." - Times Picayune, 2/10/06

The unintentional dumping of these chemicals could have a significant impact on human and animal health in Louisiana for years to come, and plants the seeds for danger in the future. This danger may not be necessarily from a Hurricane: anything that would cause movement of hazardous chemicals from the landfill via the water to humans and animals represents a threat. Given the haphazard approach to risk mitigation observed in New Orleans, it will likely take a significant manifestation of chemical related symptoms to prompt any kind of response, by which time the damage is already done, and the trend difficult to reverse.

3.3.4.2 Charities

In a post 911 report the US Government Accountability Office (GAO) examined the role charitable organizations and their contributions to disaster relief and recovery.[91] In addition to offering mass care (food, shelter and clothing) and emergency financial assistance, many charities provide longer-term assistance such as health counselling and job training. Catastrophes are notable for the number victims, overlapping jurisdictions and diversity of charities. Often many new charities emerge as a result. The GAO noted that the independence of these charitable organizations poses significant challenges in coordinating programs and integrating efforts. One of the most obvious deficiencies was the lack of a communal list of victims and survivors. Privacy policies regarding information sharing impeded collaboration and, in some cases, contributed to delays in disbursing aid. Further, many of the survivors were unaware of all the charitable services and assistance available. Hence the GAO recommended development and adoption of a common application form and confidentiality agreement, and the establishment of shared databases. An automated, central directory of benefits and linkage to a community website would go someway towards highlighting duplications and eventual implementation of cross-agency case management and seamless "one stop shopping". Typically the charities are overwhelmed by applications for assistance and have to augment staff. Exploitation of common forms and shared data would facilitate exploitation of existing collaborative planning tools and potentially reduce fraud. As in the United States, the government has fairly limited oversight into how charities are managed and how they spend their funds. A working group with representation from both government and key charitable organizations may be required to implement this vision.

3.3.4.3 National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a US Federal program to indemnify individuals against losses attributable to floods. It is noteworthy for several reasons, not least the underlying rationale. It stemmed from the realization that "private insurance companies could not profitably provide such (flood insurance) coverage at an affordable rate, primarily because of the catastrophic nature of flooding and the inability to develop an actuarial rate structure which could adequately reflect the risk to which flood-prone properties are exposed".[92] This line of reasoning has been subsequently extended and applied to damages attributable to acts of terrorism. Secondly, the NFIP has provided the means to identify and map flood plains and to prompt municipalities to introduce mitigation measures; for example communities must review proposed development to be eligible to participate in the NFIP. Enforcement of provisos tied to substantial improvement and substantial damage have proved problematic as local officials are often reluctant to coerce property owners who do not have the resources to repair and bring buildings up to standards. As might be expected maintaining risk currency is a challenge. The 2002 NFIP Program Description asserts that approximately 75% of the FEMA flood maps were more than 10 years old and observes that old maps tend to understate actual fold hazards.[93] Thirdly, the NFIP is based on a 1% annual flood probability (or 100 year flood) - this equates to a 26% (1 in 4) chance of a flood incurring over the life span of a 30 year mortgage. FEMA uses computer models to

[91] US General Accounting Office, More Effective Collaboration Could Enhance Charitable Organizations' Contribution in Disasters, December 2002

[92] Federal Emergency Management Agency, National Flood Insurance Program: Program Description. 1 August 2002, p. 1.

[93] Ibid. p. 10.

assist in calculating flood elevations but does not design, construct or approve levee/floodwall systems. Flood insurance is sold to property owners located in NFIP communities through state licensed agents or through private insurance companies participating in the "Write Your Own" program. Annual premiums were $30. Unless a waiver is granted, claims including a Proof of Loss must be filled within 60 days.

A number of issues arose in Katrina's wake. The most troublesome relates to the difficulty many property owners faced in settling claims due in large part to split liability. Many insurance companies quibbled over whether damage was hurricane or flood related; for example damages to the first floor would not be covered but roof destruction and damage to higher floors would be. Insurance companies contended that if the latter was true, then claims should be pursued under the NFIP. Next few adjusters were willing to travel to the area to provide prompt estimates of damage[94]. This may have promoted filing of fraudulent claims. Not all of New Orleans was flooded and there were incidents of self-inflicted damage being claimed. In response to the unprecedented number of claims the insurance industry implemented across-the-board rate hikes ostensible to recoup losses[95]. Katrina-related claims alone exceeded $20 billion. By design government programs such as the NFIP are inadequately funded; the premiums do not cover exposure and post-funding appropriations are used to fill the gap. This model has several implications, not least of which is that it shields homeowners in catastrophe-prone areas from risks and true costs much better than taxpayers in less risky locations provides subsidies. Katrina has spawned a re-evaluation of the role of government and a recent GAO Report offers options ranging from establishing all-perils homeowner insurance to federal loans.[96]

3.3.4.4 Resettlement

A 2007 study concluded that the major obstacle to returning home was the lack of homes. "Despite the billions of dollars that have been deposited into funds for rebuilding and many volunteer hours, few residents have received the financial and physical resources needed to rebuild their homes."[97] The New York Times reported in November of 2006, over one year after the hurricane that only 1,721 of the 79,000 famililes who applied for the $7.5 billion 'Road Home' funding have been told how much grant money they will receive, and of them only 22 families who ever received assistance.;[98] The city has hesitated to invest in permanent facilities "reportedly because resettlement trends are still unclear".[99] Equally significantly many residents have opted not to return. A poll was conducted in Houston 2 weeks after the hurricane; only 43% of the evacuees polled intended to return to New Orleans.[100] The Educated professionals had been moving out of the city prior to the hurricane and it is feared that this exodus may continue.

---

[94] Buckley et al. *The Insurance Industry's Troubling Reaction to Hurricane Katrina.* Americans for Insurance Reform. January 2006.

[95] Dean Starkman, "The Cost of Insurance; Firms Warn of Steep Premium Increases After Record Claims From Hurricanes," Washington Post, November 8, 2005.

[96] US Government Accontability Office, Natural Disasters: Public Policy Options for Changing the Federal Role in Natural Catastrophe Insurance, November 2007.

[97] Gumennik, Irina. Resettlement Trends in New Orleans after Hurricane Katrina", 6 March 2007, p.1. http://isites.harvard.edu/fs/docs/icb.topic139932.files/Resettlement_Trends_in_NO.pdf

[98] Eaton, Leslie. Slow Home Grants Stall progress in New Orleans. New York Times, 11 November 2006.

[99] Nossiter, Adam. New Orleans of Future May Stay Half Its Old Size, 21 January 2007.

[100] Morin, Richard and Lisa Rein. *"Some of the Uprooted Won't Go Home"* The Washington Post, 16 September 2005.

Living conditions – health, sanitation, water and education services – and high crime rate are further inhibitors to resettlement. By the end of 2006, although less than 1/5 of its population had returned to the Ninth Ward, New Orleans had regained half its pre-Katrina numbers. However "the demographic breakdown suggests that the city may be headed for a socioeconomic makeover"[101]. Whereas in 2000 African-Americans made up 67% of the population and white residents 28% corresponding figures for 2006 are 47% and 42%. Concurrently the Latino population has tripled from 3% to 9%.

3.3.4.5 Psychosocial Recovery

It may still be too early to assess lessons learned relating to Recovery. A second GAO Report focussed on Katrina and identified a number of longer term issues including health, environmental and energy infrastructure.[102] While palliative effect debriefings took place, it is worth underscoring that "psychological distress is often more reflective of the difficulties and hardships encountered during recovery and rebuilding, rather than the impact characteristics of the event".[103] "Dealing with relief agencies (particularly government agencies), loss of job, loss of community status, or a changed sociocultural mix in the community are all experiences that may occur following a disaster and may actually be more significant, over time, than exposure to the disaster agent itself".[104] Psychological well-being can be boosted by encouraging communal recovery planning and fostering self-determination. The absence of evidentiary confirmation suggests that this was problematic following Katrina, reinforcing the point raised earlier that disasters have crucial social and psychological impacts – prevent, protect, response and recovery are informed by pre-existing social and economic factors and vulnerabilities.

3.4 Summary

The prevention and protection measures taken for New Orleans were sufficient to address disasters, and had done so in the recent past. However, they were not sufficient to address a catastrophic even like Hurricane Katrina. The scientific community gave plenty of indication that something of this magnitude was not only possible but likely; despite that warnings were not heeded sufficiently to do something to protect the city. Research suggests that problem presentation – how options are framed - is important. Frames are used "by audiences as "interpretative schema" to make sense of and discuss an issue, by journalists to craft interesting and appealing news reports, and by policy makers to define policy options and reach decisions".[105]

---

[101] Gumennik, p. 3.
[102] US General Accounting office, Hurricane Katrina: Providing Oversight of the Nation's Preparedness, Response, and Recovery Activities.
[103] Hutton, David. Psychosocial Aspects of Disaster Recovery: Integrating Communities into Disaster Planning and Policy Making, Institute for Catastrophic Loss Reduction, p. 2
[104] Flynn, B. Disaster Mental Health: The US Experience and Beyond, in J. Leaning, S. Briggs & L. Chen (eds.) Humanitarian Crises: The Medical and Public Health Response, Harvard University Press, Cambridge, MA
[105] Nisbert, Matthew C. and Dietram A. Scheufele, The Future of Public Engagement, The Scientist Volume 21 Issue 10, http;//www.the-scientist.com/article/print/53611/

An event of the magnitude of Katrina made responders victims themselves, delaying any organized attempt to respond to the hurricane. Confusion and disjointed command was endemic the further up the local-state-federal chain of command one looked. Communications systems were only partially functional (at best), reporting lines were unclear, and resources for response were not available; this all had a significantly negative impact on response procedures. Recovery was approached in an equally disjointed manner, with little central control, and no common database or information sharing. Charitable organizations were effectively running independent mechanisms at each of their locations.

In a July 2007 report the US GAO noted that Katrina highlighted a number of deficiencies. Foremost among these was the lack of clearly understood roles and responsibilities i.e. an established and practised authority and accountability structure. DRDC Toronto has previously underscored the importance of balancing Competence, Authority and Responsibility[106]. Specific capability shortfalls included (1) situational assessment and awareness (2) emergency communications (3) evacuations (4) search & rescue (5) logistics and (6) mass care and shelter.[107] These are discussed in the following section.

[106] Pigeau, Ross., McGann, Carol. *Re-Conceptualizing Command and Control.* Canadian Military Journal. Spring 2002. pp 53-67.

[107] US Government Accountability Office, Homeland Security: Observations on DHS and FEMA Efforts to Prepare for and Respond to Major and Catastrophic Disaster and Address Related Recommendations and Legislation, 31 July 2007.

4. Application to Canadian Context

4.1 Provincial Plans

4.1.1 Ontario

There are many announcements pertaining to Emergency Management on the provincial website, though a source document could not be located. The research staff acquired a draft copy of the 2004 EM doctrine[108] however. It contains the standard information about the emergency management cycle, vague details about procedure, and a clear document outlining command from the Executive down to the Incident Command Post, as per the Incident Management System (IMS). Implementation of IMS principles in all municipalities is encouraged as a means to have consistent procedure and structure across the province. A common operation methodology will ensure more effective cooperation in the case of joint operations between municipal and provincial levels of government. Given the high level of urbanization in Ontario, effective implementation of the IMS will require significant buy in from municipal police forces and EMS in places like the greater Toronto area, Southern Ontario and the National Capital Region.

The documents are clearly stated as non-binding guideline and recommendations, significant in disclaiming its role as a central planning tool. It should be noted the document is described as a draft: no final or official version was found on the Emergency Management Ontario website. The SA did not have a copy, or knowledge of, a final version of the document.

4.1.2 Nova Scotia Emergency Management Manual

The Nova Scotia Emergency Management Manual clearly states generally that most emergencies are local in nature, and moreover that those facing Nova Scotia will begin at the local level. The manual provides the procedures and responsibilities for involvement of provincial authority when the scope and impact of a local emergency expands, requiring assistance from the province. The document states the conditions in which the Joint Emergency Operations Centre (JEOC) will be activated to coordinate assistance:

- are upon request from a municipality
- when an emergency has escalated beyond the capacity of local responders
- when an emergency affects more than one municipality
- when an emergency affects the whole province
- upon direction from the Minister responsible for Emergency Measures[109]

This manual lists the responsibilities of personnel in the JEOC: Ops Director, Public Info Officer, Planning Officer, Departmental Emergency Preparedness Officer, etc, and the organizational

[108] Emergency Management Ontario. *Emergency Management Doctrine for Ontario (DRAFT). January 7, 2004.*
[109] Nova Scotia Emergency Management Organization. *Nova Scotia Emergency Management Manual.*

structure each of these positions falls into. The document outlines the membership of the Provincial Emergency Activation Team: Provincial officials, Business actors, voluntary sector, etc. It also outlines the Emergency Public Information Plan, including procedures, org chart, duties, responsibilities, equipment list, action form, etc, necessary in a provincial level emergency.

Contingency Planning guidelines describe the preparation and alert stages for provincial response, the agencies supporting response at each level of government and their responsibilities during the response and recovery phases. Business functions, organizational charts, zone maps and the voluntary sector are included in the planning guidelines. Though not explicitly an integrated risk assessment the document identifies the types of disaster or types of events the province of Nova Scotia can likely expect:

- Severe Weather
- Dangerous Goods (non-nuclear)
- Forest Fire
- Flooding Emergency
- 'Sudden Impact' – plane crash, explosion, satellite impact, etc.
- Health Emergency
- Agricultural Emergency
- Federal Lead Agency Emergency

The list of thirteen likely emergencies is specified, and the locations where they are likely to occur:

- Airplane crash
- Construction Disaster
- Dangerous Gases
- Earthquake
- Explosion
- Flood
- Forest Fire
- Hurricane, Tornado, Windstorm
- Institutional fire (hospital, care facility, prison)
- Mine Disaster
- Power Failure
- Significant Fire
- Transportation accident (rail, highway, water)

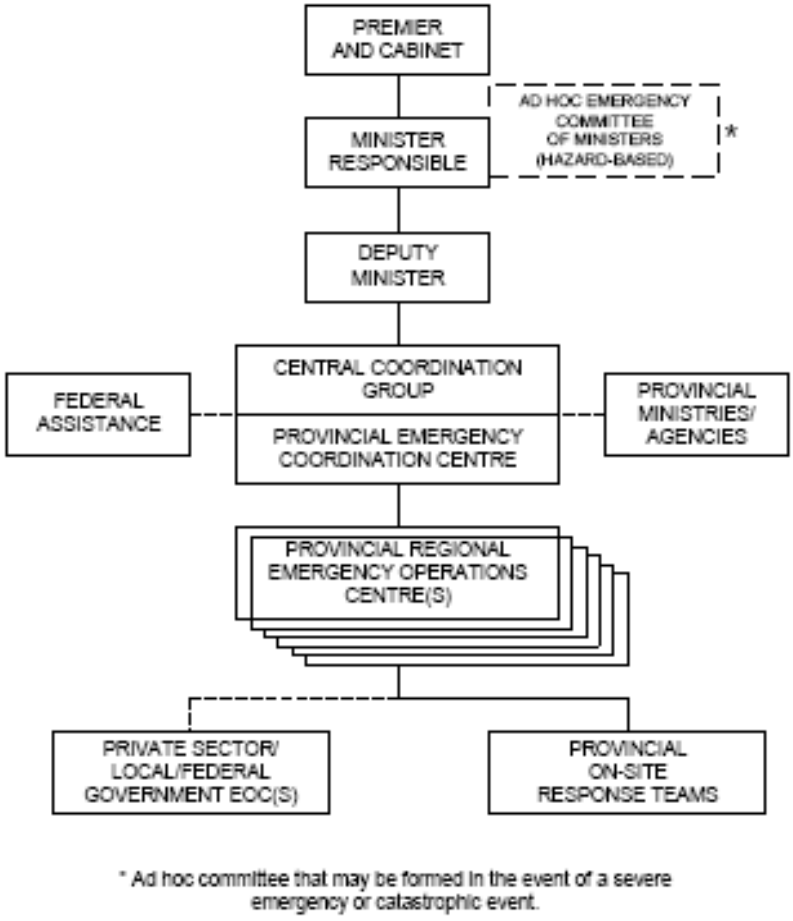
The document is comprehensive as it covers the gamut from planning based on the expected type of incident to recovery measures taken in conjunction with the voluntary sector. However, the document is comprised mostly of bulleted lists, lacking the specific procedural steps required to effectively respond to and manage an emergency. As a first summation of what is required to establish an emergency management mechanism for provincial level response it succeeds, but lacks the specificity to be a definitive guide. The guide was disseminated to all the municipalities and government departments in Nova Scotia that would play a role in a provincial level emergency.

4.1.3 British Columbia

The British Colombia Emergency Response Management System document provides a clear command structure in terms of civilian authority, command centres and their role in emergency management. This is true from Cabinet down the Provincial On-Site Response teams and Private Sector/Local/GOC Emergency Operations Centres (EOCs), and shows where Provincial Emergency Response Centres and Regional Provincial Emergency Response Centres fit in terms of hierarchy. The Diagram is depicted below in Figure 1**Error! Reference source not found.**. This model is not the end-point for all emergency management in BC, only those that do not require federal assistance. It is likely that this model would be subsumed into a federal model, with as few disruptions to the model as possible. EM training in BC centres around this model, and to introduce new procedures mid-crisis would be foolhardy and to be avoided.

