Disaster and Emergency Management in Canada
Introduction

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Table of Contents

BACKGROUND TO THE BOOK 2
INVITATION 2
FOCUS OF THIS CHAPTER 2
CANADA'S RISK LANDSCAPE 3
PATTERNS AND TRENDS 3
Global:. 3
Canadian: 4
CANADIAN HAZARD TRENDS 7
NATURAL HAZARDS 7
CLIMATE CHANGE 8
TECHNOLOGICAL HAZARDS 10
PANDEMICS AND OTHER HEALTH DISEASE OUTBREAKS 11
CIVIL UNREST AND TERRORISM 12
CRITICAL INFRASTRUCTURE 14
DEVELOPING RISK RESILIENCY AND CAPACITY: GLOBAL AND FEDERAL PERSPECTIVES 16
INTERNATIONAL PERSPECTIVES 16
CANADIAN FEDERAL APPROACHES 18
Mitigation: 19
Preparedness: 21
BUSINESS CONTINUITY MANAGEMENT 23
CONCLUSION 24
REFERENCES 25

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Background to the Book

Disaster and Emergency Management, as an academic discipline, only formally began in Canada in 2002 when Brandon University, under the leadership of Prof. Emdad Haque, created the Department of Applied Disaster and Emergency Studies. Since that time other programs at the certificate, undergraduate and graduate levels have been created at York University and Royal Roads University, as well as at numerous community colleges across the country.

One of the challenges facing academics teaching in this field is the lack of textbooks and other teaching materials that are Canadian focussed. It is because of this shortfall that this project was undertaken – to write a textbook on disaster and emergency management that is relevant to the Canadian context. This book avoids generic topics in the field that are well covered in many other existing texts (e.g., Coppola 2007, Ferrier 2009, Haddow and Bullock 2003) and instead pays more attention to issues of particular Canadian interest or specialized topics. It is intended to be a "living document" on the internet that can be added to over time, freely available to teachers and students in this field.

Invitation

Another advantage of this technology is that the existing chapters can be easily updated and new chapters can be added. We would like to invite academics, practitioners and students involved in Canadian disaster and emergency management to participate in this project by developing a paper that can be uploaded to our website. This could be a theoretical article, a practitioner-oriented guide, a case study, etc. All papers are reviewed by the editors and are also sent out for peer review prior to being uploaded to the website.

Focus of This Chapter

Given that this book is a living document, we do not offer a general summary of the individual chapters in this introduction. Instead, we provide an overview (both global and Canadian) of some of the important risks facing Canadians today and in the next few decades. Then we offer a few comments about opportunities for risk management, capacity building and resiliency. Throughout, we integrate ideas about the predominant trends and ideas we see currently unfolding within the field of emergency and disaster management.

Our focus is on broad Canadian trends and issues – it is beyond the purview of this chapter to comment on specific regional or local contexts.

Canada's Risk Landscape

This section highlights key findings about the overall issues and risk patterns that will be important within Canadian emergency management for the immediate future as well as over the next few decades. The following section outlines some of the most important trends and ideas about the management of these risks.

Patterns and Trends

Various authors, both academic and popular, have discussed how different aspects of modern society create increased risk (e.g. Clarke 2006, Moran 2003, Rees 2003, Perrow 1999, Perrow 2007). Several recent reports identify some of the most worrisome threats at both the global and Canadian levels. Below, we provide a brief summary of four reports, two international and two Canadian, which capture the flavour of these reports.

Global:

At the global scale, the *Global Risks 2011* reports that the following risks are currently perceived to be the most important in terms of both impact and likelihood (World Economic Forum 2011):

- Climate change, food and water security, infectious and chronic disease;
- Fiscal crises, price volatility and economic disparity;
- Geopolitical conflicts, terrorism, demographic challenges, migration, corruption and global governance failures;
- Storms, cyclones, earthquakes and volcanic eruptions, biodiversity loss; and
- Online data and information security.

The report argues that two risks, economic disparity and global governance failures, are especially significant because of their high degree of impact and interconnectedness (World Economic Forum 2011). These two risks

are expected to have an influence on many other risks and society's capacity to respond effectively to those risks. Both of these threats are related to globalization which, on the one hand, allows the world to be ever more connected and interdependent, while on the other hand, has highlighted and exacerbated the unevenness of the benefits flowing from globalization processes. In particular, there is a growing divergence of opinion worldwide regarding how to promote sustainable, inclusive growth. For the future, the five risks to watch are: cyber-security issues; demographic challenges; resource security issues; retrenchment from globalization; and weapons of mass destruction. The report concludes by emphasizing that these various risks and challenges are always associated with opportunities for innovation and growth; thus, the identification of risks is only the first step in developing a response strategy.

A second international report by Swiss Re, although written in 2004, echoes many of these same ideas and continues to be applicable today. The report entitled, *The Risk Landscapes of the Future* (Swiss Re 2004), notes the countervailing trends between increasing disasters, but decreasing accidents. The report asserts that at the international level it is generally agreed that "[s]ince the mid-1970s, the number of serious natural catastrophes and technical disasters has increased" (Swiss Re 2004, p.13). In contrast, in most industrialized countries, life expectancies are generally increasing whilst building fires, traffic accidents, industrial accidents etc. are generally decreasing. Larger, more efficient transportation networks, for instance, reduce accidents, but result in larger losses when catastrophe strikes. In an increasingly densely populated, urbanized, technology-oriented world, fires, natural hazards, power outages and loss of telecommunications can all have devastating impacts that lead to disaster.

