CANADA–U.S. ENHANCED RESILIENCY EXPERIMENT SERIES "CAUSE RESILIENCY"

A Canada–U.S. Resiliency Experiment (CAUSE RESILIENCY II) on Enhancing Trans-Border Resilience in Emergency and Crisis Management Through Situational Awareness Interoperability: Addressing the Beyond the Border (BTB) Action Plan

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A Joint Report by Defence R&D Canada – CSS & the U.S. Department of Homeland Security Science & Technology Directorate First Responders Group

DRDC CSS REPORT 2013-006
July 2013

Canadian Safety and Security Program

Homeland Security
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Canadian Safety and Security Program

Homeland Security

Science and Technology

Commonwealth of Kentucky Division of Emergency Management

St. Stephen "Canada's Chocolate Town"

Calais Fire-EMS

Saint John

Emergency Management Agency Washington County

New Hampshire National Guard

Table of Contents

Abstract

CANADA–U.S. ENHANCED RESILIENCY EXPERIMENT SERIES "CAUSE RESILIENCY": *A Canada–U.S. Resiliency Experiment (CAUSE RESILIENCY II) on Enhancing Trans-Border Resilience in Emergency and Crisis Management Through Situational Awareness Interoperability: Addressing the Beyond the Border (BTB) Action Plan,* *D. BOYD, M. CAPLAN, W. HOWE, J. VERRICO, J. THOMAS, C. McCULLOUGH, M. AMOABENG, B. FITZGERALD, M. LUCERO, A. JOHNSON, USA A. VALLERAND, P. DAWE, K. FORBES, D. HALES, C. COUTURE, D. O'DONNELL, D. ALLPORT, A. REBANE, J. NEILY, J. FRIM, E. BROWN, J. PAGOTTO, P. TRUDEL, R. MOREAU, CANADA, DRDC CSS TR 2013-006 July 2013*

On December 7, 2011, President Obama and Prime Minister Harper released the Beyond the Border (BTB) Action Plan, which set out joint priorities and specific initiatives for cross-border collaboration. A common goal within this partnership focused on enhancing the coordination of responses during binational disasters. Specifically, the BTB Action Plan states that Canada and the United –States will: "*promote the harmonization of the Canadian Multi-Agency Situational Awareness System with the U.S. Integrated Public Alert and Warning System to enable sharing of alert, warning and incident information to improve response coordination during binational disasters*."

To this end, the Canada–U.S. Resiliency II Experiment (CAUSE II) addressed this common goal in addition to several other initiatives. It was jointly sponsored by the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) First Responders Group (FRG), the Defence Research and Development Canada (DRDC) Centre for Security Science (CSS), and Public Safety Canada (PSC). The experiment itself was conducted on March 5 and 6, 2013 and consisted of a series of simulations enabled through the use of integrated situational awareness (SA) toolsets. New technologies that were either recently operationalized or were being transitioned into operational status were employed to enhance information exchange and augment shared SA between emergency management (EM) organizations north and south of the Canada–U.S. border. The experiment included participants from the local emergency management communities within the Province of New Brunswick (NB) and the state of Maine (ME), as well as the respective supporting federal agencies and departments within each national jurisdiction. This report provides an overview of the CAUSE II experimental methodology, a summary of the key findings and a number of recommendations for advancing the development and implementation of integrated SA tools.

Résume

***CANADA–U.S. ENHANCED RESILIENCY EXPERIMENT SERIES "CAUSE RESILIENCY":* A Canada–U.S. Resiliency Experiment (CAUSE RESILIENCY II) on Enhancing Trans-Border Resilience in Emergency and Crisis Management Through Situational Awareness Interoperability: Addressing the Beyond the Border (BTB) Action Plan,** D. BOYD, M. CAPLAN, W. HOWE, J. VERRICO, J. THOMAS, C. McCULLOUGH, M. AMOABENG, B. FITZGERALD, M. LUCERO, A. JOHNSON, **USA** A. VALLERAND, P. DAWE, K. FORBES, D. HALES, C. COUTURE, D. O'DONNELL, D. ALLPORT, A. REBANE, J. NEILY, J. FRIM, E. BROWN, J. PAGOTTO, P. TRUDEL, R. MOREAU, CANADA, DRDC CSS TR 2013-006 juillet 2013