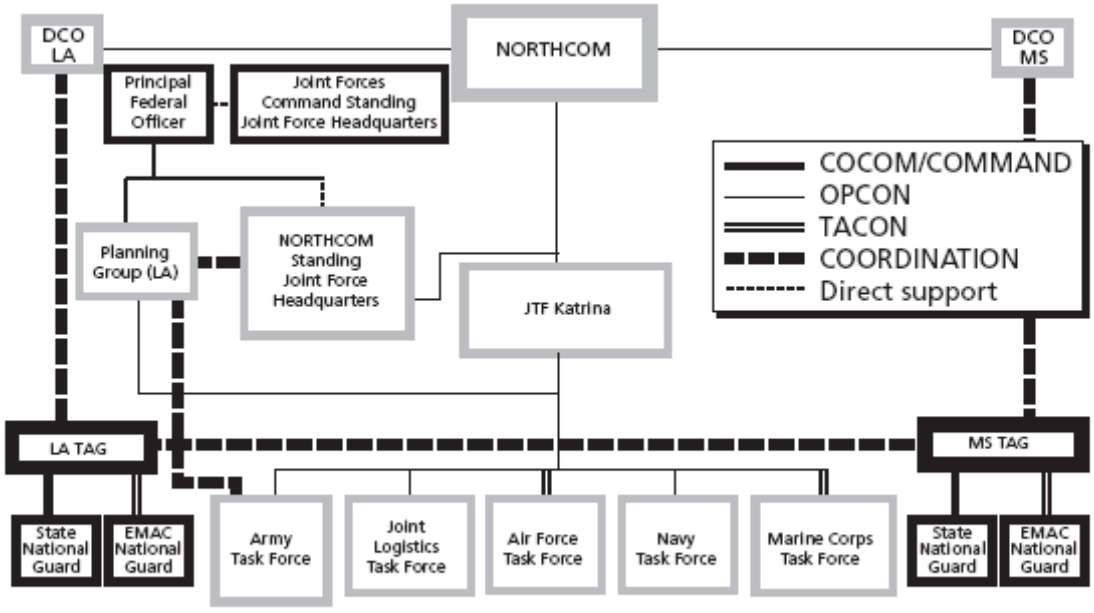
The BC document outlines the responsibilities of each position in the model, and the positions for each of the command centres: it goes so far as to prescribe supervisor to staff ratios, and the desired qualifications for director-level staff. This is in stark contrast to the soft, advisory roles often described in the US model with reference to the Primary Federal Office (PFO) and Federal Controlling Officer (FCO).

Figure 1: BC Emergency Management Structure



This is in stark contrast to the official organizational chart of JTF Katrina shown in Figure 2**Error! Reference source not found.**. This structure is unclear, involving dotted lines, and multiple lines of command and levels of support. It is not clear who in this model is the final arbiter is. This model is difficult to assign specifics to in simple observation; consider the application of this model in a situation when communications systems are unreliable, assets are not necessarily in place, supplies are lacking, etc. This model does not lend itself to clarity. The reason this model is compared to the BC EM model is because JTF Katrina was the only organizational chart diagram that could be located; how the entire mechanism functioned remains unclear. To be fair, in the case of Federal Assistance in a Canadian catastrophe, the BC EM plan would likely be supplanted into a larger Federal model. The point here is to indicate the clarity of planning in BC (as of September 2000) in contrast to the ad hoc model cobbled together mid-stream during the response to Hurricane Katrina.

Figure 2: Hurricane Katrina Command and Control Structure



SOURCE: Based on JTF-Katrina Commander's Assessment, September 9, 2005.
RAND *MG603-3.7*

It should be noted that neither plan includes the areas of responsibility specific police, fire or EMS tasks. These will be included as part of their individual drills, and will not be subject to significant change based on the scope of catastrophe'; police will always be in charge of security and law enforcement, and fire fighters will be concerned with fires, hazardous materials and rescue. The scope of devastation will dictate the conditions of work, though the purpose and functions will remain the same.

4.1.4 Other Provinces

- Alberta: The Alberta Emergency Plan[110] is mostly a bulleted list. It uses ambiguous terminology with respect to activation (ex: emergency 'can' 'may' 'could' be declared if…) of provincial response, and the role of the actors within it (ex: assess and monitor potential situations). The document is similar to the Nova Scotia Emergency Manual in that respect.
- Manitoba: The Manitoba Emergency Plan[111] suffers from the same problems as Alberta and Nova Scotia. It has many bulleted lists, lacks specificity, and the conditions under which its coordinated response mechanism is activated are unclear.

[110] Alberta Municipal Affairs: Disaster Services. *Alberta Emergency Plan*
[111] Manitoba Emergency Management Organization. *Manitoba Emergency Plan.*

- New Brunswick: The New Brunswick Emergency Measures Organization does not publish a procedural document; though there include a copy of the Emergency Measures Act on their website[112]. Most of their material tends toward public awareness campaigns, and specific programs within the mitigation, preparedness, and response and recovery domains. The site does highlight results from EM exercises, a encouraging sign that the province does conduct joint exercises, included Emergency Operations Centre management.
- Newfoundland & Labrador: They do not have one document containing all their procedures. The information available appears to be published to empower local communities to develop plans that suit their needs. A 'how to' document is published, identifying what bodies and functions are necessary for municipal emergency response.[113] They list the services available from the provincial government, like JEPP, The Emergency Air Services Program, though no singular coordination mechanism.
- NWT: The Northwest Territories Emergency Plan[114] is very clear in defining the levels of territorial assistance provided to municipalities, who can request it, and who is responsible for providing it. Though it includes many bulleted lists it is specific with respect to which organizations are delegated responsibilities. More detail to processes is provided in the annex section, comprising half the document. The document is clear and concise throughout, making it easy to understand.
- Nunavut: The Nunavut EM documents focus on tips for family preparation, emergency contact information, and opportunities for emergency training. There is no singular EM document in Nunavut.
- Prince Edward Island: PEI's EM plans focus heavily on empowering towns and organizations as the local level to prepare for emergency. Notably, these plans include evacuation procedures for nursing homes, and plans for small communities. Given the population density of the Island and its limited resources at the provincial level, this seems a logical plan for EM.
- Quebec: EM falls under the Public Security minister in Quebec, and accordingly the Strategic Plan includes the prisons, re-integration of offenders, etc, along with EM. The security objective include improvement of policing, fire services, disaster risk management, first nations strategies, review and implementation of correctional policies, and modernization of the health system. Elements of EM units are contained in the strategic plan, though not the individual focus.
- Saskatchewan: Saskatchewan's EM mechanism also falls under policing and corrections. The documents that exist tend toward crime reduction strategies, fire response, etc. The EM section relies mostly on the Joint Emergency Preparedness Program (JEPP), a cost-sharing plan between the provinces and federal government; Saskatchewan uses the transfers for policing and EM.[115]

---

http://www.gov.mb.ca/emo/eplan/index.html

[112] http://www.gnb.ca/cnb/emo-omu/index-e.asp

[113] Emergency Measures Division: Newfoundland & Labrador. *Steps in Developing and Emergency Plan.* http://www.ma.gov.nl.ca/ma/fes/emo/munplanning/pdf/emerg-plan-steps.pdf

[114] Northwest Territories Municipal and Community Affairs. *Northwest Territories Emergency Plan.* http://www.maca.gov.nt.ca/emergency_management/resource/emergency_plan/NWT_Emergency_Plan.pdf

[115] Saskatchewan Emergency Management Organization

- Yukon: The Yukon EM information focuses on specific threats (fires, floods, poor driving conditions) and how to mitigate their effect on the community. Given the population density and limited resources this should not be surprising.

4.2 Comparison

The Ontario, BC and Nova Scotia documents are the most comprehensive emergency documents published by provinces that are generally available. That does not indicate the other provinces are without plans, only that they are less well developed in some cases, or not publicly published in others.

The Nova Scotia document serves as a comprehensive checklist of tasks to be completed in the case of emergency, but provides little in the way of managing the emergency management process. The BC model provides almost as much detail, addressing the responsibilities and interactions from the provincial level, through regional down to the incident command level. In short, the Nova Scotia document is very thorough in terms of the basic description of how all the actors fit into the emergency management model, but does little to address how they will discharge their responsibilities and along which command lines. The BC document is much more thorough in terms of the significance and interactions between the actors in the EM hierarchy.

The significance of these differences it illustrates that an effective emergency management mechanism that combines different levels of governmental authority is not easily constructed. The difference in the Nova Scotia and BC models is the maturity and corporate knowledge in the design. The BC document shows more refinement in its approach, and the information contained in it.

The lesson, as it applies to Hurricane Katrina, is that effective EM capability cannot be developed quickly. Organizational hierarchy diagrams, lists of responsibilities, etc, can be quickly manufactured, but having a durable, versatile organization that can actually implement the objectives from a document a different matter entirely. The uncertainty and disjointed nature of the Katrina response is indicative of FEMA being sidelined, and the failure to properly exercise the procedures in place. Canada's EM response, and indeed that of each province, is equally vulnerable to a degraded status if procedures are not confirmed with training, exercises, and the documentation in specific terms of how actors will interact in an Emergency Operations Centre at the provincial and/or federal level.

4.3 Federal Emergency Response Plan (Volume 1) - Canada

The government of Canada has the responsibility to provide assistance in responding to emergencies and events, as per the 2006 Emergency Management Act, a supplementary update to the 1988 Emergency Preparedness Act. The implementation of the Incident Management System at the provincial and municipal level is critical in ensuring common knowledge of the response and operational procedure, specifically with respect to response involving federal, provincial and municipal levels of government. Provision of planning, analysis and other specific functions, the

---

http://www.cps.gov.sk.ca/Provincial-Preparedness

Minister (of Public Safety) is also responsible for providing and coordinating assistance to the Provinces and Territories.[116]

Provinces will forge emergency management mechanisms to address the all-hazards threats in their region. For example, Prairie Provinces will be less concerned with maritime emergency management than they will with flooding and winter storms, where BC may be concerned with wild fires, earthquakes and coastal water incidents. It is imperative however that the IMS be included as the standard methodology from federal down to municipal levels of government. Hurricane Katrina illustrated the most severe consequences that can occur when there is no consistency between levels of government, and when harmonizing the resources and personnel from each level of government into a cohesive mechanism is inhibited by organizational hurdles and incongruent procedures.

Timely integration of the resources across levels of government into a cohesive response mechanism cannot be effectively created simply by using the IMS. The procedures and plans should be validated through training and exercises between levels of government. The publication and dissemination of lessons learned, and the integration of those lessons into follow on exercises is essential in producing an iterative training capability. Training should challenge responders with scenarios from a realistic and constantly updated risk assessment. The most beneficial outcomes would be the development and trust and familiarity between organizations and people at different levels of government who may work together in a real disaster, and shared understanding of the organizational culture at different levels of government; or 'cultural interoperability'.

Too often in the Hurricane Katrina literature there are indications that response was significantly hampered by state level authorities assuming FEMA would 'push' certain critical supplies, when the onus was on the state to 'pull' them from FEMA. A lack of clarity in understanding how other EM organizations function, and how state and local organizations fit into a single mechanism contributed significantly to poor response.

4.4 National Response Framework and Federal Emergency Response Plan: Similarities & Differences

There are striking similarities and significant differences in how the United States and Canada governments have structured their response to emergencies as described in the US National Response Framework (NRF - January 2008) and the Canadian Federal Emergency Response Plan (FERP – September 2006). Both frameworks are based on the Incident Management System and, unremarkably, reflect parallel tiered organizational models. Nor is it surprising that the frameworks reflect historical roots and differing governance cultures. The Canadian model is built on more clearly accountable lines of authority, a greater sense of staff permanence and an emphasis on communal support. Speaking generally, it is less politicized. The distinctions are also attributable to disparate size and structure e.g. the US Coast Guard dwarfs the Canadian Coast Guard; the US Military/National Guard model is patently different from that of a unified Canadian Forces.

[116] Department of Public Safety. *Federal Emergency Response Plan (FERP). Volume 1 – Draft 4.* 26 September 2006. pp 26.

Both Canada and the United States emphasize that preparedness begins with the family, and that each family should be capable of sustaining itself for 72 hours. Recommendations for emergency kits include the basic survival supplies ranging from food and water reserves, to blankets, batteries, lights and candles. This reflects the expectation of reasonable individual planning on behalf of both governments. The better families are prepared (in all but catastrophes) to sustain themselves the more time they can survive without relying on agencies of government, and the more time government has to muster an effective, thoughtful response if most families can sustain themselves in the interim. Though, as Hurricane Katrina painfully illustrated, the ability to prepare for self-sustenance assumes a level of income and socio-economic status.

Preparation timelines and institutional knowledge baselines differ. The Federal Coordinating Group (FCG) in Canada is a permanent steering committee in each province and territory mandated to coordinate an all encompassing, whole-of-government federal response to events that are complex, multi-dimensional in nature. The FCG is staffed with federal and provincial officials, in anticipation of coordination across levels of government during emergencies. In the case of emergency, the FCG staff man the Federal Coordinating Centres (FCC) co-located with the Provincial Emergency Operations Centres where possible. Located in the area of operations they would be charged to respond in, there is both personal connection and geographic planning continuity.

This level of integration is not guaranteed in the US. FEMA has regions, six of them, lacking the "permanence" of relationship with State and regional authorities that is enjoyed in Canada. In the case of Katrina it took days for all the necessary authorities to link up communications and contingency plans with one another. This process would likely have taken less time had all the necessary actors and organizations been familiar with the response mechanism and with each other on a personal level. Training and exercises can mitigate some of this but, on balance, the Canadian model still seems preferable. It is more sympathetic to viewing knowledge as an object rather than a process. It would appear to afford greater opportunity to instutionalize and exploit tacit and implicit corporate knowledge spanning federal and provincial levels. This should reduce delays in coordinating a whole-of-government emergency response.

A Federal Coordinating Officer (FCO) position exists in both the FERP and the NRP though roles and responsibilities differ greatly. A Canadian FCO has responsibility for strategic coordination of the Federal Government's response. He/she is a senior public servant, ranking between a Director-General of Operations (or Deputy) to Senior ADM depending on the severity of the crisis. FCO authority is delegated to someone with significant administrative experience and inherent existing formal authority. Conversely the FCO in the US is an appointed agent of FEMA charged with overseeing discharge of the responsibilities defined in the Stafford Act. These responsibilities are discharged largely with the consent of the States. FEMA has limited resources and, like Public Safety Canada, is only intended to be a coordinating agency. The resources FEMA can mobilize reside with DHS, a conglomerate of 20+ Federal departments and agencies not legally obligated to provide those resources to FEMA. Without any actual resources, or formal statutory authority to mobilize or command them the US FCO has considerably less capability to insist on coordination than the Canadian equivalent. The ambiguity contained in the US relationship certainly hampered the response to Hurricane Katrina, and without increased clarity could seriously jeopardize response to future disasters.

There is an additional actor in the US model, the Principal Federal Official (PFO). The PFO serves as the federal official responsible for coordinating all domestic incidents requiring multi-agency federal response. However, it is noted explicitly that the PFO does not direct or replace the incident command structure established at the incident. The PFO's responsibility is limited to interfacing with federal, state and tribal authorities. Without formal authority the PFO can only *recommend* courses of action and *suggest* allocation of resources. This does not presume that parties will be uncooperative but, without statutory authority, nothing compels the timely, decisive action required in the event of an emergency. There are three additional positions, the Federal Resource Coordinator (FRC), the Defence Coordinating Officer (DFO), and the Senior Federal Law Enforcement Official (SFLEO), none of whom have statutory authority; hence, they are limited to requesting and recommending action, and assigning liaison officers. Though these positions can provide added value to the response process, there is nothing guaranteeing it. Weak authority lines prevent them from being used optimally.

Equally troubling, these positions are not permanent: individuals are assigned to staff them just prior to disaster as was the case with Hurricane Katrina. There is no guarantee that the same individual will be nominated in response to a future emergency. The lead time during Katrina was insufficient to build a functional response mechanism, and is unclear if the lessons learned were sufficient well documented for future reference. Emergency Managers in the US system appear disadvantaged in three ways: they lack the authority to commit and the organizational base to engage fully in collaboration planning and decision support, the timeframe in which to do it, and the institutional memory to prevent mistakes from being repeated. A permanent mechanism with statutory authority would resolve all three of these issues.

The response mechanisms exercised by emergency managers at the state and province levels are not equivalent either. The United States have state police, just as Canada has provincial police in Ontario, Quebec and Newfoundland, and provincially contracted RCMP in the other provinces. However, in the US state police are primarily responsible for policing state assets, like state highways. Effective contra-flow proved vital during the response to Katrina, and highlights the need for police to facilitate evacuations. The provincial police in Canada are mandated to take on all responsibilities of policing (outside metropolitan areas where city police have jurisdiction), not only highways. The Canadian Forces are not limited by provincial boundaries, or responsible to the Premier, whereas the National Guard within each state are limited to their own borders (without request to cross state lines), responsible to the Governor, and cannot be coordinated at the federal level; coordination requires imposition by the federal government. While Canadian Forces personnel are not mandated to engage in law enforcement, they can provide aid to the civil power, which including support to law enforcement. The American constitution prevents the use of federal soldiers for law enforcement, under the *posse comitatus* statute. National Guardsmen can be used for law enforcement but, once "federalized", they too are subject to *posse comitatus* constraints. The Canadian emergency response tool maintains iterative corporate knowledge by being a permanent organization, and also has response tools that require less bureaucratic wrangling to enact policing and military force for emergency management.

There is active encouragement of cooperation between the Federal, Provincial and Regional authorities in the FERP, as well as coordination within multiple departments of the federal government. Diagrams clearly indicate where information exchanges occur within levels of government, and counter-parts across federal and provincial levels of government. The NRP tends to use language like 'coordinating', 'assisting' or 'liaising', when referring to the

relationships between the federal and state levels of government. The organizational diagrams are unclear as to who has command authority, and how it is exercised across levels of government, and in some cases, how similar sounding organizations differ.

How has this happened? Why are the mechanisms so disparate in terms of authority, resources and function between the FERP and NRP? Arguably it can be traced to political culture, a permanent civil service/electoral cycles and the structure of political and apolitical advisory bodies at the top federal leadership level.

The US constitution establishes explicit checks and balances between executive, legislative and legal branches and reflects an underlying distrust of government. The United States has constitutionally mandated elections (second Tuesday in November, every four years) whereas Canada is governed through a parliamentary system. The US has a far more politicized civil service and bureaucracy, particularly at the top levels. While the Ministers and Secretaries comprising cabinet are dismissed when a new party takes over in either country, in Canada the senior civil service leadership is not replaced. Deputy Ministers and Assistant Deputy Ministers retain their jobs in Canada after an election, whereas in the US model most undersecretaries are replaced by the incoming party. This breaks the corporate knowledge chain in the upper leadership echelons in intervals as short as 4 years, though possibly longer. When that knowledge disappears the same mistakes can be made the same lessons re-learned. While the Canadian system is by no means perfect, maintaining the top leadership across elections ensures that when a new government is finding its direction the corporate knowledge to support policy is continuous. The permanent nature of the civil service in Canada is reflected in its emergency management apparatus, as we have seen.