Canadian:

The report on *Global Strategic Trends* (Ministry of Defence, Government of Canada 2010) surveys the world from a Canadian point of view. It maintains that over the next 30 years climate change, globalization, global inequality and technological innovation will be the dominant pervasive issues. This report highlights that:

- increasingly complex global systems are likely to experience systemic risks and failures (e.g. global markets, telecommunications);

- the global power structure will be unstable and will move towards Asia and towards a multi-polar distribution of geo-political power;
- instability will be further exacerbated by the impacts of climate change, unequal access to resources (e.g. food, water, energy) and population growth, especially in urban areas;
- globalization, underpinned by telecommunication innovation, will increase on-line information availability and world-wide utilization of that information and will generate winners and losers;
- radicalization of disempowered urban males combined with the opportunity for recruitment, knowledge and organization provided by the internet, is likely to contribute to a continued terrorist threat;
- the resources from oceans and polar regions will be further exploited; and
- the proliferation of modern weapon technologies (e.g. Weapons of Mass Destruction; Chemical, Biological, Radiological or Nuclear Weapons) will foster further instability.

This report concludes by suggesting that agile and versatile organizations with access to good information, training, and focused comprehensive management approaches are most likely to be successful at adapting to these various challenges.

Another Canadian perspective is provided by the *RCMP 2007 Environmental Scan* that identifies the following trends as important in the context of emergency management (Royal Canadian Mounted Police 2007):

- Ongoing technology changes are leading to an increase in the threat of cyber crime (including malicious viruses) and providing an opportunity for criminals, including terrorists, to organize activities as well as gather and disseminate information efficiently and without detection. Simultaneously, technology is providing new tools to support, assess and minimize these risks.
- Climate change is a central threat in the 21st century. It will impact the security of nations and local communities (e.g. opening of the Northwest Passageway in Canada's north); will disrupt critical infrastructure such as road transportation; and will negatively impact responsible authority's response capabilities.

- Canada's current demographic trends towards an aging population with an increasing non-European, non-Christian population will impact the types of vulnerabilities that will need to be addressed.
- Aboriginal peoples in Canada are continuing to face a range of problems, but at the same time are moving forward around such issues as health, education, self-government and land claims. This will impact the levels of resiliencies available to deal with disasters as well as the need to develop approaches to emergency management that are appropriate within an Aboriginal context.
- Domestic radicalization leading to terrorism is perceived to be a significant modern threat both within the home country of the terrorists and abroad amongst the international community.
- Improving critical infrastructure security is becoming an increasing priority for the management of natural and technological disasters including terrorist attacks and cyberspace attacks. Improvements have been focused on such activities as contingency and business continuity planning, training, security awareness and information sharing.

Over the next few decades, the overlap in ideas amongst these various perspectives suggests that factors such as climate change, demographic shifts, urbanization, globalization and geo-political unrest will underpin many of the vulnerabilities and risks facing Canadians. This is supported by the second edition of the Emergency Management Framework for Canada:

> ...accumulating risks associated with factors such as increased urbanization, critical infrastructure dependencies and interdependencies, terrorism, climate change, environmental change, animal and human diseases and the heightened movement of people and goods around the world have increased the potential for various types of catastrophes (Government of Canada and Ministers Responsible for Emergency Management 2011, 3).

Thus, when thinking about Canadian-specific hazard trends and the development of appropriate emergency management approaches, these broader contexts will undoubtedly impact both vulnerability and resiliency. For instance, the recent damage to the Japanese nuclear reactor has heightened fears about the radioactive contamination of Canada's west coast as well as concerns about the safety of nuclear facilities. Another cogent example is the concern

that the recent execution of Osama Bin Laden that may lead to an accelerated retaliatory terrorist threat[3] amongst Western nations.

Canadian Hazard Trends

Beyond these broad trends, the following section outlines a few of the specific vulnerabilities and threats likely to be especially important for Canada across the natural, biological and technological hazards. Since there is an interactive connection between critical infrastructure (CI) and hazards, CI is also included in this section.

Natural Hazards

Canada is a huge country, the second largest in the world, and is exposed to a wide range of natural hazards (Etkin, 2009), including geophysical (e.g. earthquakes, tsunamis and landslides), and meteorological threats (e.g. winter hazards such as avalanches, snow and ice storms and summer hazards such as tornadoes and heat waves). Hazard patterns have great spatial variation, especially for threats that are locally specific such as landslides, floods and snow squalls. Natural hazards often also follow a strong annual cycle depending upon the season (with the exception of some geophysical ones such as earthquakes and tsunamis).

In Canada, relative to other risks in society such as cancer and car accidents, few lives have been lost due to these natural hazards though they can cause significant hardship and large financial losses and have caused massive fatalities in other countries. In B.C., Ontario, Quebec and the Maritimes flood is the most frequent disaster, while in the Prairie province drought is the most frequent one, followed by flood. The most expensive Canadian natural disasters are the droughts of 2001-2002 and 1980 (both about $5.8 billion), with the 1998 Ice Storm in Quebec and Eastern Ontario coming a close second at $5.4 billion (Natural Resources Canada, 2004; Wheaton and Wittrock, 2005; Wheaton et al., 2007). Five other droughts since the 1930s whose cost exceed $1billion make drought Canada's most expensive hazard. The potential exists for a disaster of much larger magnitude than has thus far occurred, and it may well be that within the next few decades Canadians will experience a natural disaster that is much

[3] http://www.cbc.ca/news/world/features/binladen-dead/

worse than historical ones. This is due to several reasons: (1) No worst case scenario has yet occurred for a large disaster, (2) Climate change is likely to exacerbate some hazards (especially heat waves, flood and drought), and (3) In many ways vulnerability to hazards is increasing due to urbanization, environmental degradation, population growth (especially in flood prone areas) and our increasing reliance upon critical infrastructure.