Le 7 décembre 2011, le président des États-Unis, Barack Obama, et le premier ministre du Canada, Stephen Harper, publiaient le plan d'action Par-delà la frontière, qui énonce les priorités conjointes des deux pays et des initiatives précises en matière de collaboration transfrontalière. L'un des objectifs communs qui sous-tend ce partenariat est celui d'améliorer la coordination des interventions lors de catastrophes binationales. Le plan d'action Par-delà la frontière précise en effet que le Canada et les États-Unis : « *favoris[eront] l'harmonisation du Système interorganisationnel de connaissance de la situation du Canada et du Système intégré d'alerte et d'avertissement des États-Unis (Integrated Public Alert and Warning System) afin de faciliter les échanges d'information sur les alertes, les avertissements et les incidents en vue d'améliorer la coordination des interventions lors de catastrophes binationales.* »

Le Projet expérimental de renforcement de la résilience II (CAUSE II) du Canada et des États-Unis donnait suite à cet objectif commun et s'ajoutait à plusieurs autres initiatives. Il était financé conjointement par le First Responders Group (FRG), Science and Technology Directorate (S&T), du département de la Sécurité intérieure des États-Unis, par le Centre des sciences pour la sécurité de Recherche et développement pour la défense Canada (RDDC) et par Sécurité publique Canada. Le projet expérimental s'est déroulé les 5 et 6 mars 2013 et consistait en une série de simulations rendues possibles grâce à l'utilisation d'outils de connaissance de la situation. De nouvelles technologies devenues opérationnelles récemment ou en voie de passer à l'état opérationnel ont été employées pour accroître les échanges d'information et favoriser la connaissance de la situation par les organisations de gestion des urgences au nord et au sud de la frontière canado-américaine. Le projet expérimental réunissait des participants issus de collectivités locales de gestion des urgences de la province du Nouveau-Brunswick et de l'État du Maine, ainsi que les ministères et organismes des deux pays qui appuient ces collectivités. Le présent rapport donne un aperçu de la méthodologie employée dans le cadre du projet expérimental CAUSE II. Il renferme en outre un résumé des principales constatations et plusieurs recommandations visant à faire avancer l'élaboration et la mise en œuvre d'outils intégrés de connaissance de la situation.

1 INTRODUCTION

1.1 Overview

The construct of emergency management (EM) in Canada, as in the U.S., recognizes that local and regional entities are at the critical front end of a response to any crisis or emergency. National or Federal support is delivered upon request and is dependent upon the nature of the emergency and the need for augmentation or a specialized response capability.[1,2]

On December 7, 2011, President Obama and Prime Minister Harper released the Beyond the Border (BTB) Action Plan (Action Plan), which set out joint priorities and specific initiatives for cross-border collaboration.

The goal of the joint Action Plan is to build upon the existing perimeter approach to security and economic competitiveness and thereby lead to security enhancements and an accelerated flow of people, goods and services.[3] Further, this partnership is intended to ensure that binational coordination is not geographically limited to the border crossing but rather is extended to public safety issues that simultaneously affect both nations, regardless of where incidents occur. Indeed, the design of the simulated events during CAUSE II confirmed that an event near the border can require cooperation between officials in both countries. The shared goal within this partnership centers on enhancing the coordination of emergency responses during binational disasters.

The BTB Action Plan calls for the establishment of a Communications Interoperability Working Group (CIWG) that will:

- Coordinate national-level emergency communications plans and strategies;
- Identify future trends and technologies related to communications interoperability;
- Promote the use of standards in emergency communications;
- Promote governance models and structures; and
- Share best practices and lessons learned.

The BTB Action Plan focuses on developing and facilitating multi-jurisdictional and cross-border interoperability to harmonize binational emergency communications efforts. More specifically, it calls for the interoperability between the Canadian Multi-Agency Situational Awareness System with the U.S. Integrated Public Alert and Warning System

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[1] Public Safety Canada. "Minister Day Announces the New Emergency Management Act", Press Release Aug 07, 2007 13:41 http://www.publicsafety.gc.ca/prg/em/index-eng.aspx

[2] U.S. Federal Emergency Management Agency. "Overview of Stafford Act Support to States", National Response Framework http://www.fema.gov/pdf/emergency/nrf/nrf-stafford.pdf

[3] http://actionplan.gc.ca/grfx/psec-scep/pdfs/bap_report-paf_rapport-eng-dec2011.pdf

to enable sharing of alert, warning and incident information to improve response coordination during binational disasters.

The DHS Interoperability Continuum shown in Figure 1 below depicts a framework of core elements and key attributes of a mature interoperable capability. Canada also uses a similar framework of these five pillars and attributes for its Interoperability Continuum. The continuum identifies governance, standard operating procedures (SOPs), technology, training and exercises, and usage as the core elements required to achieve cross-border interoperability. CAUSE II focused primarily on technology integration while recognizing the importance of the human element in building a binational capability and making these systems truly interoperable. As such, the recommendations in the conclusion of this report go beyond integrating technology to include other lanes of the interoperability continuum.