The Cabinets in the two countries play different roles. A Prime Minister must retain caucus support and traditionally serves as the first among equals. Collective responsibility contributes to fostering unity of effort before a crisis. Further distinction is drawn between political and public policy advice and coordination. The United States lacks an apolitical body of advice similar to the Privy Council Office (PCO) in Canada. The US President has White House Staff, though they are doubly concerned with providing political and partisan advice, policy analysis and implementation advice. The Canadian model separates the political from policy with the Prime Minister's Office (PMO) providing mostly partisan advice, and the PCO providing apolitical policy advice and recommendations. The two can never be completely separated, because the Prime Minister must eventually make a decision weighing the tradeoffs of partisan and policy advice, but having separate agencies provide the information separates the information better than the West Wing of the White House does for the President. While the PMO is typically replaced with new leadership, the PCO is far more permanent in its composition, like the civil service.

The manner in which Canada and the United States have mandated their emergency response in the FERP and NRP is indicative of their political cultures. The Canadian emphasizes a permanent, apolitical apparatus, while the United States model tends toward greater political appointment in the senior levels of bureaucracy. We can extrapolate these cultural differences in the organization of government carry over to the organizational models for emergency response, and responsibilities contained therein.

4.5 Comprehensive Strategies

A lack of clarity or specificity was highlighted in the EM response in a number of provinces. In their report 'A Resilient Canada' the Conference Board of Canada identifies that when they asked 'public and private sector leaders to identify the greatest threat to national security and public safety in Canada, they did not focus on natural disasters, terrorism, cyber-attacks or pandemics. Instead, they believe that the greatest threat to national security and public safety is the lack of clarity around governance.'[117] The tangible threat according to the Conference Board is less menacing than the general Canadian inability to wield a cohesive emergency management response mechanism.

This is noteworthy, firstly, as the primary responsibility of government is to safeguard the security of its citizen, and secondly, because despite owning 85% of Canada's infrastructure, the private sector is equally poorly prepared to address the tangible threats to Canadian security. This is astounding, given the widespread perception that because driven by profit margins – a concept much more tangible than the nebulous 'public good' or 'public security' – the private sector is more effective at protecting itself and maintaining business continuity, they are just as worried about the sometimes haphazard response mechanisms that exist. Is this because they rely on government provided responders and not their own for reaction to infrastructure failures? This likely plays a role, though the electricity companies, telephone companies, water works, etc, all have their own response teams trained for single-sector threats, and are still concerned about response.

The report highlights to partial successes during the 1997 Red River flood, 1998 ice storm, the SARS outbreak, etc, as worrisome. What if Canada is struck by a more significant disaster, like 9/11, the London bombings, or a category four or five hurricane? As Katrina showed the hurricane itself did not flood the city: it was the poor city planning and failure to action risk assessments that facilitated the destruction of the city. If Canada does not have an effective emergency response mechanism, despite risk assessments that may indicate the viability of certain threats, Canadian society is being set up in the same manner for disaster. This is not to suggest that Canada is inviting a Katrina-like scenario, only that there are parallels in the failure to adequately address the threats to safety in Canada (according to both private and public interests) and the neglect of risk assessments leading up to Hurricane Katrina.

The Conference Board recommends, given the known threats and the uncertainties within the emergency management mechanism, four objectives[118] all of which should be implemented to establish a more robust structure:

- Recognize our governance problems: by identifying where Canadian emergency management systems are lacking, and equally where they are robust, discussion and analysis can begin in a productive manner to find solutions.
- Take a Principled approach: in times of disaster, or catastrophe witnessed during Katrina, rigid rules and procedures can break down, eroding the possibility of a cohesive response. An approach based on principles identifies imperatives that do not change, allowing for

[117] Conference Board of Canada. *A Resilient Canada: Governance for National Security and Public Saftey.* Report: November 2007.
[118] Ibid.

innovative solutions to unforeseen problems or obstacles during a crisis. This is depicted in Figure 3[119] and applies to all stages of the emergency management cycle.

- Establish clear governance where we can: an emergency management mechanism cannot be built only on principle. For known regional threats, such as hurricanes on the eastern seaboard, earthquakes on the west coast, tornadoes on the prairies, establishing clear governance practices is essential to a cohesive response. Any governance structure, whether formulated prior to a crisis or during must rely on flexibility and trust.
- Practice establishing governance structures through training: the three previous principles must be validated through training and repetition to hone an durable mechanism, and foster informal, personal ties across organizations.

Figure 3: Principles for Effective Governance

Source: The Conference Board of Canada.

The United States developed a method for disaster response call the Incident Command System (ICS).It is a disaster tools based on a series of rational bureaucratic principles similar to those often discussed in organizational studies as 'classical management theory'[120]. The theory extends rationality and bureaucracy - stability and predictability – into the uncertainty and chaos of

[119] Ibid.
[120] Morgan, Gareth. *Images of Organization.* Sage Publishing: California. 1986.

disaster response. Significantly, ICS emphasizes the integration of operations, planning and logistics from multiple internal and external sources into a response network.[121] The integration of external resources into a unified command structure of another agency (the internal) is critical to achieving unity of command, if not unity of purpose. Redundancy and gaps in effort are risked without a common operating picture from all levels of response.

As mentioned in the previous section, harmonizing ICS procedures from the level of local responders, through provincial and up to the federal level ensures a level of commonality that will greatly enhance responsiveness during a disaster. With a common methodology and system there will be minimal need to harmonize procedures during a disaster: that portion will have been addressed at least through ICS procedures and hopefully though joint exercises to regional all-hazards threats. That said, ICS is not a catch-all solution that will negate all the friction potentially associate with cooperative response operations. Effective implementation of ICS only happens when a series of pre-conditions are met:[122]

1. Agreed upon tactics, which means that the disaster-produced demands coincide with the demands for which first-responder communities train;

2. A shared vision of the response, beginning with planning, practice and experience;

3. A response community – or familiarity among participants, and a sense of sharing the responsibility of a common for the benefit of the community; and

4. Leaders are trusted and part of a system that relies on collective recognition of capabilities and limitations, and the willingness to accept outside assistance.[123]

Military leadership is encompassing some of these values with the 'revolution in military affairs' and 'net-centric warfare'. These changes in technology have opened the possibility to the disappearance of traditional constraints of command and control, permitting a shared awareness between adjacent formations; this can allow for mutual support without higher-echelon coordination, fixed physical proximity or a previously existing relationship.[124] The most commonly recurring lessons during Hurricane Katrina pertain to a lack of coordination at the command level (state/federal) despite individual initiative and cooperation between citizen groups, some elements of police forces, volunteer groups, etc. With the proper integration of net-centric tools the presence of land-line communications to higher echelons (charged with coordinating lower call signs) is not necessary for groups already deployed to launch a cooperative response. The use of a common operating procedure mechanism, like ICS, could further shorten the time required to make coordinated decisions at the ground level.

---

[121] Witt, James Lee, and Associates. *Pepco Holdings Inc. Hurricane Isabel Response Assessment.* Final Report. May 2004.
[122] Klein, Gary. Source of Power: How People Make Decisions. The MIT Press: Cambridge. 1999.
[123] Buck, Dick A., Trainor, Joseph E., Aguirre, Benigno E. *A Critical Evaluation of the Incident Command System of NIMS.* Journal of Homeland Security and Emergency Management. Vol 3, Iss 3. 2006. Article 1.
[124] Warne, Leoni; Ali, Irena; Bopping, Derek; Hart, Dennis; Pascoe, Celina. *The Network Centric Warrior: The Human Dimension in Network Centric Warfare*. Australian Government: 2004.

The design of an effective response system should differentiate between response-generated demand and agent generated demands.[125] Agent generated demands are specific to the situation, and cannot necessarily be predicted, while response-generated demands can be foreseen to some degree with strategic planning such as consideration of the threats, who and what will be affected, and anticipating the resources required to response and recover. The ability to anticipate potential response demands gives responders better preparedness. Despite the ICS attempt to anticipate response plans, its critics suggest that emphasis on formal organization and rationality fails to recognize the initiative of unorganized volunteers, and groups that emerge during a crisis,[126] and the transformation of organizational structure and function that can occur during disasters as a reaction to unforeseen circumstances.

4.6 Recent Canadian Experience

North America in general has been building at an alarming rate, and has not been structuring or controlling its growth in most cases. Canada has lost 14% of its wetlands in the 200 years settlers have populated Canada[127], and most alarmingly 80-99% of those loses are within or adjacent to urban areas.[128] The population of Vancouver has *more than doubled* in the past thirty years.[129] Vancouver faces not threats from diminishing wetlands, however there is a significant earthquake threat to metro Vancouver; most of that population growth has been in densely populated urban and suburban areas,[130] and much of it is close to the ocean, or rivers. This growth has been largely unmanaged in a systemic way, with little consideration for land use planning. Continued growth in an area where a massive earthquake is possibility silently raises the costs of recovery when a disaster occurs. With its proximity to the ocean, Vancouver is not immune from the threat of tsunami either. California, far more densely populated than Vancouver or BC is also concerned about the prospect of a tsunami; the seismic safety commission in California acknowledges that present building codes and guidelines do not adequately address the impacts of tsunamis on structures. Currently available tsunami inundation maps are not appropriate for code or guideline applications.[131] After the 2005 Pacific tsunami the dangers are very apparent, yet the resources and planning to mitigate the threat are not forthcoming.

In the case of New Orleans eroded wetlands, the natural barrier protection the city from the sea, allowed the storm surge from Hurricane Katrina to fill Lake Pontchartrain causing the levees to overtop or break. Vancouver's Fraser River delta is also being eroded due to consistent dredging

[125] Quarantelli, E.L. *The Disaster Recovery Process: What We Know and Do Not Know from Research.* Preliminary Paper 286. Disaster Research Centre: University of Delaware.
[126] Buck, Dick A., Trainor, Joseph E., Aguirre, Benigno E. *A Critical Evaluation of the Incident Command System of NIMS.* Journal of Homeland Security and Emergency Management. Vol 3, Iss 3. 2006. Article 1.
[127] Rubec, C.D.A. *Policy for conservation of the functions and values of forested wetlands.* In: Towards the wise use of wetlands: Report on the Ramsar Convention. 1997.
Wise Use Project. Ramsar Convention Bureau: Gland, Switzerland.
[128] Environment Canada – *The Federal Policy on Wetland Conservation*. 1991.
[129] Statistics Canada – *Canada Yearbook: 1997*.
[130] Kovacs, Paul., Kunreuther, Howard. *Managing Catastrophic Risk: Lessons from Canada.* ICLR Research Paper Series - No. 13. April 2001
[131] State of California: Seismic Safety Commission. *The Tsunami Threat to California: Findings and Recommendations of Tsunami Hazards and Risks.* December 2005.

to keep shipping lanes open, eroding the delta.[132] This too provides a natural barrier from the sea, and just like New Orleans is being eroded apparently without concern for the potential consequences.

Some municipalities have taken proactive measures to protect themselves from the regional threats. The most notable examples are Winnipeg, Manitoba and London, Ontario. Following the 1950 flood, the federal and Manitoba governments assessed flood mitigation and prevention options. Based upon recommendations submitted in a 1958 Royal Commission report, the Red River Floodway project (a 50 km-long diversion channel around the City of Winnipeg) was completed in 1968 at a cost of $63.2 million. The federal government contributed $37.0 million and the province spent $26.2 million on the scheme.[133] This system was further upgraded with the construction of a 29 km diversion channel which is designed to drain up to 708 m3/s away from the Assiniboine River and into Lake Manitoba, Further, a 21 m high and 1,270 m long dam on the Assiniboine at Shellmouth (near the Saskatchewan border) has created a 56 km long reservoir, with a storage capacity of 863,398 m3.[134] The cost of damage inflicted on the Red River area was only on sixth the Ice Storm in Eastern Ontario and Western Quebec, and just over half the cost of the Saguenay. The total cost of this system was less than $100 million dollars, and surely saved many times that in the cost of rebuilding had the system not been in place. The system has been used 18 times during its first 40 years of operation, and has contributed to the prevention of more than a billion dollars in property damage.[135]

London, Ontario has also taken a preventative approach to the urban planning and storm water/wetland management. The loss of wetlands is significant for both governments and the insurance industry. Higher levels of urbanization detract from water quality and increase peak flows. If increased runoff causes sewers to back-up, private residential insurance policies may cover damages. In instances where increased flows detract from downstream uses of waterways, such as golf courses, legal damages have and may be awarded. Ecological functions of a wetland can also be affected by urban development. Thus, wetland and storm water management play an important role in supporting effective water resource management.[136]

London introduced regulations to prevent constructions on lands deemed ‘provincially significant wetlands’ or ‘locally significant wetlands’ or on the lands adjacent to them that could cause a risk to the sustainability of the wetland. This was implemented using the applicable provincial regulations, consistently evolving from the 1970s to the mid 1990s. Aerial photographs, hydrographic charts and other applicable materials were consulted to make assessments as to whether construction was acceptable. There were two bodies involved in this: The Ontario Ministry of Natural Resources (OMNR) and the Upper Thames Redoubt Conservation Authority (UTRCA). Their roles were divided along biological and technical lines, respectively, though

---

[132] Natrual Resources Canada. *Geoscope Vancouver: the Fraser River Delta.* http://geoscape.nrcan.gc.ca/vancouver/fraser_e.php

[133] Topping, Steven D. *Red River Valley Flood Control Works and Related Infrastructure in the Province of Manitoba*. in: Red River '97, the Flood of the Century, Causes, Impact, Management. Winnipeg: Canadian Water Resources Association.

[134] Shrubsole, Dan, et al. *An Assessment of Flood Risk Management in Canada.* ICLR Research Paper Series - No. 13. January 2003.

[135] Kovacs, Kunreuther. 2001

[136] Schulte-Hostedde, Bridget., Shrubsole, Dan. *Adjusting to Policy and Fiscal Change: The Case of Land Use Planning in London, Ontario.* ICLR Research Paper Series – No. 22. October 2002.

considerable overlap was inevitable with tandem responsibility over the same geographic area. This is only an isolated example of regional cooperation however: 'More fundamental issues concern its exclusion of agricultural activities; the limited protection afforded locally significant wetlands and unevaluated wetlands, and the current lack of comprehensive wetland inventory.'[137] With the tainted-water incident in Walkerton, and the danger of downstream pollution from farms, public security threats can stem from water flows other than flooding.

The Saguenay experienced a significant disaster during the flooding. The largest accumulations occurred directly to the south of the Jonquière-Chicoutimi-La Baie area in the Saguenay Valley, with more than 200 mm. Most of this rainfall was recorded in a 36-hour period between July 19 and July 20. This rainfall caused extensive damage to waterways in these regions, not to mention roads, bridges, railways, water retention structures, houses, farms, and public and commercial buildings. [138]The rainfall was certainly significant in this disaster, but the manner in which it was managed contributed to the widespread flooding. During that event, fragmented dam ownership, as well as the unsystematic design and operation of reservoirs, posed very significant obstacles[139]. An integrated approval and operating system for water control structures was lacking. These weaknesses were compounded when upstream dams had much larger flow capacities than downstream structures. In addition, design elevations of control structure were different than those of downstream and nearby dykes.[140] The mechanisms were individually in place, but were not coordinated for maximum evacuation of water with the outflow of the river. Sending more water than can be handled to the dams and levees downstream ensures disaster, and was the cause of much of the flooding in the area.

Winnipeg and London reflect two different strategies, influenced by their context. Winnipeg cannot be relocated, so to mitigate flood damage to the community the Red River Floodway was developed. In London, to prevent the necessity for those sorts of measures, avoiding construction on wetlands – the natural buffer against flooding – is pursued to mitigate damage. The flow of rivers was a significant risk to the Red River and the Saguenay, but what of tidal waters? The 2005 tsunami in South East Asia and Hurricane Katrina are certainly indicative of the magnitude of devastation possible when close to the oceans.

While less polarized than the black population of New Orleans, Canada is not without its ethnic divisions, and the perception of it. During the 1997 Red River floods some First Nations communities were evacuated to facilities inferior to non-aboriginals. While people from other communities were housed in hotels, the residents of Roseau River were placed in an arena in a nearby community; non-aboriginal flood victims were offered better temporary shelters. There was no privacy, they had to sleep on air mattresses, and there were problems with the heating. People had problems cashing cheques (the community was able to resolve this problem by making arrangements with some credit unions in St. Anne). On the other hand, people relocated

[137] Ibid.
[138] Brooks G.R. and D.E. Lawrence. *Geomorphic effects of flooding along reaches of selected rivers in the Saguenay region, Quebec, July 1996.* Géographie physique et Quaternaire. – 2000. 54(3): 281-299.
[139] Commission scientifique et technique sur la gestion des barrages. *Report/ The Scientific and Technical Committee on the Management of Dams in Quebec.* Quebec: Canadian Dam Safety Association – 1997.
[140]Shrubsole, et al. January 2003.

to the same community ate very well, [141] reinforcing the perception of favouritism toward non-First Nations communities.

Long before the Red River flooding, First Nations communities were at risk in Manitoba. Development of hydro-electric generating stations on the Nelson and Churchill rivers had flooding effects on First Nations communities in Northern Manitoba during the 1970s, requiring compensation. The Economic Development Agreement (EDA) provided $3.2 million in 1977 (equally shared between Canada and Manitoba) as general funding to the Neyanun Development Corporation which is First Nation controlled. A further $1.875 million was earmarked for Cross Lake First Nation to be provided by Manitoba Hydro to the Neyanun Development Corporation under Article 17 of the NFA.[142] This plan did not make any attempt to reverse the potential for disaster by relocating dams, but only to mitigate the damaging effects in the future.

4.7 OP UNISON

The Government of Canada despatched a Joint Task Force to the Gulf Coast as a national contribution to disaster relief and emergency assistance following Hurricane Katrina. Self-sufficiency was critical and the Task Force was comprised of Halifax-based ships augmented by divers, engineers, logisticians and medical staff. Following the offload of humanitarian supplies (into the FEMA distribution network) the naval ships anchored off Biloxi working closely with the US Navy and supporting shore work parties. The Canadian Coast Guard vessel was seconded to the US Coast Guard and employed in waterway reconstitution. The Post-Deployment Report identified a number of potential lessons.[143]

As might be expected, the initial Warning Order lacked specifics. In part this is understandable. In practice, both asset visibility and resource allocation challenges were experienced mounting the Task Force; some units outside the formal chain of command were reluctant to re-direct personnel and/or resources. This would appear to re-enforce intuition e.g. “Unity of Effort”/”common purpose” assumptions are more appropriate to on-scene response than to outside assistance. The Post-Deployment Report remarks on the requirement to mature command, control and collaboration on the national-level.

The comments in the Post-Deployment Report that “many impediments raised at the national level (OPCON of a Coast Guard unit to a military commander, for example) were overcome by personal contacts”[144] is instructive. It speaks to the importance of issues of trust, cultural awareness, communication and teaming skills and may be noteworthy that the example cited involved cooperation between regionally located, operationally focused sea faring brethren. Adaptability and innovation are human rather than technological traits.