Information on Canadian natural hazards is available from a variety of sources, including academic papers in a variety of journals, Environment Canada[4], Natural Resources Canada[5], Public Safety Canada, The Institute for Catastrophic Loss Reduction, as well as provincial ministries that have responsibility for the environment and public safety. Two specific Canadian publications in this area are "Canadians at Risk: Our Exposure to Natural Hazards" (Etkin, Editor, 2009) and "An Assessment of Natural Hazards and Disasters in Canada" (Etkin, Haque and Brooks, Editors, 2003).

Climate Change

Climate change is one of those wicked problems that lies within the realm of post-normal science (Funtowicz and Ravetz 2003). Efforts from the global (such as the Framework Convention on Climate Change[6]) to the local (such as the Toronto Climate Change Action Plan[7]) are underway to reduce greenhouse gas emissions in order to slow down projected warming, though measurements of atmospheric carbon dioxide continue to grow. The best science we have tells us that the climate is going to become warmer, which means that the world will be faced with having to adapt to change. The main problem facing emergency managers from a risk perspective is, "What adaptation actions should be taken, given the large uncertainty that exists at local levels in terms of future trends?"

Climate change will reconfigure not only the hazard context, but also the physical, social and economic vulnerability in many regions. Linkages between climate change and disaster risk are non-linear and complex, and for that reason are very difficult to predict, especially at local scales. It seems likely that many

[4] E.g.,Canadian Atmospheric Hazards Network (http://www.hazards.ca/intro-e.html)
[5] E.g. The Atlas of Canada: Natural Hazards (http://atlas.nrcan.gc.ca/site/english/maps/environment/naturalhazards/1) and Earth Sciences monitoring (http://ess.nrcan.gc.ca/disdan/index_e.php)
[6] http://unfccc.int/2860.php
[7] http://www.toronto.ca/changeisintheair/

hazards will become more severe, while others such as cold snaps will be less intense. Globally, the most authoritative voice on this topic is the Intergovernmental Panel on Climate Change (IPCC), whose publications are available on the web at www.ipcc.ch. Table 1 (IPCC, 2007) summarizes scientific levels of confidence in some hazard trends. Regionally, climate change may be significantly different from global changes; Natural Resources Canada[8] and Environment Canada[9] are good sources for Canadian impacts and adaptation information.

Table 1: An overview of the state of understanding of natural hazards according to IPCC AR4 (IPCC, 2007)

Phenomenon[a] and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend[b]	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	*Very likely*[c]	*Likely*[d]	*Virtually certain*[d]
Warmer and more frequent hot days and nights over most land areas	*Very likely*[e]	*Likely (nights)*[d]	*Virtually certain*[d]
Warm spells / heat waves. Frequency increases over most land areas	*Likely*	*More likely than not*[f]	*Very likely*
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	*Likely*	*More likely than not*[f]	*Very likely*
Area affected by droughts increases	*Likely* in many regions since 1970s	*More likely than not*	*Likely*
Intense tropical cyclone activity increases	*Likely* in some regions since 1970	*More likely than not*[f]	*Likely*
Increased incidence of extreme high sea level (excludes tsunamis)[g]	*Likely*	*More likely than not*[f,h]	*Likely*[i]

In Canada, climate change could affect access to safe drinking water; drought could lead to increased wildland fires and susceptibility of agricultural products to pests and disease; warming coastal waters may experience more toxic algal blooms that could affect aquaculture; warming temperatures could lead to milder winters and less transportation mishaps, but will also lead to increased damage to critical infrastructure (e.g., railway deterioration); could cause a deterioration of health among vulnerable populations (e.g., young,

[8] http://adaptation.nrcan.gc.ca/index_e.php
[9] http://www.ec.gc.ca/default.asp?lang=En&n=2967C31D-1

immune-suppressed); and lead to the increased prevalence of flood, heat waves and disease vectors (e.g., Walkerton *E coli* associated with heavy rain event) (Natural Resources Canada 2004). Climate change is likely to have direct and indirect impacts on a range of sectors including finance and insurance, agriculture, energy, transportation, water and on ecosystems.

Generally speaking if, when and how adaptation to climate change can occur will depend on how quickly or abruptly the climate changes, how reliably these changes can be predicted, and how quickly socio-economic and environmental systems are able to respond to changed conditions. Further, if damage becomes so widespread as to affect everyone, the advantage of having insurance will be lost since there would be no 'non-victims' to bear the losses (Swiss Re 2002). Climate risks could have impacts on all insurance categories since they could affect mortality rates, transportation and industrial accidents, business disruptions and fires, and so on.

Technological Hazards

Technological disasters involve a broad range of threats including human-caused fires; major transportation accidents; releases of hazardous materials; terrorism and civil unrest; industrial equipment and structural failures; and critical infrastructure failure such as electricity blackouts. The distinction between natural and technological disasters is quite blurry. For instance, if human-induced climate change causes a more intense hurricane and if human decisions lead to higher levels of vulnerability, the resultant 'natural' disaster is socially constructed to be more catastrophic (Mileti 1999). Further, Perrow (1999, 2007) notes that most technological systems are tightly coupled; a failure in one part of the system may cause cascading and often unpredictable knock-on impacts that further exacerbate the hazard event. For instance, in the recent radionuclide release in Japan, an earthquake caused a tsunami that caused the failure of both the primary and secondary electricity systems. In turn, this triggered a series of 'loss of coolant' events that, as we write this article, continue to contaminate the surrounding environment.