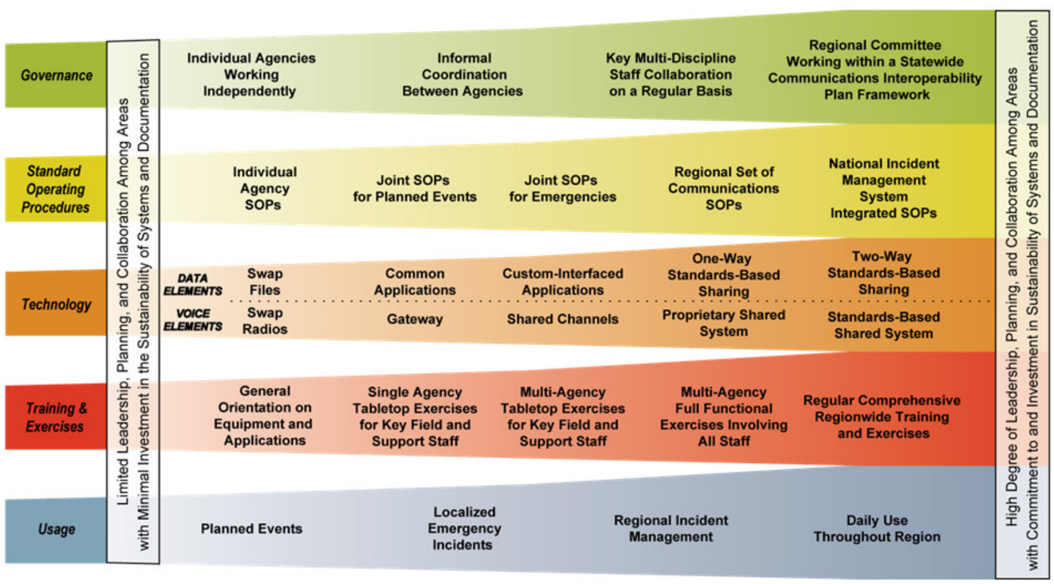

Figure 1 – The Interoperability Continuum

Both nations have been working for several years to develop the capability to enhance SA between EM organizations through the application of interoperable technology.[4] These SA systems enable the transmission and receipt of geospatial information from the initial notification of the event through the execution of the entire response. This information is relevant to multi-agency emergencies and is exchanged among partnering EM organizations in near-real time. CAUSE II addressed the intent of the BTB Action Plan

[4] Galbraith, James, Maria Miller and Gary Li. CAUSE Resiliency (West Coast) Experiment Final Report, DRDC CSS CR 2012-011 October 2012.

and demonstrated the Canada–U.S. (CANUS) commitment to jointly improve cross-border coordination of emergency responses during binational disasters by using integrated situational awareness tools and, where possible, sharing best practices.

CAUSE II was the second experiment in the series and represents the continuation of a collaborative effort between Defence Research and Development Canada – Centre for Security Science (DRDC CSS), Public Safety Canada (PSC) and the Department of Homeland Security (DHS) Science and Technology (S&T) Directorate. In addition, this experiment included the contribution and the participation of the First Responders Group (FRG), the Federal Emergency Management Agency (FEMA), the New Brunswick Emergency Measures Organization (NB EMO), and Maine Emergency Management Agency (MEMA). CAUSE II focused on facilitating information exchange leading to enhanced shared SA among partnering EM organizations. This capability was enabled by using emerging and mature technology systems, which were developed in Canada and the United States.

CAUSE II used a scenario-based approach to simulate two cross-border emergencies that required a coordinated response from partnering EM organizations. The first scenario involved an oil refinery explosion in Saint John, New Brunswick, affecting the supply chain in that region and across the border into Maine. The second scenario involved a motor vehicle accident between a specialized road tanker truck and a trailer, resulting in an explosion of compressed natural gas (CNG) that occurred at the border between Canada and the United States in Calais, Maine. Both scenarios required a cross-border response from Canadian and U.S. agencies.

1.2 Objectives

The BTB CIWG work plan contains a specific goal on interoperability between the Canadian Multi-Agency Situation Awareness System (MASAS) and the U.S. Integrated Public Alert and Warning System (IPAWS). This goal further clarifies that the working group will test and validate this goal through a cross-border technology demonstration (Goal 6.3). The work plan drives the expectation and objectives of CAUSE Resiliency series. Pilot studies were executed to test the ability of selected technological systems (e.g., Integrated Public Alert and Warning System (IPAWS) Test Development Lab (TDL), and Multi-Agency Situational Awareness Systems National Information Exchanges, (MASAS-X)) to exchange information in both directions between partnering EM organizations, in near-real time.