---

[141] Epp, Donna, Haque, C.E., Peers, Beth. *Emergency Preparedness and First Nations Communities.* March 1998.
[142] Department of Indian and Northern Affairs. *Backgrounder – Manitoba Northern Flood Agreement: Implementation.* http://www.ainc-inac.gc.ca/pr/info/bacman_e.html
[143] Canadian Fleet Atlantic, Post-Deployment Report – OP UNISON, November 2005.
[144] Ibid, p 5/11.

4.8 Prevent/Protect

4.8.1 Urban Growth

In the United States about 17% of America's landmass (save Alaska) are coastal communities, comprising approximately 53% of the US population (153 million people): this is an increase of 28% over the 1980 to 2003 time interval, equating to ten of the fifteen cities with the highest population in America.[145] America is facing $1.65 trillion infrastructure investment deficit[146], which when considering that Canada's population is approximately one tenth of the United States put the Canadian estimate at $165 billion, according to the Canadian Federation of Municipalities.[147] An extrapolation based only of population density does not account for differences in investment funding and maintenance between the two countries. This figure is over double the figure of $60 billion assessed by the Canadian Federation of Municipalities, the Conference Board of Canada and various associations of Canadian engineers, quoted in a Library of Parliament report.[148] It is unlikely the debt grew by over $100 billion in the three years between the publishing of the Library of Parliament report.

Estimate of possible earthquake damage range between $6.7 and $12 billion for Vancouver and Fraser River Delta.[149] This phenomenon is not limited to Vancouver either. California has admitted its building codes and guidelines an insufficient to address a tsunami; flood maps outdated because the sprawl of new development has not been tracked and included in new maps; yet, growth continues

4.8.2 Ecology

There is a tendency to dismiss Katrina and underplay national vulnerabilities. While scales may reflect differences in relative population, research suggests that Canadian coastal communities and ecological systems may be equally vulnerable to rising sea levels and climatic change. Light detection and ranging (LiDAR)[150] data can (and has) been used to support digital elevation modelling (DEM). A recent study, *Impacts of Sea-Level Rise and Climate Change on the Coastal Zone of Southeastern New Brunswick* (EC), concludes that the New Brunswick portions of the Gulf of St-Lawrence will become susceptible to flooding in the next hundred years. "The observed relative sea-level[151] rise results from a combination of regional subsidence and rising

[145] Crossett, K., Culliton, T.J., Wiley, P., Goodspeed, T.R. *Population Trends Along the Coastal United States, 1980-2008, National Oceanic and Atmospheric, Administration Coastal Trends Report Serie*s, September 2004

[146] American Society of Civil Engineering. *ASCE Report Card on U.S. Infrastructure* (2005).

[147] Mirza, Saeed. *Danger Ahead: the Coming Collapse in Canada's Infrastructure.* A Report for the Federation of Canadian Municipalities. November 2007.

[148] Haggart, Blayne. *Canada's Infrastructure Debt – Part I: Assessing the Infrastructure Shortfall.* Library of Parliament: 24 June 2004.

[149] Royal Society of Canada/Canadian Academy of Engineering. IDNDR Mid-Term Review and the 1994 World Conference on Natural Disaster Reduction, Yokohama, Japan 23-27 May 1994, , page 32.

[150] LiDAR mapping involves the emission of laser pulses from an aircraft and measurement time of travel to and returns from the ground. These are used to generate a digital topographic image f the area.

[151] Relative sea–level rise refers to the rise of the water level relative to fixed points on land.

sea level in the Northwest Atlantic."[152] The steady sea-rise over the past 100 years indicates expectation of an approximate average of 55cm of sea rise (plus/minus 35cm) by the year 2100. A higher baseline sea level will increase the level of flooding as result of storm-surges in these coastal areas. Like New Orleans, marshes and wetland provide a level of protection – this is particularly true with respect to the Southeastern Coast of New Brunswick.

Climate warning may accelerate this historical rate of sea-level rise. Charlottetown's tidal-gauge record is one of the longest available in eastern Canada and indicates that it has experienced a 32 cm rise since 1900. These rates need to be considered in the context of storm impact and associated damage. Storm-water levels and waves are superimposed on the mean sea level affecting flooding, wave attack and erosion "with implications for ecological impacts and adaptation measures that need to be taken to reduce losses"[153]. In Charlottetown the 21 January 2000 storm established a new record extending the previous water level set 39 years earlier by 39 cm. This storm occurred when at a time when the shoreline was protected by sea ice. The 29 October 2000 storm was more damaging to shorelines and coastal infrastructure, and could have been worse if in phase with high tide

It is believed that ice has a dampening effect on storm surges and hence the decreasing trend in ice cover and duration of the ice season may not bode well. In much the same way that the bayou wetlands served to "protect" New Orleans, the Maritimes sand dunes and salt water marshes serve to protect Canadian coastlines. There is nothing new in a trend of coastal retreat but the rate of erosion is a concern and may presage problems. "Erosion rates greater than 0.5 m per year are common on many beaches, and some sites show even higher rates".[154]

The losses of coastal salt water marsh raise similar concerns. Salt water marshes have receded due to excessive infilling for development.[155] This is significant because the marshes provide the first line of coastal defence (aside from ice in winter/early spring) from storm surges, and with their degradation weaken an essential defence system. The most serious erosion (in terms of hectares lost) of salt marshes was observed in Cape Jourimain with the loss of 28% of their marshes (88ha), due primarily to a roadway built in 1966.[156] When marshes are lost they result in a hardening of the coastline, which can no longer absorb the impacts of the sea. Previous marshes become part of the trajectory for incoming surges, rather than cushion its impact.

The erosion of this vital defence system is notable because it has been studied prior to the occurrence of a major disaster. In January 2000 the DEM indicated flooding to a magnitude of 2.55m above the previous datum level. This winter storm was significant, and caused no reported loss of life. Taking measures to mitigate the loss of coastline, and to build back from the coast lie can mitigate the effects of a future disaster; measures not taken in New Orleans despite an understanding of the risks. The magnitude of this flooding was significant: 1397ha of upland,

[152]Environment Canada. *Impacts of Sea-Level Rise and Climatic Change on the Coastal Zone of Southeastern New Brunswick*, 2006, p. 3.
[153] Ibid, p. 5.
[154] Ibid, p 13.
[155] Ibid.
[156] Ibid.

1634ha of coastal (salt) marshes, 388ha of dune, and 266 ha of beach were flooded as a result; the flooding height: 0.84m – swamp, 1.13m – dune, 1.58m – beach, 1.64 – coastal (salt) marsh.[157]

Coastal zones are home to several threatened species of plants and animals. Analyses indicate that large areas of coastal habitat may be influenced by increased water levels and storm surges. Discussions relating to network topology and biodiversity are beyond the scope of this report. Suffice to emphasize that; ideally, an All Hazards Risk Assessment might well include a study of food-web structure and complexity.[158]

These observations underscore the importance of understanding micro and macro changes in coastal morphology. Scenario generation exploiting DEM may provide a means to study a full sequence of possibilities and allow emergency measures and management staffs more information used in developing plans.

4.8.3 Aging Infrastructure

Underinvestment in infrastructure contributed to the devastating consequences of Hurricane Katrina. Although Canada is less prone to hurricanes the infrastructure, the shared, national infrastructure debt is disturbing and a potential threat to public safety. A 2004 report conducted by the Parliamentary Information and Research Service considered the problem.[159]

> *A civilization's rise and fall is linked to its ability to feed and shelter its people and defend itself. These capabilities depend on infrastructure – the underlying, often hidden, foundation of a society's wealth and quality of life. A society that neglects its infrastructure loses the ability to transport people and food, provide clean air and water, control disease and conduct commerce.*[160]

In 2002 it was assessed that Canada's public infrastructure (civil engineering, roads, dams, etc) was worth $257 billion and accounted for about 70% of public capital stock. Responsibility is shared with local government responsible for about 50% of all public infra-structure, provincial and territorial government for 40% and the federal government responsible for the remainder. Notwithstanding recent initiatives – steps in the right direction - the infrastructure shortfall is not being addressed. The magnitude of the problem is disturbing and the deficit may be increasing; the Canadian Society of Civil Engineers assessed the infrastructure deficit in 2003 to be $57

---

[157] Ibid.

[158] Several studies have introduced the concept of keystone species, species that have a disproportionate impact on their ecosystem. For example, Dunne et al. studied trophic species examining species richness, connectance, links and ominvory, and concluded that more secondary extinctions occur due to removing highly connected species compared to random removals. As might be expected this is particular true for low connectance webs. Dunne, Jennifer A., Richard J. Williams and Neo D. Martinez. Network Topology and Biodiversity Loss in Food Webs: Robustness Increases With Connectance, Romberg Tiburon Centre, San Francisco State University.

[159] Haggart, Blayne. Canada's Infrastructure Debt, Parliamentary Information and Research Service, Library of Parliament, Ottawa, June 2004.

[160] US National Science Foundation, quoted in Canadian Council of Professional Engineers "*Brief to the Standing Committee on Finance regarding the federal government's pre-budget consultation process*" 25 September, 2003, p.3.

billion, less than the $123 billion claimed by the Federation of Canadian Municipalities.[161] TD Economics estimated $17 billion of this represented under-investment in roads and highways and concluded that the shortfall is growing by $2 billion per year.[162] These figures are supported by a Conference Board of Canada study commissioned by Union des municipalities du Quebec. The *Civil Infrastructure Systems Technology Road Map 2003-2013* suggested that Canada has used 79% its infrastructure lifespan expectancy and that 59% of Canada's infrastructure is more than 50 years old[163] - 50% of all infrastructure will have reached the end of its lifespan by 2027. While some of these details may be open to interpretation, it would be difficult to challenge the conclusion that public infrastructure is both a critically important element of public safety and woefully vulnerable.

In part the challenge is structural. Municipalities do not have the tax generation capability to resolve the problem. Federal transfer payments have dropped as a share of total municipal revenue and most provinces/territories limit municipalities revenue to property taxes. The down-loading of responsibility for services has resulted in municipal governments directing "more of their expenditure growth away from infrastructure and towards paying for more immediate costs"[164] i.e. O&M. Transferring a 'gas tax' to the municipalities will allow for some infrastructure investment but not enough to occasion a reversal: it will likely only prevent further growth of the deficit. An All-Hazards Risk Assessment methodology must integrate infrastructure concerns. The Canadian Council of Professional Engineers recommends[165]:

- Catalogue/assess infrastructure inventories;
- Identify risks and priorities;
- Support lifetime costs for maintenance and repair; and
- Implement strategies for greater longevity, safety and value

These measures are critical to safeguarding Canadians against disaster. An excellent example of failure in all four areas was the flooding on the Saguenay river in 1997. This disaster exposed shortcomings in the ability to mitigate disaster in the St-Jean/Chicoutimi Region. For example, fragmented dam ownership, spread over 25 public and private agencies had constructed over 2,000 dams and other control structures,[166] as well as the unsystematic design and operation of reservoirs, posed very significant obstacles. These weaknesses were compounded when upstream dams had much larger flow capacities than downstream structures. In addition, design elevations of control structure were different than those of downstream and nearby dykes, and some

[161] Mirza, Saeed. Danger Ahead: the Coming Collapse in Canada's Infrastructure. A Report for the Federation of Canadian Municipalities. November 2007.
[162] TD Economics, "A choice between investing in Canada's cities and deinvesting in Canada's future" 22 April 2002, p.15.
[163] Association of Consulting Engineers of Canada, "The second national debt: Canada's growing infrastructure challenge" submission to the House of Commons Standing Committee on Finance, 2 September 2003, p.3.
[164] Statistics Canada, "Government finance, 2003/04" The Daily, 18 June 2004.
[165] Canadian Council of Professional Engineers. *Brief to the Standing Committee on Finance regarding the federal government pre-budget consultation process.* 25 September 2003.
[166] Grescoe, T. *After the Deluge.* Canadian Geographic. 117(2): 1997. pp 29-40.

reservoirs overtopped downstream dykes. During the flood, six major water control structures failed and several others were damaged.[167] Differences in the level of water upstream facilities were designed to pass downstream, and the level of water downstream facilities were capable of processing invited disaster in the future. However, there was no loss of life in the flooding.

In the case of disasters destroying the infrastructure meant to defend from them, the risk associated with rebuilding to the previous specifications should be revisited. In the case of the Saguenay the infrastructure was rebuilt quite quickly, with intent to "Safeguard people, buildings and infrastructures against the risk of flooding, high water and ice, as well as, landslides and shoreline erosion."[168] There is no specific mention of whether that is beyond the stated specifications previously destroyed. In Quebec Bill 152 was passed in response. The Department of Transportation acquired ownership of the relevant riverbeds, as well as, a strip of shoreline to the 1:100 year flood mark covering a distance of about 35 km in length. If this bill is simply mandating reconstruction to the previous standard this type of disaster can be expected every hundred years, in accordance with the Government of Quebec's own risk assessment.

Though the Saguenay resulted in no loss of life, imagine if New Orleans' solution to Katrina was to rebuild the levees to the same standard. Does this not invite another catastrophe?

4.8.4 Sociological Structure

The 2000 census of New Orleans proper (Orleans Parish) identified 67.3% of the population as black, or about 324,000 people. [169] Within that parish alone The U.S. Census Bureau reports that 27.9% of the city's population is below the poverty line, 27.3% did not have cars. In addition to poverty, New Orleans is a city in which 11.7%are age 65 or older, and only 74.7% are high school graduates. Furthermore, a larger than average percentage of residents have disabilities: 10.3% of 5-20 year olds, 23.6% of 21-64 year olds, and 50.% of those age 65 and older have disabilities according to the 2000 U.S. census.[170] This certainly lent creditability to statements that those left behind were the most vulnerable and predominantly poor, black and/or disabled, and that without cars to evacuate, or money to mobilize alternate solutions, much of Orleans parish was put at significant risk well before landfall. There is the additional threat of predatory tendencies in New Orleans: its murder rate is 10 times the national average, and robberies run at three times the national average.[171] These facts, and the burden disproportionately borne by the most vulnerable reinforces the notion that "racism" is not just a matter of the psychology of hatred but is instead also a matter of the racial structure of political and economic inclusion and exclusion.[172] This perception was likely further reinforced by the commentary of hip-hop artist

[167] Commission scientifique et technique sur la gestion des barrages. *Report/ The Scientific and Technical Committee on the Management of Dams in Quebec.* Canadian Dam Safety Association: Quebec. 1997
[168] Environnement Canada (1997). *Pluies diluviennes du 18 au 21 juillet 1996, au Québec : Analyse et interprétation des données météorologiques et climatologiques*. Région du Québec: Division des services scientifiques. 1997.
[169] Dominguez, Virginia R. *Seeing and not Seeing: Complicity in Surprise*. 11 June 2006.
[170] Fussell, Elizabeth. *Leaving New Orleans: Social Stratification, Network and Hurricane Evacuation.* 11 June 2006
[171] Scanlon, Joe. *Two Cities, Two Evacuations: Some Thoughts on Moving People Out.* 11 June 2006.
[172] Gilman, Nils. *What Katrina Teaches About the Meaning of Racism*. 11 June 2006

Kanye West when he charged that "George Bush doesn't care about black people," and that America is set up "to help the poor, the black people, the less well-off as slow as possible."[173]

If true, this is certainly a deplorable statement about the status of minorities in Louisiana. However, is the Canadian context any better? Certainly questions of structural discrimination were raised during the Red River Flood of 1997. In commenting on the experience of the Roseau River Anishinabe First Nation, suggested that the floodplain location of its Emergency Operations Centre and inadequate communications with other relevant parties were problematic. With respect to evacuation procedures, some band members perceived that they were not treated fairly because they were re-located to an arena that offered no privacy while non-aboriginal flood victims were offered better temporary shelters,[174] mostly in local hotels. Water infrastructure has been acknowledged as generally inferior on First Nations reserves compared to the rest of Canada.[175] The Story of Kashechewan, a reserve in Northern Ontario, indicated a 2 year boil-water advisory before government intervention.

This is by no means to make an equal comparison between New Orleans structural bias against the black population, and the Canadian treatment of its First Nations people, it is meant to indicate that Canada is not immune from criticism of structural bias resulting in less equal treatment for a segment of the population. During a catastrophe the social underpinnings are clear to see in terms of who is made a casualty.

4.9 Recover

The House of Commons Finance Committee estimated in 2000 that natural disaster recovery cost the government of Canada an average of $500 million dollars a year between 1996 and 1999.[176] The Insurance Board of Canada stated specifically that the Saguenay flooding cost $1.6 billion, the Red River flooding $815 billion, and Ice Storm of 1998 $5.4 billion.[177] These three events combined, the most disastrous to happen in Canada is recent memory cost, combined, less than one tenth of the estimated cost of $160 billion of Hurricane Katrina on New Orleans and Louisiana.

The National Flood Insurance Plan in the United States has been insufficient in providing the help needed to victims of the Hurricane Katrina. The New York Times reported back in November of 2006 that only 22 of the 79,000 families that had applied for assistance from the $7.5 billion Road Home program had actually received funds.[178] Having established that those hardest hit were the

---

[173] Strolovitch, Dara; Warren, Dorian; Frymer, Paul. *Katrina's Political Roots and Divisions: Race, Class, and Federalism in American Politics.* 11 June 2006

[174] Rahman, M.M. Roseau *River Anishinabe First Nations. Emergency Preparedness and First Nation Communities in Manitoba.* Epp, D; Haque, C.E.; Peters, B (eds.). Ottawa: Emergency Preparedness Canada. 1998.

[175] Haggart, Blayne. *Canada's Infrastructure Debt: Part I – Assessing the Infrastructure Shortfall.* Parliament of Canada: June 2004.

[176] House of Commons Standing Committee on Finance. *Spending Today…Savings Tomorrow*. 2nd Session, 36th Parliament. 31 May 2000.

[177] Insurance Bureau of Canada. *Natural Disasters in Canada – Facts.*

[178] Eaton, Leslie. *Slow Home Grants Stall Progress in New Orleans.* The New York Times. 11 November 2006.

least well prepared financially to save themselves, how can they be expected to rebuild their lives without financial assistance? This makes returning home more difficult for members of the population with less financial and advisory resources[179] than those who left before landfall. This represents a pittance of assistance from the federal government in the US.