In Canada, the potential release of radionuclides is mostly related to the nuclear power generating plants located in Ontario, New Brunswick and Quebec. Additional localized threats are associated with the mining and processing of uranium ore and the use of medical isotopes (Ahier and Bliss 1998). A further, ongoing issue is the long-term management of nuclear wastes

including mine tailings, processing by-products and spent fuel rods (Durant and Fuji Johnson 2009, Murphy 2009). To date, Canada has not experienced a major radionuclide release and the probability of a release is very small. However, the consequences of such a release are large and potentially catastrophic. As Canada considers ramping up nuclear production to deal with climate change, the risks of radionuclide contamination should be assessed and evaluated against the threats of climate change.

Notable Canadian technological disasters include the 1917 Halifax, Nova Scotia harbour disaster; the 1979 Mississauga, Ontario train derailment; the 2003 electricity blackout that affected the eastern part of Canada and the USA; and the 2003 Barriere, British Columbia fires. Other technological disasters are explored in subsequent sections below.

Pandemics and Other Health Disease Outbreaks

Similar to the SARS experience[10], a pandemic is likely to lead to number of broad economic effects including loss of income for any business that involves the gathering of people together in one place (malls, theatres, etc.); unwillingness of employees to report for work; increased vulnerability and illness to those professions in direct contact with the public (e.g. health care workers, hair stylists); reduced supply of both raw materials and finished goods; and perhaps a crash in consumer confidence (Weisbart 2006). Further, once a pandemic starts, it can be quickly spread by international travellers.

Since the stronger immune response of healthy adults may lead to an overactive and potentially fatal immunological reaction to pandemic viruses, it is thought that the highest fatalities will occur among this group. This could cause long-term societal effects because healthy adults are the most economically productive age group within society (Cooper 2005).

Internationally, past pandemics attacked about 25-35% of the total population. Until recently, the World Health Organization considered the avian viruses known as H5N1 to be among the most virulent and lethal (WHO FAQ[11]). Between 2003 and 2006, 217 people from 10 countries were known to have been infected with the H5N1 virus, resulting in 123 deaths. To date, only a few of those infections were contracted through human to human transmission; most individuals contracted the virus from direct contact with infected birds

[10] Severe Acute Respiratory Syndrome: http://www.who.int/csr/sars/en/
[11] http://www.who.int/csr/disease/influenza/pandemic10things/en/index.html

(Weisbart 2006, 2). In the future, it is estimated that 2-7.4 million deaths will occur for a mild pandemic outbreak, or up to 40 million for an outbreak similar to the 1918 pandemic (WHO FAQ).

Despite these fears about H5N1 in 2009-2010 another virus, H1N1 led to a world-wide pandemic that resulted in 1.6 million infections and 19,600 confirmed deaths[12]. This new strain of Influenza A infected about 10% of Canadians and led to 400-500 confirmed deaths[13]. A national vaccination campaign resulted in the immunization of about 40% of Canadians. When compared to the general population, there were a higher percentage of First Nations peoples in Manitoba and northern Ontario infected with the virus[14].

In Canada, the federal-territorial-provincial governments have developed the *Canadian Pandemic Influenza Plan for the Health Sector* (Government of Canada 2006). It provides guidelines for monitoring disease spread and the use of vaccines and medicines to reduce illness. It does not outline an approach to deal with the financial costs that would be incurred during the response and recovery periods. More recently, the governments of Canada, the USA and Mexico committed to the *North American Plan for Avian and Pandemic Influenza* (Security and Prosperity Partnership of North America 2007). The plan is designed to detect and control an outbreak, minimize illness and deaths and mitigate the impacts to infrastructure and the economy.

Other human health diseases important for Canada include tuberculosis, West Nile Virus, outbreaks of *E.coli* and other infections and antibiotic resistant "super bugs" such as MRSA (methicillin-resistant Staphylococcus aureus). Animal and plant disease outbreaks that can impact Canadians include exotic pests such as the Mountain Pine Beetle and Asian Long-horn Beetle, as well as Foot and Mouth Disease, BSE (bovine spongiform encephalopathy), infectious salmon anaemia, avian influenza and many others.

Civil Unrest and Terrorism

Civil unrest includes public protests, civil disturbances and riots. Beyond Aboriginal protests related to long-standing issues around land claims, the most recent examples in Canada are related to the Toronto G20 Summit and the

[12] http://en.wikipedia.org/wiki/Template:2009-2010_flu_pandemic_table
[13] http://www.phac-aspc.gc.ca/alert-alerte/h1n1/surveillance-archive/20100128-eng.php
[14] http://www.phac-aspc.gc.ca/alert-alerte/h1n1/faq/faq_rg_h1n1-anic-eng.php; http://www.nccah-ccnsa.ca/99/The_NCCAH_and_Pandemic_Planning.nccah

Quebec City, Summit of the Americas meetings in 2001 involving 20,000 anti-globalization protestors. Other large recent events include the 1994 and 2011 Stanley Cup Riots in Vancouver. To assess the effects of such events on critical infrastructure, Public Safety Canada evaluated the following British event because it is also possible in a Canadian context. When British farmer and truck drivers launched a direct action campaign to protest a fuel duty in 2000, it led to a fuel crisis that paralyzed critical infrastructure sectors. Following protests that blockaded fuel refineries and distribution depots, just-in-time delivery systems were affected, panic buying ensued, and shortages in the energy sectors led to chain reactions in the health, transportation, food, financial and government sectors. It ultimately cost about $2.2 billion Canadian[15].