The overall objective of CAUSE II was to conduct a scenario-based, technology demonstration between Canada and the U.S. using interoperable toolsets (e.g., MASAS-X, IPAWS TDL, Virtual USA (vUSA), etc.) to demonstrate the ability to share information between nations during a cross-border emergency event. The specific objectives of CAUSE II were as follows:

- Connect, test, and demonstrate technology that enhances resilience and reduces regional and national risks through enhanced multi-jurisdiction and cross-border interoperability, particularly with respect to sharing situational awareness information that supports prevention, mitigation, response, and recovery from major trans-border incidents;

- Advance emergency management and responder situational awareness capabilities along the border for all stakeholders including municipal, regional, provincial/state, federal, non-governmental organizations, and key critical infrastructure owners;
- Demonstrate the value of federal science and technology investments with and for the response community;
- Evaluate the integration of MASAS-X, IPAWS TDL, and vUSA; and
- Identify technological and operational challenges and gaps, as well as emerging technological trends.

2 METHOD

This section describes the participants, scenario design, software system requirements, and the procedure used to execute CAUSE II.

2.1 Participants

The principal Canadian agencies participating in the experiment included Saint John Fire Department, St. Stephen Fire Department, NB EMO, DRDC-CSS, and Public Safety Canada (PSC). The principal U.S. agencies participating in the experiment included Calais (ME) Fire Department, Washington County (ME) Emergency Management Agency, MEMA, New Hampshire National Guard, DHS S&T, FEMA, and Kentucky Emergency Management.

Each of these stakeholder organizations comprised four groups of participants: the players, controllers, observers, and CAUSE II champions. At the beginning of the experiment participants completed a demographic questionnaire (N=25) which did not differentiate between the roles played during the experiment. Following the experiment the players and observers completed a post-experiment questionnaire (N=22) in which the participants' roles were identified. A brief description of each group is provided below.

- Players: The players consisted of the operational personnel from the EM organizations represented during the experiment.
- Observers: The observers were invited to attend the experiment by the exercise controllers and represented stakeholder organizations at the local, provincial/state, and federal levels.
- Controllers: The controllers designed the scenarios, facilitated the pace of the experiment and managed the interoperable toolsets in each of the three physical locations.
- CAUSE II Champions: The CAUSE II Champions were responsible for leading and facilitating the experiment, which their respective organizations funded. The Champions, Dr. Andrew Vallerand (Canada) and Dr. David Boyd (U.S.), attended the experiment both in NB and in ME.

2.2 Scenario Design

2.2.1 Context

The general scenario consisted of a large-scale emergency requiring a coordinated response from partnering EM organizations in both the U.S. and Canada. The coordinated response involved local first responders, provincial/state EM agencies, and federal EM organizations. The cross-border response was coordinated through the use of emerging and mature integrated situational awareness technologies. Geospatial information, which all participants could view in near-real time, was shared in accordance with participants' current technological capabilities, limitations, and SOPs. Shared data included, but was not limited to, mobile incident reports, significant event reports, Emergency Operations Center (EOC) activations, mobile alerts created for official use, public alerts and warnings, Mission Ready Packages[5] (MRPs), and requests for mutual aid.

2.2.2 Detailed Scenarios

Two detailed scenarios were designed and were then simulated in three physical locations: Fredericton (NB), Calais (ME), Ottawa (ON). A brief description of each scenario is provided below.

- Scenario 1: A massive oil refinery explosion and fire were simulated at an oil refinery in Saint John, NB. Such an event would necessitate mutual aid to sustain a long-term firefighting and containment operation that would overwhelm local capacity. Initially the cause of the explosion was unknown, but later it was determined to be the result of an accident. The refinery explosion resulted in the City of Saint John requesting provincial assistance in evacuation and response efforts. Mutual aid response was considered, and the action was informed by cross-border information sharing of specific information related to the event and response efforts. The explosion also affected the oil supply chain in both Canada and the U.S., causing a backup of railway cars carrying crude oil from ME to NB and a disruption of refined oil products traveling from NB to ME. The objective of this scenario was to drive information sharing from the local level through to the provincial and federal levels within Canada and within organizations in the U.S., including agencies operating along the borders.