Not surprisingly, with various obstacles to returning faced by former residents, by the end of2006 New Orleans had regained half of its pre-Katrina population numbers.[180] Notably, The Ninth Ward had regained just under one fifth of its pre-Katrina population,[181] strongly changing the racial composition of New Orleans. The percentage of New Orleans that was black prior to landfall was 67.3%, and as of 2007 had dropped to approximately 47%[182]. The loss of about 30% of the black population, expressed numerically accounts for about 145,000 people; this can be the only conclusion, as credible reports indicate a absence of evacuees returning, not additional white people settling in New Orleans. Canada has not witnessed a level of relocation on this scale, though it is not impossible given the potential vulnerability in places like British Colombia.

The disasters costs seen so far do not represent the pinnacle of vulnerability and costs in Canada. Catastrophic risk exposure will continue to grow as the population of hazard-prone areas such as the Lower Mainland of British Columbia, California and Florida continue to grow. The total value of property at risk in Canada's highest earthquake risk area alone, British Columbia's Lower Mainland, is approximately $260 billion.[183] Canada is by no means immune to potential catastrophic loss of life and sheer destruction.

Insurance companies in Canada can hedge their losses in capital market. Given the international nature of the reinsurance market, and the mobility of reinsurance capital, the Canadian market not only represents a small portion of the international reinsurance market exposure, but is also likely viewed as an opportunity for diversification by reinsurers with significant exposures elsewhere.[184] The nature of insurance is such that the costs are spread across many policy holders: only those with damage to claim receive payment, while the remainder of policy holders continue to pay premiums and not make claims. At a macro level this applied in Canada more so than in the United States: with a smaller population and smaller markets our share on the global insurance pool is smaller, reducing the magnitude of capital risk. That does nothing to reduce the all-hazards threat; it only means the Canadian insurance is less likely to become insolvent and require critical government bail-outs. Many insurance reinsurers and emergency management academics assess increasing population and property densities in these and other endangered areas heighten the risk of increased natural catastrophe losses.[185]

---

[179] ACORN Housing/University Partnership. 2007. A *Peoples' Plan for Overcoming the Hurricane Katrina Blues: a comprehensive strategy for building a more vibrant, sustainable, and equitable 9th Ward.* http://www.rebuildingtheninth.org/resources/

[180] Nossiter, Adam. *New Orleans of Future May Stay Half Its Old Size*. The New York Times. 21 January 2007.

[181] ACORN. 2007.

[182] Gumennik, Irena. *Resettlement Trends in New Orleans After Katrina.* 6 March 2007.

[183] Scawthorn, Charles; Waisman, Federico. *Assessment of Risk due to Fire Following Earthquake Lower Mainland, British Columbia*. EQE International, January 2001

[184] Carayannopoulos, Peter; Kovacs, Paul; Leadbetter, Darrell. *Insurance Securitization : Catastrophic event exposure and the role of insurance linked securities in addressing risk.* January 2003

[185] Swiss Re a, *Natural catastrophes and man-made disasters in 2000: fewer insured losses despite huge floods*. Sigma, No. 2/2001.

4.10 Summary/Observations

There was clearly an ethnic predisposition to vulnerability in New Orleans within the black community. To a lesser extent this exists in Canada within the First Nations community. Those communities were not sufficiently well protected from natural hazards. Money spent on mitigating disasters through robust infrastructure construction programs is never wasted, and prevents the loss of life.

The global rate of urbanization is constantly increasing, and with that trend in mind development of cities must be done in a sustainable manner that avoids sowing the seeds of future disaster. Development on floodplains, coastlines, wetlands, unstable ridgelines should be avoided. Development should account for urban sprawl, ecological concerns, and the infrastructure to support both. Despite potential government adherence to sound risk management in development, the overwhelming majority of infrastructure owned by the private sector, or by municipalities; in both cases outside the direct control of the federal government. This is significant given that most disasters occur at the local level. The failure of communication infrastructure (privately owned) in New Orleans crippled response.

In the case of infrastructure failures, reconstruction to pre-disaster levels is illogical: the notion that rebuilding something whose destruction caused havoc to the same standard will do nothing to prevent a disaster under the similar conditions, let alone worse conditions. Hurricane Betsy's damage to New Orleans in 1965 was cause by levee failure, just as it was in 2005. It is unacceptable to accept disasters of that magnitude every forty years, or even every fifty or seventy five years. The risk assessments that underpin assumptions about the nature of threat must also be consistently revisited to identify new threats, or those credibly assessed as being effectively mitigated

Any Canadian plan for emergency management reforms needs to include critical stakeholders like municipal government and the private sector. In addition, without the tax revenue to adequately fund infrastructure programs, municipalities are a significant disadvantage in self-sustainability. The Federal government will remain the final guarantor of security. With the power of taxation to generate capability and surge capacity, and emergency exclusivity of jurisdiction over public safety, the Government of Canada will continue to exercise the widest powers over disaster and catastrophe response. However, disaster will manifest at the local level, and meta-collaboration on infrastructure renewal, and common risk assessments will facilitate a common operating picture for monitoring and response to threats.

There is no document that addresses a long-term strategy for balancing the needs of modernity with environmental sustainability. These seemingly conflicting needs must be reconciled to ensure the sustainability of Canadian communities. The Canadian political culture and constitutional division of powers permits a more robust 'whole of government' emergency management mechanism. The unity of military command, the provincial divisions of national policing, and statutory authority in the hands of senior bureaucrats charged with managing crisis all contribute to a more concise, coherent mechanism than in the United States. This alone will not however be sufficient to expect the spontaneous materialization of an effective response; it simply means there are fewer bureaucratic ambiguities and hurdles.

.

5. Mapping to DHS Capabilities

5.1 Explaining Capability Structure

The Homeland Security Target Capabilities List establishes a schema to facilitate analysis and planning. A capability can be viewed as the ability to achieve a desired effect or outcome to defined standards under specified conditions. Conditions can include magnitude, temporal and/or geographic components, and these can be applied at the capability or task level. It is displayed in Figure 4: Capability

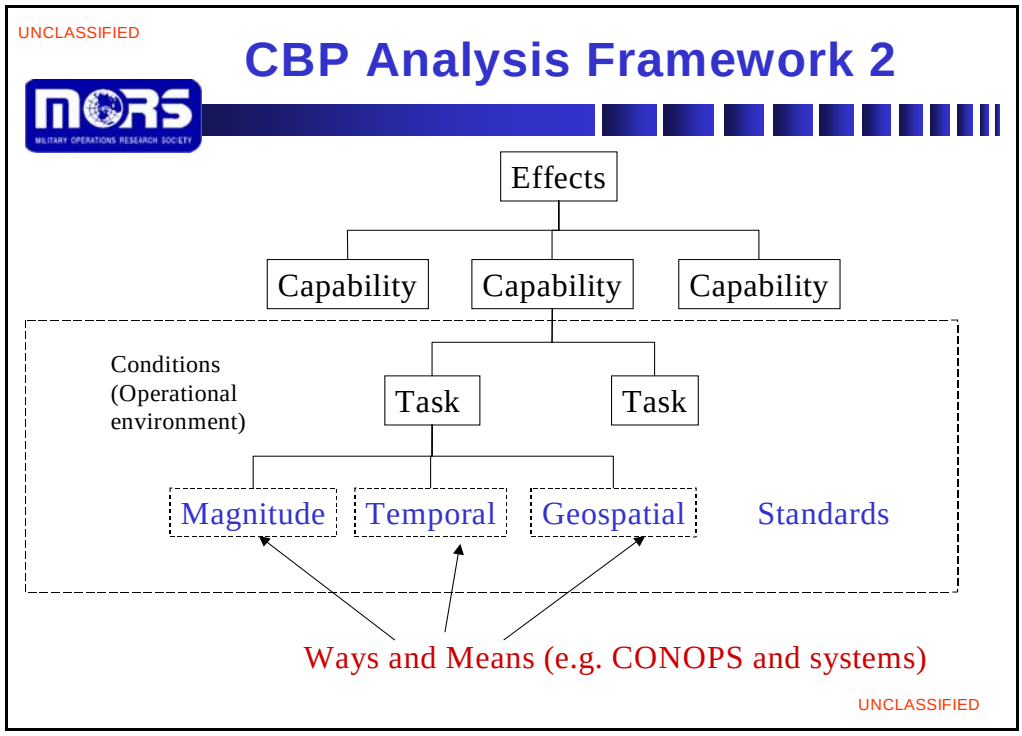


Figure 4: Capability

Capabilities are inherently abstract and are scalable. When applied, they can be defined in terms of the successful completion of discrete tasks. The attraction is that capabilities define what must be done, not how it must be done opening up the possibility of discovering new combinations of process, organization and technology. Tasks can be thought of as assigned activities and process as sequenced activities transforming inputs into outputs. Concepts of Operations, Doctrine and Tactics, Techniques and Procedures (TTPs) prescribe capability employment and preferred activity sequences. It is vitally important that these can be traced back to higher level goals and mission objectives. Typically scenarios provide the contextual setting and "mission analysis" determines objectives, related task and capability packages. This is shown below in Figure 5: Mission Analysis.

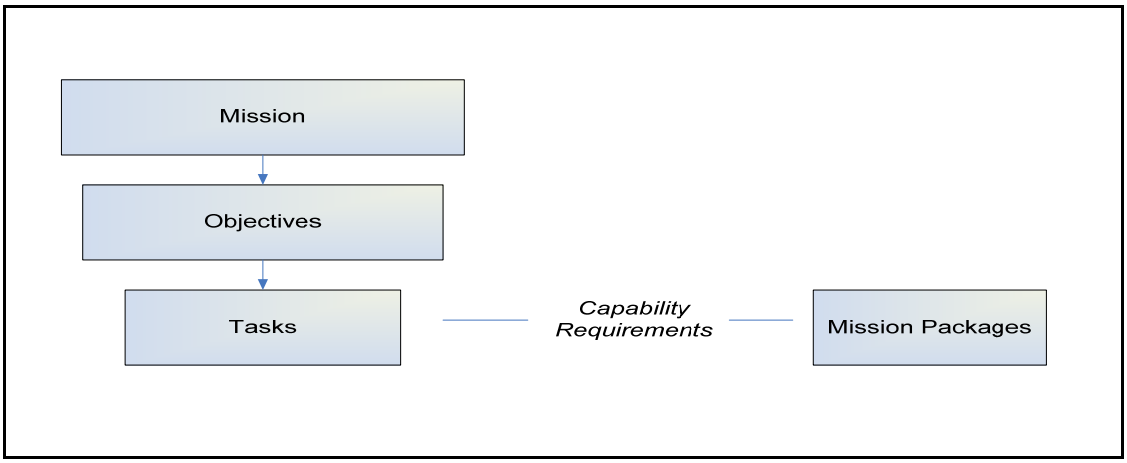


Figure 5: Mission Analysis

The Target Capabilities List provides a common schema (37 capabilities) and associated task "menu" to facilitate planning integration. A summary description of each capability and each task is included and discussion of performance indicators. This provides the framework for synthesis and evaluation.

5.2 Mapping Lessons Learned

The Target Capability List (TCL) provides a guide to addressing the priorities and achieving the objectives listed in the National Preparedness Guidelines. The tasks and capabilities below are from the DHS Security Tasks list v2.01. Capabilities provide the means to accomplish a mission and achieve desired outcomes by performing critical tasks, under specified conditions, to target levels of performance. Capabilities are delivered by appropriate combinations of planning, organization, equipment, training, and exercises. The TCL supports an all-hazards approach to building capabilities that may be needed in the event of terrorist attacks, natural disasters, health emergencies, and other major events. It identifies 37 capabilities (divided into common functions, protect, prevent, respond and recover) that were developed with the active participation of stakeholders representing all levels of government, non-governmental organizations, and the private sector.[186] This document is the comprehensive listing of the capabilities that are required to satisfy the objectives of the Department of Homeland Security, implemented through the National Preparedness Guidelines.

The most recent incarnation of this document was published in September 2007, and included feedback from elements of the federal, state and municipal governments, non-government organization and the private sector. The document makes it very clear each agency is not expected to maintain all of the capabilities on the list, nor are they expected to maintain them all to the same standard. A list of all thirty seven capability areas is included in Annex A.

[186] US Department of Homeland Security. *Target Capability List: a companion to the National Preparedness Guideline.*

5.2.1 Recurring Capability Areas

In all the documents reviewed, there was a consistent repetition of capability areas found insufficient to respond to Hurricane Katrina. They are described by mission area

- **Common**: Resource Management, Planning, Communications, Training and Exercise, Risk Management

The resources required for the basic functioning was missing in many cases. This deficiency was not limited to one department or level of government, but was quite endemic to the entire response. FEMA supplies (water, food, medicine) were stored in places beyond the flooding, vehicles to move supplies into New Orleans were lacking, aircraft were missing, while the National Guard did not have additional forces closer than Baton Rouge, and the city itself did not keep its relief shelters properly stocked for the volume of people needing assistance. Though not specifically a planning issue, the lack of forethought in pre-positioning of supplies and other critical response equipment indicated failures in resource management and planning.

The Hurricane Pam exercise was only partially completed, limiting its effectiveness as a planning template when the exercise scenario basically played itself out in August 2005 as Hurricane Katrina. Command was unclear, the organizational hierarchy was fragmented, and response was often quite piece-meal. All of this indicates endemic deficiency in planning for disasters, and potential catastrophes.

Communications interoperability is often framed as essential for inter-agency cooperation. This was highlighted on 9/11 when firemen couldn't talk to policemen, or to their own headquarters. Interoperability certainly hampered the response to Katrina, though *basic operability* after landfall was lacking, hampering all levels of response. Jackson barracks was out of communication with higher headquarters for 36 hours, 9-1-1 exchanges were flooded, police stations were flooded, hospitals were flooded, and there was patchwork communications operability in and out of the city. With almost no communications across the city, and very little to the State level in Baton Rouge response was immediately stunted by communications deficiencies. This is a significant point to note, because hand-held radio interoperability was not effectively tested during Katrina. Cellular towers, blackberry towers, phone lines, power lines, exchanges are large, fixed pieces of infrastructure on which communications devices (mobile handsets) rely. Lacking functional infrastructure, the interoperability of the devices is a moot point.

Training and exercises were rarely conducted involving multiple levels of government. When it was attempted during Hurricane Pam the process was firstly never completed, and secondly never revisited. Exercises help identify shortcomings in emergency management writ large when lives and property are not at stake, with the intention of fixing them. Without even seeing the exercise through to completion revisiting lessons learned is impossible. This is unfortunate in the case of the Hurricane Pam exercise, because it was an accurate assessment of the risks present in New Orleans, and is basically what happened when Katrina made landfall. Pam was a more catastrophic event, though the sequence and priority of response were almost identical.

All levels of government were aware of the risks present in New Orleans. FEMA listed a Gulf Coast Hurricane striking Katrina as one of the three worst things to happen to America; the others

are a terrorist attack on New York and a catastrophic earthquake in Los Angeles. State level officials instituted more efficient contra-flow practices for the vehicular evacuation of New Orleans after a shaky first attempt during Hurricane Ivan in 2004, and were certainly aware of the risks. The United States Army Corps of Engineers (USACE) were aware of the dangers of not repairing the levees, though had funding for Louisiana cut by 80% in the five years leading up to Katrina. The city knew the dangers, and pre-positioned supplies in shelters, and buses for evacuation. Sadly, they had insufficient supplies, too few shelters, and parked the buses in areas that had never flooded before, assuming it was safe; Hurricane Katrina flooded the whole bus park, submerging the City's means of evacuation. The risks were known at each level of government, though were not acted upon in manner sufficient to address them.

- **Protect**: Critical Infrastructure Protection, Mitigation of Life Safety Protection, Environmental Monitoring, Natural Hazard Monitoring, Stockpile Management,

The failures of critical infrastructure in New Orleans are essentially a failure of adequate risk assessment, and a failure to implement mitigation policies. USACE knew the levees were insufficient to handle a category four hurricane, and New Orleans emergency managers knew where the water would dump into the lowest parts of the city. Infrastructure still failed when it was overcome by a threat that was known, understood, and had struck New Orleans in 1965. The infrastructure was all there, but was not robust enough to protect the city.

Moreover, the infrastructure was not sufficient to mitigate the loss of life in New Orleans, and nor were the supplementary policies. The most vulnerable portions of the population, the poor, infirmed, and disabled were not evacuated from nursing homes in many cases, literally dying in their beds and wheelchairs, despite the state requiring nursing homes to have evacuation plans by law. The poor, mostly black urban population in the lower ninth ward, the most economically depressed part of the city, were not bussed out of the city, left to their fates. The city did little to protect them, preferring to allow churches and faith-based organizations to take responsibility for them. Dissemination of warnings was mostly on television and radios, luxuries many in the lower ninth ward did not have. The mitigation of life safety failed.

Environmental monitoring was very effective prior to Hurricane Katrina making landfall. The national hurricane centre and FEMA were tracking Hurricane Katrina from across the Atlantic Ocean over a week prior to landfall. As the hurricane made its way up the Gulf of Mexico US Air Force weather monitoring planes were dispatched to take readings from the eye and eyewall of the storm. The natural hazard monitoring was also very effective. Environmental organizations in New Orleans warned against the development of wetlands citing the increased exposure to a Hurricane's storm surge eroded wetlands allow. Not surprisingly, the wetlands did not provide the necessary protection to Lake Pontchartrain or the canal and levee system when the storm surge hit.

Food, water and ice were not pre-positioned close enough to New Orleans, and lacked means of delivery. The stockpiles of basic, critical supplies was not managed effectively, nor were special supplies. Doctors were forced to break into department stores and pharmacies to distribute necessary medicine to those still trapped in New Orleans. When DHS tried to send medicine to those stranded, they sent thousands of anthrax vaccines, a particularly useless piece of equipment for people who haven't eaten or had water in days.

- **Prevent**: Information Gathering and Recognition of Indicators and Warning, Intelligence/Information Sharing.

Information was gathered and recognized long before Katrina made landfall, though this deteriorated very quickly. The mass of people still trapped in the city were unbeknownst to FEMA for two days after landfall, with no attempt to get supplies into the city. In fairness this was derivative of the failure of most major communications systems. The significance was the failure to predict that a whole segment of the population would not be capable of evacuating, despite indications that many in certain wards had no personal vehicles, and little disposable income to self-evacuate.