"Terrorism refers to the strategy of achieving a political objective by means of a campaign of seemingly random violence"[16]. Perpetrators of such attacks typically do not see themselves as terrorists, rather as freedom fighters or soldiers fighting for a just cause (Swiss Re 2003). The objective of a terrorist attack is not always to inflict widespread physical harm. It might be related to the psychological impact; fear can destabilize society and challenge the status quo power relationships within society. Terrorism can involve either domestic or foreign organizations and involves potential threats posed by chemical, biological, radioactive, nuclear and explosive (CBRNE) weapons. Canadian society's overall capacity to accommodate ethnic diversity has meant that it has had little experience with terrorism. Domestic terrorism in Canada has been limited to such events as the Direct Action bombing in 1982 and the FLQ crisis in 1971. Foreign terrorism has touched Canadians in several ways such as the Air India bombings in 1985 and September 11, 2001[17].

The risk of terrorism can be assessed by evaluating the terrorist's intentions, potential for harm and the vulnerability of the society at risk. It is thought that for future attacks the potential to do harm has increased dramatically and that the intention to ratchet up the level of damage inflicted has also increased (Canadian Centre for Intelligence and Security Studies 2007). Targets particularly vulnerable to attack are symbolically significant locations

[15] http://www.publicsafety.gc.ca/prg/em/ccirc/2005/ia05-001-eng.aspx

[16] http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0007926

[17] http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0007926

and landmarks, especially public facilities that are difficult to monitor or control. By 2025, attacks against the energy infrastructure of oil producing United States allies, such as Canada, are likely to increase (Canadian Centre for Intelligence and Security Studies 2007). According to the Canadian Security Intelligence Service (2004-2005), terrorism involving foreign organizations, or "transnational" terrorism, began to emerge as the most serious security threat to Canada during the 1990s. Among other concerns, the report asserts that transnational terrorists "have conducted preliminary reconnaissance against potential Canadian targets" (Canadian Security Intelligence Service (CSIS) 2004-2005, 3) and that these groups are increasingly sophisticated, well-educated, multilingual and skilled in the use of modern technology and cyberattacks (See also Canadian Centre for Intelligence and Security Studies 2006). In terms of domestic terrorism, it maintains that a "number of people are prepared to resort to violence to achieve their goals. Among these are neo-Nazi and violent fringe elements of single-issue groups from the ecological, animal-rights and anti-globalization movements" (Canadian Security Intelligence Service (CSIS) 2004-2005, 5).

Critical Infrastructure

Canada's critical infrastructure (CI) consists of those physical and information technology facilities, networks, services and assets which, if disrupted or destroyed, would have a serious impact on the health, safety, security or economic well-being of Canadians or the effective functions of governments of Canada (Office of Critical Infrastructure Protection and Emergency Preparedness 2003, 7).

CI sectors include energy and utilities, communications and information technology, finance, health care, food, water, transportation, safety, government and manufacturing. These could be affected by both physical and cyber threats, thus an 'all hazards approach' is required (Public Safety Canada 2009). The three key threats to Canada's CI are natural hazards (e.g., ice storms – see section 3.1 above), accidental hazards (e.g., human error, mechanical or programming errors), and malicious hazards (e.g., bombings, computer virus). Since CI are typically interdependent and connected, cascading effects are common (e.g. power outage impact on banking and transportation). Several of

the impacts on various CI sectors have been outlined above (e.g. ice storms). In this section a few additional details about Canadian CI threats are provided.[18]

A cogent example of the impact on the energy and utilities CI sector is the electricity power failure of 2003. It is estimated that the 2003 power failure caused foodstuff losses of $75-100 million USD. Similarly, the 2001 California power failures caused productivity losses of $21.8 billion and income losses of $4.5 billion (Swiss Re 2004, 15).

Communications and information technology, including hardware, software, networks and services, are another important component of Canada's critical infrastructure. Canadians are "becoming increasingly dependent on the Information Infrastructure for both our safety and the function of our society" (Public Safety and Emergency Preparedness Canada 2004, iii). The internet is a key example of information infrastructure and of the risks inherent in this technology. Since it has no natural political boundaries, security is reliant on the private or semi-private sector enterprises that manage and operate the infrastructure. Cyber-security issues include email spam and denial of service attacks. Given the multiple private and public stakeholders involved, dealing with cyber security will necessarily involve the coordinated efforts of key actors across sectors and scales (Bruce et al. 2005). For this reason, initiatives such as the Ontario Critical Infrastructure Assurance Program, outlined in the Emergency Management Doctrine for Ontario 2010[19], has been developed (Nelson 2009).

Whereas governments have traditionally focused on the threats to physical infrastructure, the advent of cyber threats now requires significant attention since the capacity to inflict damage is readily available and relatively easy to use and the 'threat agents are diffuse in nature'(OCIPEP 2003). For instance, the 2000 "slammer worm" caused a denial of service attack that led to a global internet slowdown and negatively impacted airline automated booking procedures leading to flight delays and cancellations in the USA (Office of Critical Infrastructure Protection and Emergency Preparedness 2002).