- Scenario 2: A CNG truck on the main route through Calais, ME, exploded as the result of a motor vehicle collision near the Canada and United States border. This location is upwind from the border crossing as well as significant residential and business areas of both towns. The resulting fire and devastation from the explosion required an emergency medical response to address 25 seriously burned victims and a large-scale evacuation of residents and motorists who were close to or affected by the explosion and fire. Cross-border information sharing was critical to determine the level of danger to which jurisdictions were exposed as well as to treat the severe burn victims from the fire. Maine officials led the response effort's support of local fire officials, who were used to dealing with the border events and providing automatic mutual aid to help each other. Using the Mutual Aid Support System (MASS), Maine officials were able to seek and identify emergency medical transport and aircraft for evacuating victims to a selected Level 1 trauma unit in Saint John, NB. Virtual Maine (vMaine) was used to identify the number of available beds and shelter facilities from state and

[5] MRPs include a combination of personnel and equipment. Examples include: Foam Trailer Hazmat Teams and Swiftwater Rescue Team.

national shelter systems to address the crisis on both sides of the border. MASS also identified further specialized air medical evacuation assets from New Hampshire National Guard's air units.

Scenarios were built around the following three-step methodology that represented the processes associated with information exchange:

- Create – Information about the simulated emergency was created by entering a unique set of scenario injects into a single system, where it was shared in near-real time using other integrated SA tools.
- Exchange – EM organizations that had authorized access to the information could exchange information and incorporate geospatial references using a wide range of emerging and mature technological systems.
- Receive – EM organizations received the information using the integrated SA technology and were equipped to monitor the progress of the event and coordinate simulated responses. Decision support was supplemented using increased SA provided by the technologies, in addition to the usual information sources used by EM organizations and officials.

Figure 2 illustrates the information exchange in Scenario 1 as an example of integrating information across various systems. Incident-specific information was *created* in MASAS Mobile, *exchanged* by MASAS-X and vUSA and *received* by the other systems, including vMaine and the CAUSE II Viewer. The incident information was created once and exchanged and received by the other systems in near-real time.

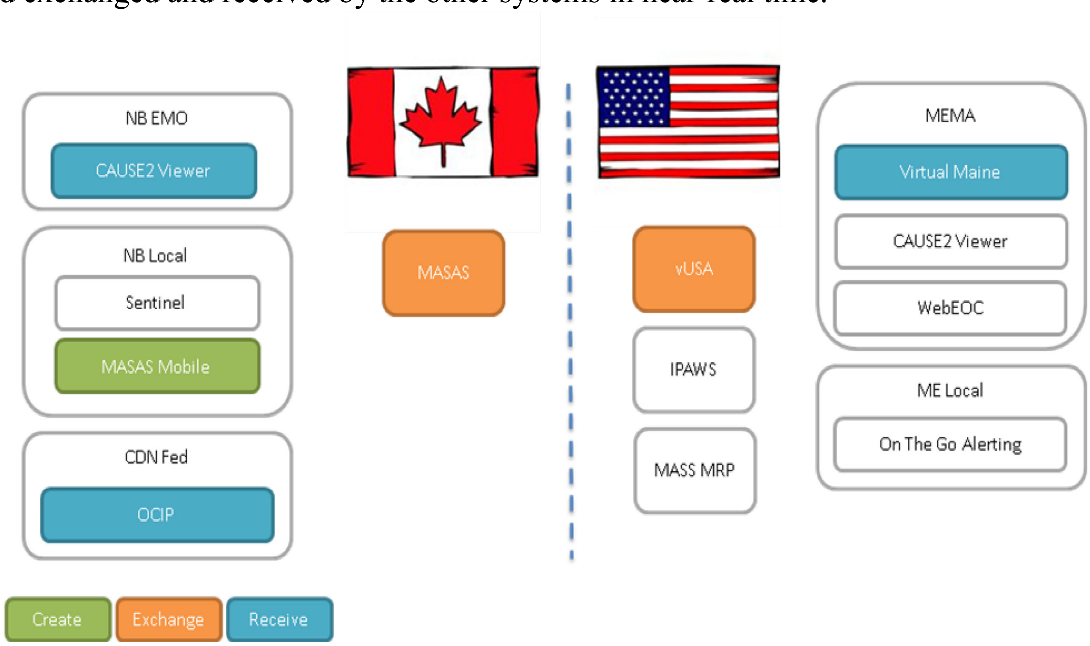

Figure 2 Scenario Systems and Agencies[6]

[6] Figure 2 is just one of many sample workflows tested during CAUSE II.

2.3 Software Systems

Information exchange was enabled through the use of open standards including the Common Alerting Protocol (CAP), Open GeoSpatial Consortium Standards (i.e., Web Map Service (WMS), Geographical Rich Site Summary (GeoRSS), Keyhole Markup Language (KML), Representational State Transfer (REST)) and the Organization for the Advancement of Structured Information Standards (OASIS) approved Emergency Data Exchange Language (EDXL) - Hospital Availability Exchange (HAVE). MASAS-X adopts known standards (e.g., Atom and CAP) and provides a REST-ful Application Programming Interface (API) that is easily integrated into modern web and internet applications. In addition, vUSA adopts open and well-established industry standards to create an environment where geospatial information and emergency incident information can be shared among systems.