Information sharing as the crisis continued was poor in most areas. FEMA remained unaware of the internally displaced persons still in the city until two days later, and thus made almost no effort to deliver supplies into the city. Mayor Ray Nagin went on a radio talk program, and lost composure. He was upset that most government spokespersons at the State, FEMA and White House level were insisting help was on the way, despite the mass of people still un-rescued dying in the streets. Accurate information was clearly not making its way beyond the local level of response, or if it was, was not being actioned properly. The military (National Guard and federal troops once they arrived) had predictably good communications throughout their deployment, albeit with minimal cooperation between the two organizations at first.

- **Respond**: Scene and Consequence Management, Critical Resource Management and Distribution, Water Search & Rescue, Urban Search & Rescue, Emergency Operations Center Management, Responder safety and Health, Firefighting Operations and Support, WMD/hazardous materials response and decontamination operations, Public Safety and Security Response, Triage and pre-hospital treatment, medical surge, medical supplies management and distribution, Mass Care, Emergency Public Information and Warning, Fatality Management, Volunteer Management and Donations.

Scene and consequence management was performed poorly at most levels initially. Much of the response effort was ad hoc and driven by individuals in emergency response, and even private citizens eager to help people in distress. It was by no means organized at this level, and was not managed beyond line-of-sight level in most cases. This too was derivative of the communications failure, which in turn seriously limited the ability of emergency managers to achieve even a modicum of situational awareness.

Resources were not effectively managed is distributed from the start of the catastrophe. For the population stuck in the city that resorted to breaking and entering to find food and water, there was clearly no distribution of supplies. If they had supplies, finding additional supplies would have been redundant. Even city managers admitted to raiding pharmacies to secure necessary supplies.

Search & Rescue efforts were both urban and waterborne. Some parts of the city were under almost twenty feet of water. Boat rescue was the only possible means under these circumstances. Efforts were not well organized, with unclear areas of responsibility for different responders. Some areas received no coverage from search and rescue assets, while others enjoyed redundant coverage from multiple agencies. Search and rescue efforts deteriorated in some places with the arrival of a seemingly hostile police force, predisposed to using force to herd internally displaced

persons. The National Guard and federal troops were guilty of the same thing in some cases as well. The major deficiency was the coordination of assets, and the lack of communication between agencies. These are not strictly deficiencies in the search and rescue apparatus, and indicative of the cascade effect of marginally effective communications.

EOC Management suffered from a lack of situational awareness, sufficient response assets, and clear priorities for response. The command structure in terms of how regional centres fit into State level centres, and how those cooperated and reported to FEMA, the National Guard was unclear. Insufficiently comprehensive planning for the disaster meant organizational relationships were derived on the fly. Weak communications flows atrophied many of those already weak linkages. Local responders had little direction from State, and FEMA had little situational awareness in New Orleans.

Responder Health and safety was not considered carefully enough during the prevention and protection phases and of secondary importance during the response. The difference between a disaster and catastrophe is that in disaster responders become victims themselves, making then unable at least temporarily to address civilian victims. Many 9-1-1 call centres were flooded, in addition to police stations and National Guard barracks. Once a response was mustered responders tried to save and evacuate as many victims as possible, during which some were shot at, assaulted, or had their boats stolen by those they were sent to rescue. Legitimate concerns were raised about the caustic content of the water in New Orleans. Oil and gas storage tanks, water treatment facilities and sewers ruptured in many places, spilling into the water that filled the below-sea-level bowl of the city. The nature of the contamination in the water lends itself to a hazmat situation. None of the literature suggests there was adequate equipment to address a hazmat response situation. Given the dire situation, responders performed admirably, often without concern for their own health, and without the necessary equipment to protect themselves.

Public safety and security response is a reasonably vague security task, though given the scale of destruction and number of people stranded, and fatalities, there was clearly some deficiency in the response. Responsibility should not be levelled at responders; the catastrophic nature of the incident provided highly unfavourable conditions under which to mobilize a response.

Triage and pre-hospital treatment was not clear through the evacuation or response. The elderly, infirmed, disabled or otherwise vulnerable made up the bulk of the fatalities to Hurricane Katrina, many dying in their beds and wheelchairs. For those stranded at the Superdome and convention centre, medical assessment was virtually non-existent. When help did arrive priority was placed on evacuation to Houston or Baton Rouge, not on immediate medical needs. People were medically evacuated by helicopter, though not to the scale required. Once at the hospital medical surge was reasonably addressed in most cases. The notable exception was the direction of patients to a hospital that was preparing to evacuate, further taxing limited resources. Doctors from other states were prevented from practicing medicine in Louisiana because medical licensing is a state level classification. Preventing additional capacity from being mobilized limited the resources to address the huge surge in need. Medical supplies management and distribution was subpar throughout New Orleans. Too few medical supplies were stocked prior to landfall meaning they ran out much earlier than anticipated. Emergency managers admitted looting pharmacies and supermarkets for drugs necessary to refill urgent prescriptions. The medical aid DHS did send to New Orleans was part of their anthrax vaccine stockpile, underlining their priority on terrorism response, not natural disasters or emergency management. Mass Care was also lacking, evidenced

by the approximately 1300 people who lost their lives as a result of Katrina, and the thousands of people stranded in the city, or at the Superdome and convention centre. Many went without food and water for four days before help arrived.

Emergency public information and warning was very thorough, and also very selective. The city made numerous announcements on local television and radio prior to landfall strongly encouraging people to leave town, and facilitating contra-flow traffic lanes to facilitate evacuation. The necessary highway signage was in place indicating the evacuation route to Baton Rouge from New Orleans. However, for those who didn't have a television, let alone a car, evacuation information was a very laissez-faire process led by the City of New Orleans. Churches and faith-based organizations were charged with informing the remainder of the population, with no measures of accountability or adequate dissemination function to actively warn people in the community; it was an entirely consent based operation. There were too few buses to evacuate all those without cars who were warned in time, and the buses to evacuate survivors after landfall who did not evacuate were flooded by the Hurricane. Those with the means to action the warnings fared exceptionally well, however those without the means suffered disproportionately to the rest of the population.

Fatality management was as best could be expected from the situation. Images of swollen, bloated bodies floating in flood waters are iconic of Hurricane Katrina. Some abandoned nursing homes were not evacuated of the deceased until days after landfall, creating potential health hazards to say nothing of the indignity for the families of the deceased. Morgues were flooded along with hospitals, and the thousands of pounds of ice required to keep casualties and fatalities cool were not delivered. Makeshift morgues in the higher floors filled quickly, further hampering management efforts.

Volunteer management and donations was not coordinated, resulting in each organization running its operations independently. The unnecessary duplication of effort inhibited effective management of all the goodwill, from inside America and internationally; very little was delivered in a timely manner. The Red Cross was prevented by police from entering New Orleans to distribute aid on the grounds that it would encourage the population to stay. The population, after four days in the city were perceived as 'looters' and criminals by many law enforcement agencies because people were taking survival into their own hands by breaking and entering into grocery stores to find supplies. This is beyond administrative incompetence in managing a disaster. Actively preventing the distribution of aid is inexcusable in any humanitarian crisis. International donations were also mismanaged. The official channel for accepting international donations resided within the military hierarchy, via the state department. The military was justifiably more concerned with restoring order and distributing supplies than to focus on international paperwork requirements; as a result much of the international goodwill was later arriving, if it arrived at all.

- **Recover**: Long-term Assistance for Affected Persons, Resettlement and Repatriation of affected persons,

The long-term assistance for affected persons in New Orleans has been unclear at best, and conspiratorial at worst. FEMA established temporary housing for many of the victims of Katrina, some of them pre-fabricated houses and some tents supplied by the National Guard and the Army. The insurance issues surrounding compensation for property owners are unclear. Adjusters were

understandably unwilling to enter the city, negating a timely assessment of the value of the damage caused. Compensation was uneven, with companies willing to pay for damage above the flood lines, others insisting that the breeching of the levees was an act of God, and thus not their responsibility. Many of those who left the city have not returned. Some have no intention of returning. There are suspicions that many prefer the mostly poor, black population that was evacuated not return. The process of resettlement and repatriation is still not complete, prompting questions about why the administrative issues like insurance, compensation and repatriation have not yet been addressed. There is suggestion that the process is being intentionally drawn out as long as possible to prevent the poor, black segments of the population from returning to New Orleans. Efforts to rebuild the poorest areas of New Orleans are missing, as are most of the former residents.

5.2.2 Missing Capability Areas

The section outlines the capability areas in the DHS security task list that showed no deficiency as result of Hurricane Katrina. The nature of disaster highlighted deficiencies in many capability areas; below are the ones not applicable to this situation.

In terms of prevention identification and tracking of suspected terrorists and their motives is not applicable to a natural disaster like Hurricane Katrina, nor does the recognition of extremism or the ability of terrorists to execute on threats, or anything to do with weapons effects. Anything that related to an active human threat does not apply. Pre-entry detection falls into the same category, along with port of entry inspection. Credentialing is partially applicable in terms of ensuring that responders have a common training and knowledge base, but when addressing a cooperative response so many agencies with divergent purposes, it is not applicable. Border control would only apply if the disaster was international. Though checkpoints were established by the police and military, these false borders are not the same. Missing from the DHS list are broader capabilities such as ensuring a city can warn its citizens effectively of any impending threat, plan urban development in such a manner to mitigate the level of destruction that could be inflicted on a city, ensuring a city has validated plans for response and that they are disseminated.

Though food was in short supply in New Orleans, the questionable safety of the agriculture industry was not the source of the problem; too few supplies within the city was the cause. The levees, sea wall at Lake Pontchartrain and canals are relative to the defence & devaluation of physical assets, and communications systems are relative to defence & devaluation of cyber systems. During Katrina the levees didn't require defending, they required being built to a more robust specification, along with the communications systems. Public health laboratory testing is not applicable to the case of Hurricane Katrina. Most deaths resulted from drowning, or from persistent medical conditions requiring consistent care that never arrived, not a disease or contagious affliction. Better public health labs would not have saved the dead, or diagnose their causes of death any better or sooner.

Most of the response capability areas were addressed. The list of those not included is comparatively very short. In the case of the near chaos in the city centre investigation was unnecessary. By the time the police were deployed (along with the National Guard) very few people were arrested. Most had guns pointed at them, or were shot at, to dissuade them continuing on the spot. The other security agents (defence contractors; Blackwater among them) were more concerned with point security, not law enforcement. There were very few fires during the flood.

The fire department is responsible for high angle rescue, though this capability is probably more appropriate in the ‘search and rescue’ capability section. Explosives were not an issue, and lacking a contagious disease crisis neither was isolation and quarantine, or mass prophylaxis. The animals that perished drowned along with people, and not an animal health issue.

The long-term health care issues are unclear, and because of that were not included. With the number of vulnerable people who have not returned to New Orleans, we can assume that some the weak, infirmed were among them. They were vulnerable prior to the hurricane however, not as a result of it, making it a social issue, not specifically a DHS issue. The restoration of natural resources, like the wetlands of New Orleans, was an issue prior to the hurricane, and will remain an issue in the future, and projected to get worse as development continues on the bayou.

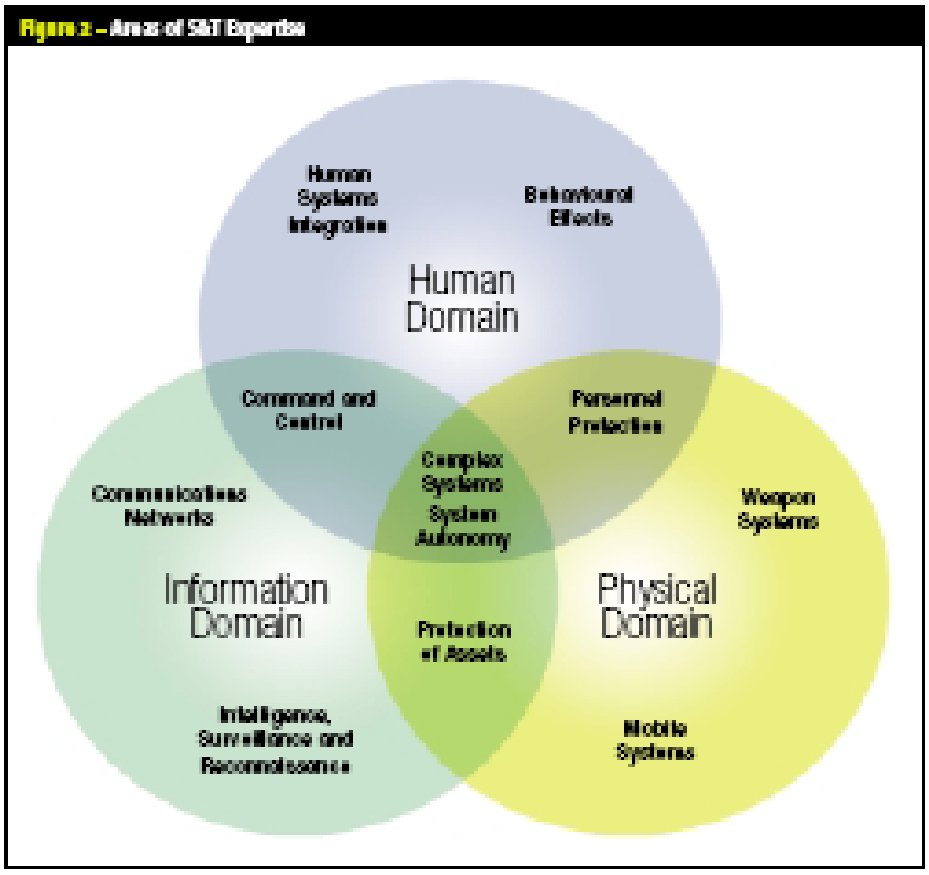
6. Mapping to Defence S&T Areas

6.1 Explain Defence S&T Document

The *Defence S&T Strategy: Science and Technology for a Secure Canada* was published in December 2006.[187] It is intended to establish a framework which can be used to inform Research and Development (R&D) investment. The framework included two complementary Work programs:

- Research, Technology and Analysis (RTA) focusing on knowledge generation; and
- Development, Engineering and Evaluation (DEE) focusing on the maturation and exploitation of technology.

Eleven primary areas of S&T expertise were identified arranged in domain groupings as depicted below in Figure 6.



[187] Defence Research and Development Canada, Defence S&T Strategy: Science and Technology for a Secure Canada, December 2006.

Figure 6: Areas of S&T Expertise

It can be appreciated readily that the majority of these areas have relevance beyond defence and are pertinent to emergency management. Many of the lessons derived from Hurricane Katrina relate directly to Command and Control, Communications Networks, Human Systems Integration, Behavioural Effects and the intersection of Human, Information and Physical Domains, Complex Adaptive Systems. In similar fashion, these can also be viewed as extensions - beyond DND - of the Mission Critical Outcomes *The Defence S&T Strategy* identify (e.g. Trusted Situational Awareness, Robust Command & Control, Seamless Interoperability, and Sustainability). *The Defence S&T Strategy* provides further elaboration with a description of each area and enumeration of related challenges.

6.2 Katrina Lesson mapped to Canadian Defence S&T

This section overlays the lessons from Hurricane Katrina onto the Canadian Defence S&T document to show how shortcomings would be identified if a similar disaster were to occur in Canada. The numerology used below is taken directly from the Defence S&T Strategy.

1. Command & Control (C2)

1.2 Flexible and adaptable C2 concepts and structures for achieving common intent: a significant shortcoming in the response to Katrina was the rigid yet weak nature of the command and control hierarchy. Due to the statutory differences between the National Guard and the US Army their command structures were not immediately compatible, to say nothing of the other like the US Marine Corps an the Air National Guard. The PFO and FCO had little power, and appeared to be go-betweens for different levels and agencies of government. S&T research into more flexible and adaptable C2 concepts and structures for greater situational awareness could be useful.

2. Communications

2.1 Robust, reliable networks: failure of critical communications infrastructure inhibited information collection, transmission and basic communications. The event hampered the initial response in New Orleans, and the lack of reliable communication had crippling effects throughout the command structure from the responders up to State, and eventually FEMA and DHS, the adjacent organizations at each level, and the voluntary sector.

2.3 Robust wireless communication: landlines and exchanges were largely destroyed by the flooding, as well as wireless towers across New Orleans. The failure of physically robust communications systems had a more detrimental effect of response than did P2P handsets or software networks.

3. Intelligence, Surveillance and Reconnaissance

There is no indication that the failures in the response to Hurricane Katrina resulted from insufficient information collection, or systems incapable of finding the necessary information.

Transmission was a significant problem, but that is independent of the actual collection of information. This section does not apply to Hurricane Katrina in any meaningful way.

4. Complex Systems

4.2 – Capability-based Planning: this method of planning requires a clear, concise statement of what capabilities an organization requires to fulfill its mandate. There are two parts to this: a clear statement of what your goals are, and what effects you seek to achieve to support that goal. That most of the response infrastructure, systems and personnel were not serviceable once the levees broke indicates failure in one area, and possibly both. A clear understanding of the task required by responders could have led to more focused capability development.

4.3 - Capability Engineering: once an organizations goals are understood, identifying the effects required, the systems required to achieve a spectrum of effects is necessary.

4.4 - Analysis of Integrating Concepts: this would be useful, in conjunction with examining flexible and adaptable C2 concepts.

5. System Autonomy, 6. Mobile Systems, 7. Weapons Systems

These sections focus on manned and unmanned military systems and weapons. None of these were significant in the response to Hurricane Katrina. The use of UAVs could be investigated as a monitoring platform during response.

8. Personnel Protection

8.1 Evaluation and mitigation of hazards from toxic materials, infectious threats and weapons: the flood water during Katrina reached a very high caustic level, and much of the debris evacuated was contaminated with toxic materials. S&T into how to prevent or mitigate the effects of leaking of hazardous materials during and after the crisis, or things that could become hazardous under certain conditions would be useful.

8.2 Diagnostic and Adaptive Systems for Environmental Stresses: Understanding the threats to personnel and equipment from environmental stresses could allow for more realistic time-exposure guidelines for responders and equipment during a disaster.

9. Protection of Assets.

9.5 Decontamination of equipment and structures exposed to toxic and corrosive materials: the volume of toxic material released into New Orleans was significant, and could occur in a Canadian disaster. Given the vulnerability of densely populated areas, like Vancouver or Toronto, understanding how to neutralized areas that were exposed to hazardous materials is important, and to prevent creating new risks by improper disposal of toxic material during the recovery phase.

10. Human Systems Integration

10.1 Human performance models for military simulations: modelling the response to likely events, and the worst possible case scenarios can be useful to highlight where deficiencies exist,

and consider organizational and capability solutions to solve the problem. Modeling the specific effects of each threat is an area known to be at risk would be useful in visually depicting expected consequences.