The interconnected impact of a disaster event on CI is demonstrated by the September 11, 2011 terrorists attack. OCIPEP's (2002) assessment of the terrorist attacks maintained that the strikes affected critical infrastructure in two main ways. First, CI facilities were directly disrupted and damaged by the

[18] For more details see: http://www.publicsafety.gc.ca/prg/em/ci/ntnl-eng.aspx
[19] http://www.emergencymanagementontario.ca/english/goverment/oemd/doctrine.html

physical impact of the attack. Second, decisions of CI regulators, owners and users caused further impacts. This included the national grounding of all commercial aircraft, temporary closing of key financial and banking sectors and the increased demand for communication network access forced the truncation of service to avoid network crashes.

Developing Risk Resiliency and Capacity: Global and Federal Perspectives

Our future....What it really becomes will depend on how successful we are in taking advantage of our opportunities and mastering the risks they entail (Swiss Re 2004, p.3).

Given the risk landscape outlined above, this section outlines global views and Canadian federal approaches to mitigate risk and increase resiliency. Resilience is the capacity of a system or community to adapt to disturbances resulting from hazards by preserving, recuperating or changing to reach and maintain an acceptable level of functioning (Government of Canada and Ministers Responsible for Emergency Management 2011, 8). Resilience minimizes vulnerabilities and strengthens social and physical capacity to cope, adapt, respond, recover and learn from disasters. In terms of emergency management, resilience strategies include proactive risk identification and response strategies, as well as mitigation, preparedness and business continuity approaches.

International Perspectives

At the international scale, three organizations that have provided broad advice regarding risk resiliency are the OECD, Swiss Re and the World Economic Forum. All three argue that dealing effectively with future risks is possible if today's managers adopt a proactive approach and that ongoing, timely access to accurate information is critical for threat assessment and management. The reports also stress the increasingly interconnected and complex nature of risk assessment and management. The more specific recommendations of each organization are provided below.

The OECD International Futures report, *Emerging Risks in the 21st Century* (Organization for Economic Cooperation and Development 2003) argues that while the magnitude of potential disasters has never been greater, effective management of future risks is possible. First, the report asserts that in our increasingly inter-dependent world, the risk assessment and management approaches need to be broadened to include a wide range of perspectives from across the physical and social sciences as well as from the public and industry. Second, risks should be evaluated as part of complex systems in order to mitigate hazards and project the implications of a disaster event (e.g., the domino impacts of earthquakes – an earthquake can lead to fires). Third, since many modern risks have world-wide causes and consequences, disaster resilience requires international cooperation and coordinated approaches. In this regard, both government-to-government agreements and public-private partnerships are recommended.

In a broad analysis of future risk landscapes and the insurance industry, Swiss Re (2004) reminds us that absolute security is an illusion, that every change involves risk, that future risks arise in the present and that the faster change occurs the faster the future risk landscape becomes today's reality. They maintain that dangers are becoming increasingly difficult to understand and that hidden risks related to increasingly complex technological systems are likely to trigger cascading impacts and widespread losses. Swiss Re (2004) maintains that if we are to manage future risks successfully we must first recognize the changes leading toward those risks and develop an early approach to influence them systematically. Early warning about potential risks is the key to controlling and mitigating the future risk landscape.

The *Global Risks 2011* report reviews common global risk response strategies. These include risk avoidance, risk mitigation, adaptation to risk, risk transfer and the acceptance of residual risk. Although avoidance and mitigation are usually preferred, adaptation to risk and risk transfer (e.g. insurance) are important opportunities to further manage the potential damage caused by risk events. However, it is impossible to control all risk, therefore awareness of residual risk allows for the development of additional contingency planning such as the maintenance of contingency cash reserves (World Economic Forum 2011)

Canadian Federal Approaches

In the Canadian public sector, resiliency in the area of emergency management rests with a suite of federal, provincial, territorial and municipal initiatives, plans, policies and laws. After outlining two key critiques of the federal system, this section focuses on some key federal approaches aimed at increasing disaster resiliency at the national level.

The Standing Senate Committee on National Security and Defence released a report in 2008 that outlines 12 key problems and associated recommendations about emergency management in Canada (Standing Senate Committee on National Security and Defence 2008). These problems include the failure to table an annual report to Parliament documenting the business continuity plan for each federal department and agency; poor federal leadership on critical infrastructure protection; the lack of coordinated approaches to national emergency response; lack of communications interoperability; the need for a national alerting system; the need for a "lessons learned" archive; and the lack of funding for equipment and training for CBRNE events. This report, a follow-up to a 2004 study (Standing Senate Committee on National Security and Defence 2004), also soundly criticized Public Safety Canada for procrastination in implementing the previous recommendations.

Similarly, the Auditor General of Canada published a report in 2009 about the role Public Safety Canada (PSC) plays in coordinating and leading emergency management across federal departments and agencies (Auditor General of Canada 2009). The Auditor General found that PSC had not exercised the leadership necessary to coordinate emergency management activities, but that it was making improvements through the development of the Government Operations Centre and a draft strategy to protect Canada's CI. Cyber-security and interoperability of responder equipment and communications were two further issues where progress has been slow.

That said, in January 2011, the federal government announced several new initiatives that suggest a more pro-active and resilient approach for Canadian emergency management (Canadian Intergovernmental Conference Secretariat 2011). These initiatives include a revised Canadian emergency management framework (Government of Canada and Ministers Responsible for Emergency Management 2011); a national emergency response system (Government of Canada 2009); a CBRNE resilience strategy and action plan (Government of Canada 2011a); and a strategy and action plan for

communications interoperability (Government of Canada 2011b, Government of Canada 2011c). Further, a memorandum of understanding to enhance emergency management relationships amongst provincial and territorial governments was announced, and it was mentioned that progress has been made to develop a national public alerting system and an emergency management strategy in support of Aboriginal communities.