CAUSE II followed a System-of-Systems (SoS) approach whereby existing systems were connected based on open standards. Table 2-1 identifies the systems that were used during the experiment. Specifically, MASAS-X was successfully made interoperable with CAUSE systems and included Sentinel^{TM}, Operations Centre Interconnectivity Portal (OCIP), vMaine, and vUSA. IPAWS TDL also was successfully integrated into CAUSE systems including vUSA, MASAS-X, and vMaine. This integration took approximately 2–5 days for each system.

The summary of systems included in the experiment is presented in Table 2-1 below. below.

Table 2-1 Systems used in CAUSE Resiliency II

Technology	Details
Multi-Agency Situational Awareness Systems National Information Exchanges (MASAS-X)	
Owner:	Government of Canada (i.e., DRDC-CSS / PSC)
Intended Use	The system enables creation, consumption, and publication of official incident-specific data, alerts, and warnings required to support shared SA at the local, provincial and national level. Information shared in MASAS-X is visible to all MASAS-X users but not to the general public.

Sub-technology	MASAS-X at its core is a server-based, non-visible system that supports a graphical user interface. The CSS/MASAS-X team made available two components that enable users to consume and publish MASAS-X data from within a Flex Viewer (e.g., CAUSE II Viewer) and a mobile application that enables users to use MASAS-X from iOS™ or Android™ devices.
Operations Centre Interconnectivity Portal (OCIP)	
Owner:	Public Safety Canada
Intended Use	Enables the immediate sharing and accessing of incident data and information among federal EOCs in order to improve shared SA.
Sub-technology	Microsoft SharePoint™ 2010, MASAS-X SharePoint Service.
Sentinel	
Owner	Sentinel™ Systems
Intended Use	An incident management and alerting system that enables officials to create and publish incident and alert information that can be shared with responders at various levels of government.
Sub-technology	N/A
Virtual USA (vUSA) Library	
Owner	DHS Science & Technology Directorate (and the National Information Sharing Consortium (NISC))
Intended Use	The tool enables cross-jurisdictional information sharing and discovery of real-time, static or incident-specific information at any level of government and enables use of the data through the user's current geospatial applications. Information shared in vUSA can be targeted to all users or only to specific agencies, roles, and personnel.
Sub-technology	vUSA provided the vUSA library widgets that enable consumption of data from within users' Flex Viewer or Microsoft Silverlight Viewer® (e.g., CAUSE II Viewer, VT Silverlight Viewer).

Virtual Maine (vMaine)	
Owner	MEMA
Intended Use	The tool enables Maine officials to consolidate various datasets into a virtual map that provides SA from sources at every level of government, the private sector, and other key partners for Maine officials. This tool includes key datasets provided from MASAS-X, IPAWS TDL, vUSA, NB, etc.
Sub-technology	vMaine is based on the Google Earth ™ platform. The vMaine viewer is powered by numerous other datasets provided from incident management systems such as WebEoC®. and geospatial data warehouses.
WebEoC™	
Owner	MEMA
Intended Use	Used to manage all EM incidents. It is used for county and local government information sharing. Incident logs are created for each incident.
Sub-technology	None.
Integrated Public Alert and Warning System Test Development Lab (IPAWS TDL)	
Owner	U.S. FEMA
Intended Use	The tool enables authorized officials (including the President) to deliver alert messages to the public. (Note: the Canadian equivalent is the National Alert and Aggregation Dissemination System – [NAADS]).
Sub-technology	IPAWS TDL alert aggregator is populated with alerts and warnings generated by numerous CAP alert origination tools in use by officials at various levels of government.
CAUSE II Viewer	
Owner	Joint (Government of Canada and DHS S&T)

Intended Use	The tool enables any CAUSE II participant/observer to view and use experimental data on a situational awareness viewer that includes access to the vUSA library, IPAWS TDL and MASAS-X information exchanges.
Sub-technology	ESRI™ -based Flex technology.
Mutual Aid Support System (MASS)	
Owner	Kentucky Emergency Management Agency
Intended Use	The tool enables officials to create, share, and discover mutual aid resources (i.e., MRPs) to support local, state-to-state, or international requests for assistance from an official government agency.
Sub-technology	MASS is built on a Microsoft® SQL(Structured Query Language) database and has made available a web application and widgets that enable the visualization of MRPs in an organization's ArcGIS Viewer for Flex (e.g., CAUSE II Viewer).
On-The-Go Alerting™	
Owner	Eye Street Solutions LLC
Intended Use	An EM alert and warning origination application, which inter-operates with FEMA's Integrated Public Alert and Warning System (production and test versions) to allow authorized users to send alerts and warnings to selected aggregations of the public and other collaborating EM organizations.
Sub-technology	iOS application, IPAWS TDL