11. Behavioural Effects

11.2 Strategies for promoting collaborative behaviour among teams, agencies, organizations, and societies: This is the most critical area of research for disaster response. Any response will be spread across agencies and levels of government, the private sector and NGOs. Understanding how those pieces will interact is critical to affect response.

Not selected

Many S&T Challenges identified in the Defence S&T Strategy were not applicable to the capability deficiencies that allowed a disaster to become a catastrophe in New Orleans. The challenges below were not included because they lack specific applicability, or the challenge resides in a domain with where no capability gaps was identified during Katrina.

- 1.1 - Enhanced decision making in C2 environments: Lacks specificity. How to enhance, and in which domains is not addressed.
- 1.3 - Effects-based visualization and awareness for the decision maker: no indication that insufficient visualization played a role (either not having any, or that its presence would have greatly facilitated the response)
- 1.4 - Information Fusion and Knowledge Management and Representation: there was no information: the issue wasn't that abundant information was being fused improperly. A flexible, adaptable C2 mech would likely resolve that.
- 1.5 - Software protection and counter measures: hard ware (infrastructure level) crapped out, not the software.
- 2.2 - Computer Network Operations: there was no indication of the networks being the critical issue in communications breakdown
- 2.4 - Communications Electronic Warfare (CEW): there was no indication of aggressive communications action against the authorities, or the need for authorities to launch EW measures against any group or individual.
- 2.5 - Navigation Warfare: there are no indicates that navigation was the cause of emergency management difficulties, or that any attacks on navigation systems were experienced.
- 3.1 - Collaborative adaptive sensing: there is no indication that landfall was a surprise, or that information gathering played a role in the response; transmission of information however was critically flawed.
- 3.2 - Sensing systems to exploit diversity (in phenomena, space, time and spectrum): not applicable, see above
- 3.3 - New sensing technologies: not applicable, see above
- 3.4 - Sensing systems to exploit diversity (in phenomena, space, time and spectrum): not applicable, see above

- 3.5 - Exploitation of adversaries' emissive systems: not applicable, see above.
- 4.1 - Smart acquisitions and enhanced materiel support: no indication that material support failure inhibited response efforts or that once the military equipment requested was in place that it was insufficient to complete its tasks. The inability to deliver supplies in the early stages was a result of flooded and no coordination, not the absence of supplies to deliver.
- 4.6 - Improvements in multi-purpose capability of new and existing systems: the focus is on capabilities designed primarily for war-fighting. The issue in New Orleans was not insufficient military capability in the armed forces, just insufficient equipment immediately available.
- 5.1 - Intelligent Autonomous Systems for operation in complex environments: there is no indication that better military equipment would have lessened the impact of the disaster. A small cross-section of this category (UAV) could be considered to monitoring water spread, concentration of internally displaced persons, infrastructure damage, etc. However, with no threat of enemy action in a disaster, a manned platform is also acceptable.
- 5.2 - Emergent behaviour of simple autonomous systems: see above comment.
- 6.1 - Condition-based monitoring and prognostic and health management methodologies: there is not indications that platform health monitoring played a role in the hurricane response
- 6.2 - Integrated platform models and their application: There is not indication that deficient platforms played a role in the response
- 6.3 - Characterization of effects of environment and expanded operating envelope on vehicles: there is not indication of environmentally induced equipment deficiencies.
- 6.4 - Development of efficient energy storage and power sources: there is not indication that vehicle performance was impaired by efficiency. However, alternate power sources could be considered for home emergency kits to power small heating devices, or radios for those lacking hand crank radios.
- 7 - Weapons systems: weapons are not specifically applicable for emergency management, nor are the current weapons insufficient as a last resort.
- 8.3 - Personnel Protection Systems and Signature Reduction: This section focuses on armour plating, and CBRN, though mostly aerosolized agents. This is not applicable
- 8.4 - Casualty Prevention and Management: the purpose of this section is for serving members, to prevent injury, not operational tempo. S&T in this context is not intended for emergency management purposes.
- 9.1 - Structures and materials for protection against weapons attacks: this section focuses on withstanding weapons effects. Some technologies may apply to potentially high-value targets a terrorist may choose, but overall this is not applicable
- 9.2 - Reduced observables through active and passive signature management: not applicable
- 9.3 - Active countermeasures for platform protection: not applicable
- 9.4 - Minimization of impact of military operations, including training, on the environment: not applicable – applies to training areas.

- 10.2 - Human Systems Integration (HSI): this may be something to consider for the future, but there is no indication that inefficient interfacing between emergency managers and their command and control systems was a problem area.
- 10.3 - Monitoring, predicting and enhancing psycho-physiological readiness: there is no indication that responders were not ready for what they expected. The issue was the unexpected breeching of the levees. This may be an area for secondary research, but not a primary area with comparison to the other more directly related areas of research.
- 10.4 - Increased effectiveness and efficiency of the CF HR system: no indication that HR deficiencies played a roll in the response to Katrina.
- 10.5 - Distributed, adaptable, and on-demand learning, training and rehearsal: there is not indication that individual training was to blame. Joint training and exercises, in terms of the lack of understanding of other agencies capabilities, and the command structure was significant, not the level of individual training.
- 11.1 - Understanding, prediction and influence of adversaries' intent: not applicable
- 11.3 - Selection and development of leaders and members consistent with the ethos of the CF: there is not indication that HR played a roll in response.
- 11.4 - Strategic Outlook – Tools and models to analyze and assess implications of changes in national and international policy, socio-economic trends and political climate: this focuses on overseas operations, thus not specifically applicable to disaster response.

6.3 Summary

Most of the capability deficiencies witness during Hurricane Katrina map to the S&T research areas in the DHS Security Task list. Some areas were written with terrorism prevention and interdiction in mind, and do not apply to a natural disaster. The deficiencies in common planning and risk assessment prevented appropriate and sufficient prevention and protection measures from being drafted and implemented. Without a realistic understanding of the threat, and more importantly the necessary measures to prevent the threat for unleashing its maximum destructive power on the city, the responders' ability to do their jobs was biased long before landfall. Responders are effective in the overwhelming majority of situations in which they have the necessary vehicles, communications equipment and support systems to direct and coordinate their response. When all that is taken away response will be unorganized and haphazard. Effective risk assessment and the allocation of the necessary resources to prevent and protect adequately is essential for an effective response. This process should be iterative, to validate that the response mechanism is shaped by a consistently revisited risk assessment, and the corresponding prevention and protection measures.

The Defence S&T Strategy is a military focused document, defining capability needs such as unmanned platforms, superior detection of enemy movement, discerning adversaries' intentions, etc, with little focus on specifically emergency management tasks as is the case in the DHS document. This should not be surprising considering that DHS is not a military organization, and thus has very different priorities than DND and the CF. Public Safety is responsible for coordinating policy choice for emergencies and disasters in Canada, and DND is just one department of many that will contribute to those efforts. The DHS and DND document in that

sense are not comparable in parallel because both organizations have different objectives. Not surprisingly then, there are many capability areas in the Defence S&T Strategy that do not apply to emergency management.

7. Conclusions & Recommendations

"Hundreds live in a makeshift village of tents and old sofas under highway underpass. Many neighbourhoods are a jumble of collapsing homes and empty lots. Whole sections of the city looks like a set for some post-apocalyptic sci-fi movie. But the cameras have long since moved on, fixated on the never-ending presidential primaries and Britney Spears's fall from grace. New Orleans is forgotten for new scandals, new disasters. The bumper stickers and T-shirts of those who have struggled back to the The Big Easy tell their tale of frustration, neglect and greed: Proud to Swim Home to New Orleans; Make Levees, not War; After we Rebuild Iraq can we start on New Orleans? Sot next time a natural or man-made disaster splashes across your TV screen or makes the front page of the Citizen for a few days, think about the survivors left behind, many of whose lives will be changed forever. You might want to begin by thinking about the people of New Orleans, who day by day work grimly to clean up the mess left by years of social neglect, as well as hurricane Katrina."[188]

This section provides a brief summary of the lessons learned from the response to Hurricane Katrina. These lesson are mapped against the Defence S&T Strategy in the following section

- Cultural Interoperability is necessary: an effective architectural design for emergency response will not function effectively when it is applied if the disparate organizations that comprise the mechanism do not understand the roles and organizational cultures of the other organizations, and moreover develop trust between organizations. Measures to develop familiarity between organizations that are likely to cooperate during emergency response should be implemented. This includes cooperation between federal departments, between federal departments and their likely points of contact within provincial government, and provincial departments with the federal government and key municipal leaders.
- Planning should be adaptive to the situation on the ground: incident commander plans for general intent are necessary to guide the overall response mission, though adaptations to those plans based on an evolving situation on the ground will provide a more effective response. The general intent should remain to prerogative of the incident commander; however implementation strategies at the tactical level should be equally adaptive at the local level.
- Information Management performance will likely fall short of expectations under disaster or catastrophe situations: the destruction of communication infrastructure, and the lack of a centralize information sharing node during Hurricane Katrina left many organizations, notably the National Guard and FEMA, more or less in the dark as to what was actually happening on the ground in New Orleans. Reporting from the Superdome and Convention Centre does not really apply – these efforts were largely passive reporting on the situation of people evacuated.
- Visualization support to modelling and simulation of all-hazards risk will communicate threats more tangibly to decision makers: to properly represent the consequences of known risks coming to fruition modelling and simulation of all-hazards risk could have more impact. Visual representation of what Vancouver or Halifax will look like underwater, the

[188] Sawyer, Don. *The Forgotten Disaster*. The Ottawa Citizen. 3 March 2008. A9-Arguments.

effects of a bombing or chemical spill in Ottawa or Toronto will carry more impact when shown to decision makers than a paper statement of a nebulous threat in the non-descript future. In addition, using modelling and simulation will provide a much sharper point to risk assessments in terms of the specifics (depth of flood waters, neighbourhood affected, effects on mass transit systems, communications, etc). With a finer understanding of the consequences associated with each threat the more effective emergency management planning and training can address tangible threats.

- Re-examination and restatement of risk assessment is essential to a temporal understanding of risks: the nature of risk is not stagnant. The assumption on which risk assessments are grounded must be continuous re-examined to ensure the plans in place to mitigate risk are based on a realistic understanding of the situation. Appropriate modelling and simulation should accompany updated risk assessments.
- All-hazards risk assessment needs to be continually applied through the emergency management cycle: risk does not only apply to predicting the likely threats to a particular area. The recovery from a disaster could create new risks not previously anticipated. For example, the debris management solutions in New Orleans have left millions of gallons of toxic chemicals near ground-water, leading to new environmental threats to the city. Risk assessment must consider the potential threats posed by recovery strategies.
- Disaster response should emphasize linear planning, with minimal reliance on cyclical operations: too often planning assumes that for every command decision there will be implementation, and informational feedback reporting progress, and subsequent decisions that must be made. OP Unison for example declared that the operational cycle would be ‘faster’ in New Orleans. Given the marginal communications coming from US agencies in general, the feedback in the command loop would be absent. Response organizations would be well advised to adopt a linear approach to response whereby a number of plans are implemented, and whatever information feedback that can be received is implemented into future plans. Reliance on a loop that may never complete itself is an unwise approach to planning that risks wasting time better spent on additional response plans.

References

ACORN Housing/University Partnership. 2007. A Peoples' Plan for Overcoming the Hurricane Katrina Blues: a comprehensive strategy for building a more vibrant, sustainable, and equitable 9th Ward.
http://www.rebuildingtheninth.org/resources/

Alberta Municipal Affairs: Disaster Services. Alberta Emergency Plan
American Society of Civil Engineering. ASCE Report Card on U.S. Infrastructure (2005).

Association of Consulting Engineers of Canada, "The second national debt: Canada's growing infrastructure challenge" submission to the House of Commons Standing Committee on Finance, 2 September 2003, p.3.

American Red Cross – Frequently Asked Questions.
http://www.redcross.org/faq/0,1096,0_682_4524,00.html

Bradberry, Johnny B. (Secretary; Louisiana Department of Transportation and Development) Written Testimony Of:.
http://hsgac.senate.gov/_files/013106Bradberry.pdf.

Block, Robert, et al. 2005. "Behind Poor Katrina Response, a Long Chain of Weak Links." Wall Street Journal, September 6, p. 1.

Brooks G.R. and D.E. Lawrence. Geomorphic effects of flooding along reaches of selected rivers in the Saguenay region, Quebec, July 1996. Géographie physique et Quaternaire. – 2000. 54(3): 281-299.

Buchanan, James M; Tullock, Gordon. The Calculus of Consent: Logical Foundations of Constitutional Democracy. The Library of Economics and Liberty.
www.econlib.org/library/buchanan/buchCv3c1.html.

Buck, Dick A., Trainor, Joseph E., Aguirre, Benigno E. A Critical Evaluation of the Incident Command

System of NIMS. Journal of Homeland Security and Emergency Management. Vol 3, Iss 3. 2006. Article 1.

Buckley et al. The Insurance Industry's Troubling Reaction to Hurricane Katrina. Americans for Insurance Reform. January 2006.

Canadian Council of Professional Engineers. Brief to the Standing Committee on Finance regarding the federal government pre-budget consultation process. 25 September 2003.

Canadian Fleet Atlantic, Post-Deployment Report – OP UNISON, November 2005.

Carayannopoulos, Peter; Kovacs, Paul; Leadbetter, Darrell. Insurance Securitization : Catastrophic event exposure and the role of insurance linked securities in addressing risk. January 2003

Carroll, James. House of War: The Pentagon and the Disastrous Rise of American Power, Boston, Houghton Mifflin, 2006, pp. 28.

Commission scientifique et technique sur la gestion des barrages. Report/ The Scientific and Technical Committee on the Management of Dams in Quebec. Quebec: Canadian Dam Safety Association – 1997.

Conference Board of Canada. A Resilient Canada: Governance for National Security and Public Safety. Report: November 2007.

Crossett, K., Culliton, T.J., Wiley, P., Goodspeed, T.R. Population Trends Along the Coastal United States, 1980-2008, National Oceanic and Atmospheric, Administration Coastal Trends Report Series, September 2004

Defence Research and Development Canada, Defence S&T Strategy: Science and Technology for a Secure Canada, December 2006.

Department of the Army. Annual Inspection of Completed Works Program: 2004 Annual Inspection for Maintenance of Completed Flood Control Works in the New Orleans District. Prepared for the Commander of the Mississippi Valley division. 20 December 2004

Department of Homeland Security. Securing the Homeland. http://www.dhs.gov/xabout/strategicplan/index.shtm

Department of Homeland Security. Target Capabilities List: A companion to the National Preparedness Guidelines. November 2007

Department of Indian and Northern Affairs. Backgrounder – Manitoba Northern Flood Agreement: Implementation. http://www.ainc-inac.gc.ca/pr/info/bacman_e.html

Department Indian Affairs and Northern Development. News Release - Progress on Keshechewan Action Plan. 3 November 2005. http://www.ainc-inac.gc.ca/nr/prs/s-d2005/2-02730_e.html

Department of Public Safety. Federal Emergency Response Plan (FERP). Volume 1 – Draft 4. 26 September 2006. pp 26.

Dominguez, Virginia R. Seeing and not Seeing: Complicity in Surprise. 11 June 2006.

Dunne, Jennifer A., Richard J. Williams and Neo D. Martinez. Network Topology and Biodiversity Loss in Food Webs: Robustness Increases With Connectance, Romberg Tiburon Centre, San Francisco State University.

Dynes, Russell R. Social Capital: Dealing with Community Emergencies. Homeland Security Affairs Journal.

Eaton, Leslie. Slow Home Grants Stall Progress in New Orleans. The New York Times. 11 November 2006.

Emergency Measures Division: Newfoundland & Labrador. Steps in Developing and Emergency Plan. http://www.ma.gov.nl.ca/ma/fes/emo/munplanning/pdf/emerg-plan-steps.pdf

Emergency Management Ontario. Emergency Management Doctrine for Ontario (DRAFT). January 7, 2004.

Environment Canada – The Federal Policy on Wetland Conservation. 1991.

Environment Canada. Impacts of Sea-Level Rise and Climatic Change on the Coastal Zone of Southeastern New Brunswick, 2006, p. 3.

Environnement Canada (1997). Pluies diluviennes du 18 au 21 juillet 1996, au Québec : Analyse et interprétation des données météorologiques et climatologiques. Région du Québec: Division des services scientifiques. 1997.

Epp, Donna, Haque, C.E., Peers, Beth. Emergency Preparedness and First Nations Communities. March 1998.

FEMA History. http://www.fema.gov/about/history.shtm

FEMA – National Situation Report. “as of 5:30 am Friday, August 26, 2005”. http://www.dhs.gov/xlibrary/assets/2005Aug26_FEMA_Natl_sitrep.pdf

FEMA – National Situation Report. “as of 5:30 am Saturday, August 27, 2005”.

FEMA: National Flood Insurance Program: Program Description. 1 August 2002, p. 1.
FEMA Press Release. Hurricane Pam Exercise Concludes. 23 July, 2004. Release Number: R6-04-093

FEMA. Project Impact: Building a Disaster Resilient Community. Release Date: November 22, 1999. Release Number: 1293-71.
http://www.fema.gov/news/newsrelease.fema?id=8895

FEMA Website – What We Do. http://www.fema.gov/about/index.shtm

Flynn, B. Disaster Mental Health: The US Experience and Beyond, in J. Leaning, S. Briggs & L. Chen (eds.) Humanitarian Crises: The Medical and Public Health Response, Harvard University Press, Cambridge, MA

Franklin, Daniel. The FEAM Phoenix: The Reform of the Federal Emergency Management Agency. Washington Monthly. July/August 1995. http://www.washingtonmonthly.com/features/2005/0509.franklin.html

Fussell, Elizabeth. Leaving New Orleans: Social Stratification, Network and Hurricane Evacuation. 11June 2006

Gilman, Nils. What Katrina Teaches About the Meaning of Racism. 11 June 2006

Government Accountability Office. Catastrophic Disasters: Enhanced Leadership, Capabilities and Accountability Controls Will Improve the Effectiveness of the Nation's Preparedness, Response and Recovery System. September 2006 - GAO-06-618.

Government Accountability Office. Homeland Security: Management and Programmatic Challenges Facing the Department of Homeland Security, GAO-07-452T (Washington, D.C: Feb. 7, 2007)

Government Accountability Office. Homeland Security: Observations on FEMA and DHS Efforts to Prepare for and Response to Major and Catastrophic Disasters and Address Related Recommendations and Legislation, GAO-07-1142T. (Washington, D.C: July 31, 2007).