Another important new initiative is the National Platform on Disaster Risk Reduction that is mandated through the United Nations International Strategy for Disaster Reduction and the Hyogo Framework for Action (United Nations/International Strategy for Disaster Reduction 2008). As a signatory to this agreement, Canada announced in 2009 that it would establish the platform to build multi-sectoral stakeholder involvement and leadership to reduce the risks caused by disasters. In the fall of 2010, in coordination with the Canadian Risk and Hazards 7th annual conference, the inaugural Annual National Roundtable for Disaster Risk Reduction was held[20].

With these, and the many other more local actions taken by different levels of government and the private sector to increase resilience and capacity, the question of interest is "How are Canada's risk profiles and resiliencies evolving?" Answering this difficult question requires a comparison of the effectiveness of different programs aimed to reduce risk to the different trends that influence it. Only a few local studies of this sort exist, the effectiveness of the Red River Floodway (Kelman and Pooley 2006) being one exception, and so the answer to this question is not well known. Data on the number and costs of disasters imply that risk is increasing (Etkin & MacGregor, 2011), which suggests that the policies and actions taken are insufficient. There is a great deal that is known regarding ways to reduce risk, but unfortunately it is not implemented as often as one might hope (White & Burton, 2001). Below we provide a few overarching observations regarding some specific strategies in the areas of mitigation, preparedness and business continuity.

Mitigation:

Mitigation has only recently come to the forefront as an important approach in emergency management. Mitigation "strategies can reduce or prevent disasters, losses and emergency response and recovery costs that would otherwise be

[20] http://www.publicsafety.gc.ca/prg/em/ndms/drr-eng.aspx

incurred" (Government of Canada 2010, 1). Mitigation includes both structural (e.g., dams) and non-structural (e.g., planning) activities that reduce disaster risk. A review of mitigation studies from various countries (Kelman and Pooley 2006) supports the notion that mitigation, in general, has a very positive cost-benefit ratio.

Global Risks 2007 asserts that within the international context, there is a fundamental disconnect between risk and mitigation (World Economic Forum 2007). The report argues that there is a need for active engagement of all sectors and that no one group can effectively mitigate risks independently; instead joint responsibility and action are required. Five pathways to mitigation are presented including research to improve insight, enhanced information and communication flow, development of mitigation incentive frameworks, improving investment in mitigation and developing risk mitigation institutional frameworks.

According to *Canada's National Disaster Mitigation Strategy*, mitigation actions provide an excellent return on investment. For instance, the $63.2 million invested in the Manitoba Red River Floodway in 1960 has saved an estimated $8 billion in damage and recovery costs. Current priorities in Canada's strategy include the development of a centre for mitigation excellence to facilitate information exchange; the advancement of non-structural mitigation programs; oversight of national awareness activities; promotion of social and physical and social science disaster mitigation research; and the facilitation of community/regional hazard identification. Additional funding for mitigation will be provided by leveraging the Building Canada Fund[21] to provide structural mitigation and research grants and through the revised Disaster Financial Assistance Arrangements[22] that now allow 15% of recovery funding to be allocated to post-disaster structural mitigation.

Part of mitigation is educating and training professional emergency managers, and in this area there has been a great deal of progress in Canada. Beginning with Brandon University in 2002, the academic sector now offers numerous courses at community colleges, as well as several BA and MA programs. Over time, as these graduates enter the profession, there will be a positive impact, though currently there is still a significant (though narrowing) gap between academia and practitioners. Nirupama and Etkin (2009) found that

[21] http://www.buildingcanada-chantierscanada.gc.ca/funprog-progfin/target-viser/bcf-fcc/bcf-fcc-eng.html

[22] See http://www.publicsafety.gc.ca/prg/em/dfaa/index-eng.aspx#guide

a large majority of emergency managers surveyed in Ontario felt that they had sufficient education for their job, yet about half of them demonstrated beliefs in common disaster fallacies. This gap may result in very divergent views – for example Nirupama and Etkin (2009) found a lack of consensus on the degree to which mitigation strategies should be top-down or community-based. This lack of consensus probably creates challenges in terms of developing resilient communities.

Preparedness:

The degree to which Canada and individual Canadians are prepared for disaster events is unclear. At the national level, some reports (mentioned above) by the Senate Committee on Security and National Defence (Standing Senate Committee on National Security and Defence 2004) and Auditor General Sheila Fraser (Auditor General 2009) have been highly critical of some aspects of Canadian levels of preparedness, and especially of Public Safety Canada. As outlined above, the response to these reports will likely increase Canadian resiliency; this section will provide details of other initiatives, including those undertaken to increase individual emergency preparedness and will briefly address the issue of social vulnerability as an impediment to resiliency.

At the federal-provincial-territorial levels, one of the key approaches to augmenting emergency preparedness in Canada is through the long-standing Joint Emergency Preparedness Program (JEPP). JEPP "was established in 1980 to enhance the national capacity to respond to all types of emergencies and to enhance the resiliency of critical infrastructure" (Public Safety Canada 2010, 5). Through the program, the Government of Canada contributes to provincial and territorial preparedness by funding emergency planning and training, the purchase of response equipment, urban search and rescue, etc.