Each of the physical sites that participated in the experiment used a set of integrated SA tools to exchange information. The toolsets are represented in Table 2-2 below. Certain tools (e.g., MASAS-X, vUSA) were commonly used across all locations. Moreover, each location used additional tools that were already implemented within their respective EM organizations.

Table 2-2 Integrated Situational Awareness Tools Across Physical Sites

Physical Location	Technology
Fredericton (NB)	• MASAS-X, MASAS-X Flex widgets, MASAS Mobile, vUSA, MASS, MRP, Sentinel™.
Augusta (ME)	• vMaine, vUSA, IPAWS TDL, MASAS-X, MASAS Mobile, MASS, MRP, WebEOC™, On-The-Go Alerting™.
Ottawa (ON)	• MASAS-X, vUSA, OCIP.

2.4 Data Collection Tools

Phase 1 of the data collection plan was designed to gather feedback directly from the study participants at each physical site (i.e., Fredericton, Augusta, Ottawa). A set of instruments was administered to the participants during the experiment. All identifiers were removed from the data that were compiled upon conclusion of the experiment. Each instrument is briefly described below:

- **Demographic Instrument:** This instrument gathered descriptive data from participants that described their operational experience and perceptions of integrated SA technology.
- **Participant Instrument:** This instrument assessed the participants' experiences regarding the impact of integrated software tools on information exchange: it was administered at the end of Days 1 and 2 of the experiment. Short answers and 5-point rating scales were used to gather data. A rating of "1" indicated that participants strongly disagreed with a statement. A rating of "5" indicated that participants strongly agreed with a statement, and a rating of "3" indicated a moderate level of agreement.
- **Workload:** The NASA Task Load Index (NASA TLX) measured the participants' apparent workload level across six dimensions using a custom 10-point rating scale. A rating of "1" indicated a low level of demand, whereas a rating of "10" indicated a high level of demand. A rating of "5" indicated a moderate level of demand.

3 RESULTS

The data gathered from players and observers (N = 25) were analyzed using descriptive statistics. The participants were distributed across the three physical sites as follows: Fredericton (n = 15), Augusta (n = 3) and Ottawa (n = 7). Perceived differences among the groups were not statistically significant. Qualitative comments gathered during the experiment are presented in Section 3.1

The following high-level findings were identified by the analyses:

- Participants in the experiments represented several EM organizations and were associated with a wide range of operational roles. These findings indicated that the participants were knowledgeable about the types of information exchanged during emergency events for maintaining shared SA with other EM organizations.
- The use of integrated situational awareness tools enabled the sharing of information to a wider, cross-border EM community and enhanced SA within and among all EM organizations at all governmental levels and between nations. The technology used during the experiment enabled the exchange of information necessary to support decision making (e.g., planning and execution of responses) within the organizations.
- The participants' perception of technology as an *enabler* for developing shared SA will be important in determining whether this technology will be adopted and implemented effectively within an EM organization. Indicators of technology adoption identified in this study included the tools currently used to manage emergency events (e.g., tablets, desktops), the familiarity with web-based and geospatial tools, and the use of technology for planning/tracking of resources, deployments, and equipment.
- Integrated SA tools enhanced the participants' initial understanding of the emergency event and continued to enhance their understanding as the emergency event unfolded over time.
- MASAS-X and vMaine respectively were identified as the most valuable tools by Canadian and U.S. participants,. Valuable data were provided and shared through the use of the other tools included in the experiment.
- The most valuable types of data that were shared included location, size/scope of problem, live shots of incidents, Twitter™ feeds and Twitter™ monitoring system, information mapped with symbols, potential impacts at the CA/U.S. border, and details of the ongoing responses.
- The integrated SA tools are expected to increase awareness of and assist in mitigating the risks associated with managing emergency events in ways such as speeding up information gathering, increasing situational awareness when responding to hazards, improving timelines for delivering responses, providing visibility at all governmental levels of response, and reducing the need to prompt other EM organizations to provide updates.
- The workload demands were higher for players than for observers. However, all participants indicated that the highest workload during the experiment was

associated with the performance and mental dimensions. The performance dimension focused on measuring how participants thought they accomplished the goals of the tasks. The mental dimensions measured the level of mental and perceptual activity required (e.g., thinking, deciding, calculating, remembering, looking, searching, etc.) for the task. These workload findings suggest that operational personnel would benefit greatly from practicing the actual tasks that will be executed using this technology to increase their familiarity with the systems.