Government Accountability Office. Hurricane Katrina: Providing Oversight of the Nation's Preparedness, Response, and Recovery Activities.

Government Accountability Office. More Effective Collaboration Could Enhance Charitable
Organizations' Contribution in Disasters, December 2002

Government Accountability Office, Natural Disasters: Public Policy Options for Changing the Federal Role in Natural Catastrophe Insurance, November 2007.

Grescoe, T. After the Deluge. Canadian Geographic. 117(2): 1997. pp 29-40.

Gross Stein, Janice; Lang, Eugene. Unexpected War. Canada in Kandahar. Viking Canada. 2007. pp 187.

Gumennik, Irina. Resettlement Trends in New Orleans after Hurricane Katrina", 6 March 2007, p.1.
http://isites.harvard.edu/fs/docs/icb.topic139932.files/Resettlement_Trends_in_NO.pdf

Haggart, Blayne. Canada's Infrastructure Debt, Parliamentary Information and Research Service, Library of Parliament, Ottawa, June 2004.

Howell, S.E., Bonner, D.E. Citizen Hurricane Evacuation Behaviour in Southeastern Louisiana: A Twelve Parish Survey. Survey Research Centre – University of New Orleans. July 2005.

House of Commons Standing Committee on Finance. Spending Today…Savings Tomorrow. 2nd Session, 36th Parliament. 31 May 2000.

Hutton, David. Psychosocial Aspects of Disaster Recovery: Integrating Communities into Disaster Planning and Policy Making, Institute for Catastrophic Loss Reduction, p. 2

Insurance Bureau of Canada. Natural Disasters in Canada – Facts.

Kauffman, Sarah. The Criminalization of New Orleanians in Katrina's Wake. 11 June 2006.

Klein, Gary. Source of Power: How People Make Decisions. The MIT Press: Cambridge. 1999.

Kovacs, Paul., Kunreuther, Howard. Managing Catastrophic Risk: Lessons from Canada. ICLR Research Paper Series - No. 13. April 2001

Landau, Martin and Donald Chisholm, The Arrogance of Optimism: Notes on Failure-Avoidance
Management, Journal of Contingencies and Crisis Management, Vol 3 No 2, June 1995, p 69.

Lindblom, Charles E. The Science of 'Muddling Through'. Institution for Social and Policy Studies: Yale University. 1983.

Lindblom, Charles E; Barybrooke, David. A Strategy of Decision: Policy Evaluation as a Social Process. Free Press: New York. 1970.

Lukes, Stephen. Questions about Power: Lessons from Hurricane Katrina. 11 June 2006

Manitoba Emergency Management Organization. Manitoba Emergency Plan. http://www.gov.mb.ca/emo/eplan/index.html

Martin F. Guillen's review of Mission Impossible: Using Fantasy Documents to Tame Disaster (lee Clarke, Chicago, University of Chicago, 1999) Administrative Science Quarterly, March 2001., pp 151-153

Meyer & Rowan, DiMaggio & Powell. Institutional Theory: http://faculty.babson.edu/krollag/org_site/org_theory/Scott_articles/rs...

Mittiga, Mary., Sharpe, Vicki. The Aftermath of Hurricane Ivan: reconstructing roadways while recovering species. John Muir Institute of the Environment – University of California. 2006.

Mirza, Saeed. Danger Ahead: the Coming Collapse in Canada's Infrastructure. A Report for the Federation of Canadian Municipalities. November 2007.

Morgan, Gareth. Images of Organization. Sage Publishing: California. 1986.

Morin, Richard and Lisa Rein. “Some of the Uprooted Won’t Go Home” The Washington Post, 16 September 2005.

Morrow, B.H., Peacock, W.G. Hurricane Andrew: Ethnicity, Gender and the Sociology of Disasters. Routledge – 1997. pp 227

National Academy of Science. Hurricane Debris Disposal in New Orleans.

National Hurricane Center, (2005), “Costliest U.S. Hurricanes 1900-2004 (unadjusted), http://www.nhc.noaa.gov/pastcost.shtml.

National Oceanic and Atmospheric Administration. Hurricane Andrew: 16-28 August 1992 – Preliminary Report. http://www.publicaffairs.noaa.gov/andrew92.html

Natrual Resources Canada. Geoscope Vancouver: the Fraser River Delta. http://geoscape.nrcan.gc.ca/vancouver/fraser_e.php

National Science Foundation, quoted in Canadian Council of Professional Engineers “Brief to the Standing

Committee on Finance regarding the federal government’s pre-budget consultation process” 25 September, 2003, p.3.

Nisbert, Matthew C. and Dietram A. Scheufele, The Future of Public Engagement, The Scientist Volume 21 Issue 10, http;//www.the-scientist.com/article/print/53611/

Northwest Territories Municipal and Community Affairs. Northwest Territories Emergency Plan.

Nossiter, Adam. New Orleans of Future May Stay Half Its Old Size. The New York Times. 21 January 2007.

Novak, Julie. Public Choice Theory; An Introduction. Centre for Independent Studies: Autumn 1998. www.cis.org.au/Policy/autumn98/aut9810.htm

Nova Scotia Emergency Management Organization. Nova Scotia Emergency Management Manual.

PBS Frontline – 14 days: A Timeline.
http://www.pbs.org/wgbh/pages/frontline/storm/etc/cron.html

PBS Frontline – Brown’s 2005 Memo of Concern.
http://www.pbs.org/wgbh/pages/frontline/storm/etc/brownconcern.html

PBS Frontline – The FEMA Story.
http://www.pbs.org/wgbh/pages/frontline/storm/themes/fema.html

PBS Frontline – Interviews: Michael Brown.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/brown.html

PBS Frontline – Interview Richard Falkenrath.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/falkenrath.html

PBS Frontline – Interview James Lee Witt.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/witt.html

PBS Frontline – Interview Walter Maestri.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/maestri.html

PBS Frontline – Interview: Ray Nagin.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/nagin.html#4

PBS Frontline – Interview Walter Rudman.
http://www.pbs.org/wgbh/pages/frontline/storm/interviews/rudman.html

PBS Frontline - A Short History of FEMA.
http://www.pbs.org/wgbh/pages/frontline/storm/etc/femahist.html

PBS Nova Science Now – Hurricanes. Aired: Jan 25, 2005
http://www.pbs.org/wgbh/nova/sciencenow/dispatches/050901.html

Peters, B. Guy. Institutional Theory: Problems and Prospects, Institute for Advanced Studies, Vienna

Pigeau, Ross., McGann, Carol. Re-Conceptualizing Command and Control. Canadian Military Journal.Spring 2002. pp 53-67.

Quarantelli, E.L. Catastrophes are Different From Disasters: Some Implications for Crisis Planning and Managing Drawn From Katrina. Disaster Research Centre – University of Delaware.

Quarantelli, E.L. The Disaster Recovery Process: What We Know and Do Not Know from Research. Preliminary Paper 286. Disaster Research Centre: University of Delaware.

Quarantelli, E.L. Disaster Related Social Behavior: Summary of 50 years of Research Findings

Rahman, M.M. Roseau River Anishinabe First Nations. Emergency Preparedness and First Nation Communities in Manitoba. Epp, D; Haque, C.E.; Peters, B (eds.). Ottawa: Emergency Preparedness Canada. 1998.

Roberts, Patrick S. What Katrina Means for Emergency Management, The Forum Volume 3 Issue 3 2005 Article 2

Roe, Ronald C. Exploring the Limits of Privatization. Public Administration Review. No 47: Nov/Dec 1987.

Rosa, Eugene A. The Sky is Falling; The Sky is Falling… It Really is Falling! Contemporary Sociology, 35,3

Royal Society of Canada/Canadian Academy of Engineering. IDNDR Mid-Term Review and the 1994 World Conference on Natural Disaster Reduction, Yokohama, Japan 23-27 May 1994, page 32.

Revkin, Andrew. Gazing at Breached Levees, New York Times 2 September 2005.

Rubec, C.D.A. Policy for conservation of the functions and values of forested wetlands. In: Towards the wise use of wetlands: Report on the Ramsar Convention. 1997.

Saskatchewan Emergency Management Organization
http://www.cps.gov.sk.ca/Provincial-Preparedness

Sawyer, Don. The Forgotten Disaster. The Ottawa Citizen. 3 March 2008. A9-Arguments

Scahill, Jeremy. Blackwater Down. The Nation. 22 September 2005.

Scanlon, Joe. Two Cities, Two Evacuations: Some Thoughts on Moving People Out. 11 June 2006.

Scawthorn, Charles; Waisman, Federico. Assessment of Risk due to Fire Following Earthquake Lower Mainland, British Columbia. EQE International, January 2001

Shane, Scott., Lipton, Eric. Government Saw Flood Risk, but not Levee. New York Times – 2 September

Shaw, Jane S. Public Choice Theory. The Concise Encyclopedia of Economics. http://econlib.org/library/enc/publicchoicetheory.html.

Schulte-Hostedde, Bridget., Shrubsole, Dan. Adjusting to Policy and Fiscal Change: The Case of Land Use Planning in London, Ontario. ICLR Research Paper Series – No. 22. October 2002.

Shrubsole, Dan, et al. An Assessment of Flood Risk Management in Canada. ICLR Research Paper Series - No. 13. January 2003.

Smith, Nell. There's No Such Thing as a Natural Disaster. 11 June 2006.

Starkman, Dean "The Cost of Insurance; Firms Warn of Steep Premium Increases After Record Claims From Hurricanes," Washington Post, November 8, 2005.

S.W.A.N.A. Hurricane Katrina Disaster Debris Management: Lessons Learned from State and Local Governments. 21 September 2005.

State of California: Seismic Safety Commission. The Tsunami Threat to California: Findings and
Recommendations of Tsunami Hazards and Risks. December 2005.
Statistics Canada – Canada Yearbook: 1997.

Statistics Canada, “Government finance, 2003/04” The Daily, 18 June 2004.

Strolovitch, Dara; Warren, Dorian; Frymer, Paul. Katrina’s Political Roots and Divisions: Race, Class, and Federalism in American Politics. 11 June 2006

Swiss Re a, Natural catastrophes and man-made disasters in 2000: fewer insured losses despite huge floods. Sigma, No. 2/2001.

TD Economics, “A choice between investing in Canada’s cities and deinvesting in Canada’s future” 22 April 2002, p.15.

Tierney, John. 2005. “Going (Down) by the Book.” New York Times.

Tierney, Katherine. Foreshadowing Katrina: Recent Sociological Contributions to Vulnerability Science, Contemporary Sociology 35, 3.

Teisanu, Radu. Evolution and Institutionalized Intertia.Rethinking the European Decision-Making Process. July 2006

Topping, Steven D. Red River Valley Flood Control Works and Related Infrastructure in the Province of Manitoba. in: Red River '97, the Flood of the Century, Causes, Impact, Management. Winnipeg: Canadian Water Resources Association.

Warne, Leoni; Ali, Irena; Bopping, Derek; Hart, Dennis; Pascoe, Celina. The Network Centric Warrior: The Human Dimension in Network Centric Warfare. Australian Government: 2004.

Wiles, Don. Bureau ‘Life Cycle’ and Budget ‘Muddling’.
www.albany.edu/~dkw32/s3_cycle&muddle.html.

Witt, James Lee, and Associates. Pepco Holdings Inc. Hurricane Isabel Response Assessment. Final Report. May 2004.

This page intentionally left blank.

List of symbols/abbreviations/acronyms/initialisms

[Enter list here, if applicable. If not, delete the page.]

DND	Department of National Defence
OPI	Office of Primary Interest
R&D	Research & Development

This page intentionally left blank.

Distribution list

Document No.: DRDC CSS CR 2008-xxx

LIST PART 1: Internal Distribution by Centre:

DG DRDC CSS
DRDC CSS Library
DRDC CSS: Attention – Dir CRTI
DRDC CSS: Attention – Dir PSTP
DRDC CSS: Attention – Mr. J. Pagotto
DRDC CSS: Attention – Dr. P. Chouinard

(6 copies total)
TOTAL LIST PART 1

LIST PART 2: External Distribution by DRDKIM

DRDC (8 copies)
ADM S&T
DRDC COS
DRDC KIM
DG DRDC CORA
DRDC CORA Chief Scientist
DRDC CORA Library
DRDC CORA Section Head JOR

Dept of National Defence (7 copies)
Strategic Joint Staff
Major N Cyr
101 Colonel By Dr.
Gen Pearkes Bldg -15NT CC05
Ottawa, ON K1A 0K2

Assist Deputy Minister, Infrastructure & Environment
Mr. J. Scott Stevenson
101 Colonel By Dr.
Gen Pearkes Bldg
K1A 0K2
Ottawa, ON

Chief of Force Development
MGen SA Beare
101 Colonel By Dr.

Gen Pearkes Bldg- 12CBN D008
Ottawa, ON K1A 0K2

Canada Command, CO
VADM PD McFadden
Commander
Canada Command
1600 Star Top Rd
4SA04
Ottawa. ON

Joint Task Force Atlantic, CO
RAMD P.A. Maddison
Commander
Maritime Forces Atlantic
P.O. Box 99000, STN Forces
Halifax, NS, B3K 5X5

Joint Task Force Pacific, CO
RDAM T. Pile
Commander
Maritime Forces Pacific
P.O. Box 17000, Stn Forces
Victora, BC, V9A 7N2

Canadian Operational Support Command, CO
MGen Dan Benjamin
Commader
Canadian Operational Support Command
1600 Star Top Rd 1 ST03
Ottawa, ON

RCMP Headquarters: Attention Ms. W. Nicol
1200 Vanier Parkway, Ottawa, ON, K1A 0R2

Transport Canada: Attention – Mr. Scott Dunlop
Place de Ville, 330 Sparks St., Ottawa, ON, K1A 0N5

CAE (2 copies)
Attention – Mr. D. Hales
Attention – Mr. J. Miller
1135 Innovation Drive, Suite 300, Ottawa, ON, K2K 3G7

Public Safety Canada: (4 copies)
Attention: DG Operations
Attention: Dir, CIP
Attention: Mr. Chantz Strong

Attention: Mr. Shane Roberst
269 Laurier Ave W, Ottawa, ON, K1A 0P8
Dept of Homeland Security, Attention: Mr. Kevin Kirsch
Science and Technology Directorate
Washington, D.C., 0528

Conference Board of Canada: Attention – Ms. Deborah Fleck
255 Smyth Rd, Ottawa, ON, K1H 8M7

The Canadian Council of Professional Engineers: Attention – Ms. Deborah Wolfe
1100 – 180 Elgin St., Ottawa, ON, K2P 2K3

Federation of Canadian Municipalities: Attention – M. Talusier Lasalle
24 Clarence St., Ottawa, ON, K1N 5P3

Pubic Safety and Emergencies Directorate: Attention – Mr. A. Easton
P.O. Box 6000
65 Brunswick St., Fredericton, NB, E3B 5H1

City of Vancouver: Attention – City Manager
453 West 12th Avenue, Vancouver, BC, V5Y 1V4

(28 copies)

TOTAL LIST PART 2

TOTAL COPIES REQUIRED

34 copies

This page intentionally left blank.

DOCUMENT CONTROL DATA

(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1. ORIGINATOR (The name and address of the organization preparing the document. Organizations for whom the document was prepared, e.g. Centre sponsoring a contractor's report, or tasking agency, are entered in section 8.)

DRDC Centre for Security Science

2. SECURITY CLASSIFICATION (Overall security classification of the document including special warning terms if applicable.)

Unclassified/Unlimited

3. TITLE (The complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C, R or U) in parentheses after the title.)

Meta-Analysis of Hurricane Katrina: Lessons Learned

4. AUTHORS (last name, followed by initials – ranks, titles, etc. not to be used)

Hales, Doug; Miller, Jordan

5. DATE OF PUBLICATION (Month and year of publication of document.)	6a. NO. OF PAGES (Total containing information, including Annexes, Appendices, etc.)	6b. NO. OF REFS (Total cited in document.)
March 2008	87	133

7. DESCRIPTIVE NOTES (The category of the document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)

[Document Category]

8. SPONSORING ACTIVITY (The name of the department project office or laboratory sponsoring the research and development – include address.)

9a. PROJECT OR GRANT NO. (If appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant.)	9b. CONTRACT NO. (If appropriate, the applicable number under which the document was written.)
	W7701-054996/001/QCL W771470-0145

10a. ORIGINATOR'S DOCUMENT NUMBER (The official document number by which the document is identified by the originating activity. This number must be unique to this document.)	10b. OTHER DOCUMENT NO(s). (Any other numbers which may be assigned this document either by the originator or by the sponsor.)
DRDC CSS CR 2008-07	

11. DOCUMENT AVAILABILITY (Any limitations on further dissemination of the document, other than those imposed by security classification.)

(X) Unlimited distribution
( ) Defence departments and defence contractors; further distribution only as approved
( ) Defence departments and Canadian defence contractors; further distribution only as approved
( ) Government departments and agencies; further distribution only as approved
( ) Defence departments; further distribution only as approved
( ) Other (please specify):

12. DOCUMENT ANNOUNCEMENT (Any limitation to the bibliographic announcement of this document. This will normally correspond to the Document Availability (11). However, where further distribution (beyond the audience specified in (11) is possible, a wider announcement audience may be selected.))

[Document Announcement]

13. ABSTRACT (A brief and factual summary of the document. It may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall begin with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified) represented as (S), (C), (R), or (U). It is not necessary to include

here abstracts in both official languages unless the text is bilingual.)

This work provides analysis of the meta-organizational factors that contributed to the catastrophic results of Hurricane Katrina in New Orleans in August 2005. Organizational, cultural, sociological and technical issues were examined, and interactions between them, to underline the conditions that allowed New Orleans to be so significantly flooded. Research began with White House documents, and quickly branched out into varied collateral sources including the US Senate, the US Army Corps of Engineers, the Government Accountability Office, State and Local government documents and interviews with officials, the Public Broadcasting Service, and academia. The research was performed in support of a Defence Research and Development Canada (DRDC) Technology Investment Fund (TIF) supported by the Centre for Security Science (CSS).

The research sought to identify capability gaps, organizational and institutional limitations that allowed Katrina to manifest catastrophe on the scale observed, and to draw comparisons to the Canadian context where applicable. Identified gaps were mapped to the Defence S&T Strategy to identify where lessons are applicable in the Canadian all-hazards Emergency Response context.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (Technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus identified. If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

Hurricane Katrina, Emergency Planning, Emergency Response, Lessons Learned, Prevention, Resilience, Recovery