Preparedness at a personal level has been a recent priority for all levels of Canadian governments. In the last few years, campaigns to encourage individuals and families to be prepared to handle emergencies for 72 hours without outside assistance have been prominent. For example, Public Safety Canada regularly advertises and assesses the effectiveness of its72 hour preparedness campaigns (Strategic Counsel 2008, Phoenix Strategic Perspectives Inc. 2010). The effectiveness of these campaigns has been mixed. In 2005, a survey about emergency preparedness in Canada concluded:

- Canadians are generally aware of hazards, with natural hazards most commonly mentioned. Importance of various threats was mediated by location; residents on the west coast, for instance, were most concerned about earthquakes.
- Only one third of Canadians have taken preparedness actions such as the development of an emergency plan or an emergency kit. Of those who were not prepared, many did not believe they needed an emergency kit. Conversely, most Canadians have some emergency supplies on hand, e.g., flashlights and first aid kits.
- Over 40% of Canadians believe that disasters in their area will quickly be resolved and feel confident they could handle an emergency (GPC Public Affairs 2005). This confidence may not be totally justified. It is one thing to have a plan, but it is quite another to implement it – witness how ineffective the hurricane response plan was for New Orleans, during and after Hurricane Katrina. Emergency plans need to be practised, if they are to be effective, and this aspect of preparedness is often neglected.

Given these perceptions, the report argues that there are a number of attitudinal barriers preventing Canadians from actively engaging in preparedness activities. A study of preparedness in Canada completed for the Canadian Centre for Emergency Preparedness reported similar findings[23] while a study of on-reserve emergency preparedness perceptions found that First Nations people were more likely to rely on their community for help when compared to other Canadians (Ekos Research Associates Inc. 2007).

At a deeper level, underpinning these emergency preparedness campaigns and perceptions, are the levels of social vulnerability that can impinge on the capacity of Canadians, including emergency management organizations, to prepare for, and respond to, disasters. For instance, a recent Canadian Red Cross Study (2007) identified ten high-risk groups: seniors, medically dependent persons, low-income residents, children and youth, persons with low literacy levels, women, transient populations, and new immigrants and cultural minorities. It identified significant gaps in meeting the needs of these high-risk populations; asserted that resources and relationships do not always

[23] http://www.ccep.ca/survey/

exist to meet the existing needs; and that networking and bridge-building between emergency management and volunteer organizations is needed.

It is easy to become complacent about future disasters. At the time this introduction is being written, Japan, probably the world's most advanced country in emergency preparedness, has experienced the cascading impacts of an earthquake, tsunami and nuclear catastrophe. Despite their mitigation and preparedness efforts, their defences have been overwhelmed and the impacts of planning errors are being felt (e.g., the siting of backup generators close to the ocean). It is not possible to be totally prepared for all worst case scenarios or to reduce risk to zero, and a common approach to mitigation is to address what are considered to be the more realistic or common scenarios. This strategy, which Lee Clarke calls probabilistic thinking can be used to justify dangerous systems, and should be augmented by *possibilistic* thinking, which incorporates worst case scenarios in risk assessments (Clarke, 2006).

Business Continuity Management

Business continuity management or planning (BCM, BCP), sometimes called Continuity of Operations Planning (COOP) seeks to protect and ensure the continuation of an organization's "mission critical" functions during a risk event. The process of BCM identifies key functions and resources, identifies potentially disruptive events, develops a plan to maintain functionality and builds capabilities to increase organizational capacities and resiliencies (Hiles 2007). BCM is increasingly recognized by private companies, non-government organizations and governments as a key risk management strategy (Government of Saskatchewan 2006, Standing Senate Committee on National Security and Defence 2008). Although BCM first emerged as a disaster recovery mechanism for the information technology sector, it has now been embraced as a way to manage emergency events across entire organizations, including governments.

Some organizations have gone further and have embedded BCM into the broader concept of Enterprise Risk Management. This approach focuses on the strategic aspects of risk, including understanding an organization's appetite for risk, and balancing the opportunities afforded by taking risks with the negative aspects of risks (Chapman 2006). The Treasury Board of Canada Secretariat updated approach to risk management partially mirrors this broader focus. *The Framework for the Management of Risk* outlines the risk management principles that are to guide deputy heads across Canadian departments and agencies 'in the

effective management of their organizations in all areas of work, including policy and program implementation'[24].

As well, standards by a technical committee, based upon a comprehensive emergency management model, have been created by the Canadian Standards Association (CSA Canadian Standards Association 2008). This standard, designed to be aligned with the U.S. NFPA 1600 standard, provides a very good guide for the development of emergency management or business continuity programs by government, NGOs or the private sector. The development of such standards are important, since surveys (Quarterly Tracking Survey 2009) have found that most businesses, especially small ones, do not devote resources to business continuity and are therefore vulnerable to crises.

Conclusion

Canada is exposed to a very large range of hazards – natural, technological and biological – and we are very vulnerable to many of these threats. Moreover, our risk environment is highly dynamic because of the evolving nature of the hazard, vulnerability and resiliency contexts. Education and training is needed at every stage of the emergency management cycle, particularly as Canadian authorities move towards more proactive management approaches. This includes a host of activities such as effective disaster plan exercise training and recovery strategies that lead to increased resiliency. By achieving a better understanding of these issues, by training emergency managers to have a greater insight into the Canadian context, and by translating this knowledge into more effective institutions and policies, progress can be made towards a more resilient and safer nation.

The field of disaster and emergency management is both interdisciplinary and vast. In Canada, it is a relatively recent addition to academia, though its practise has a much longer history. The articles in this on-line textbook are intended to help fill the gap related to Canadian content, thus making the teaching of it more relevant to Canadian students. This set of papers is a living document. If you would like to contribute to our collection, either by adding to an existing topic, or suggesting a new direction, please contact the

[24] http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=19422&section=text

editors. We are interested in both conceptual papers and case studies that would be relevant to Canadian students studying in the field of emergency management.

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