- The integrated SA tools had a positive impact on information exchange with respect to the precision and timeliness of the responses. These two factors are particularly relevant to operational personnel when they judge whether to trust the data that are shared among EM organizations.

3.1 Qualitative Findings

Qualitative observations were also gathered during the experiment; these are presented in the subsections below.

3.1.1 Scenario 1 – Saint John, NB Refinery Explosion Observations

This scenario demonstrated the information flow from the Canadian local, to provincial, to federal and U.S. levels. The scenario also showed the successful flow of support information from U.S. systems to Canadian systems, including key information that enhanced SA (such as location of the emergency, contextual geospatial information, details about the emergency and a situational report). The scenario demonstrated the ability of the Sentinel™ system to geographically filter social media to find current discussion topics pertaining to an emergency incident. Despite the use of test data, the experiment was able to demonstrate that geographical boundaries could be applied to identify relevant information. Participants indicated this functionality would be helpful for locating relevant information within a defined space.

The scenario successfully demonstrated using the Sentinel™ System to send a Short Message Service (SMS)-based notification to EM officials in the Saint John, NB area. This demonstration showcased the system's ability to rapidly inform the public about an ongoing emergency situation.

The MASS from Kentucky was used during the scenario to demonstrate the use of prepopulated and available MRPs by the EM community. This system is significant as it reduced the time needed to identify, request and acquire resources from days to minutes when preparing for and responding to an emergency. Participants agreed that the MRP approach is useful; however, the key to its success will be whether the information is current and available. The participants also pointed out that although information sharing was dramatically accelerated, decisions still had to be made based on current processes. Participants in the Government Operations Centre (GOC) indicated that the integrated technologies enabled the seamless, near real-time exchange of information and facilitated SA from the Operations Centre Interconnectivity Portal. Information input using the different tools (e.g., CAUSE II Viewer, Sentinel™, MASAS Mobile, vMaine) was quickly made available to participating EOCs through OCIP. The GOC mostly operated in a monitoring role and as such only paid close attention to the SA entries that were deemed relevant above a certain threshold (e.g., combination of geographic proximity to critical infrastructure and government facilities, incident type, incident severity). Future configuration of OCIP will allow filtering of entries (e.g. users can choose to filter out minor road closures).

3.1.2 **Scenario 1 – Summary**

This scenario demonstrated successful flow of information from Canadian first responders and local government officials to provincial, state, and federal partners in Canada and the United States. Information shared included oil refinery incident reports, MRPs, and related transportation information. Although the experiment demonstrated various ways to exchange information, participants indicated that human intervention is still required. From a functional standpoint the system does not currently replace a telephone call as system notification is not at a sufficient level. However, the focus of the phone call will change from notification to confirmation that the information has been received and understood, with the resulting decision support processes initiated and ideally addressed in a more timely fashion. Because the call recipient will have information in hand already, the duration of the call can be shortened, avoiding long and repeated explanations of the current situation and allowing a focused conversation. This change will occur as more contextual information (e.g. geographically based view of the situation) will already have been exchanged among the EM organizations. The telephone call may be shorter but person-to-person communication is still critical to the EM process.

As a result of the system's one-to-many sharing of information to a wider EM community, its information flow was associated with fewer layers of hierarchy compared with the current information flow which requires one-to-one information sharing. Various players could see the information in their own systems. For example, information is created once and exchanged using several systems; when it is received, it can be used to monitor the progress of the EM responses. Although the system moves information faster than previously, the policy, governance and mandates of the recipients must be maintained. The system's flat hierarchy of information exchange also raised the risk that some agencies and groups may not have an appropriate level of understanding about the event or the information being forwarded. The receiving organizations will need to be able to gauge their own awareness of the situation(s) they are facing and how they fit into the larger picture.

As progress continues in connecting all levels of government within and between Canada and the U.S., information layers and filters will be necessary so that information can be exchanged effectively. That is, information that is most relevant to the mandate of an EM organization should be provided without the users having to search for relevant information among distracting pieces of information. For example, information requirements at the national level are very different from those at the local level. Further, users should be notified when certain types of information (e.g. combination of geographic proximity to critical infrastructure, government facilities, incident type, and incident severity) are entered into the system so that they do not have to constantly monitor the system for changes.

Participants indicated that in an emergency situation it may be difficult to find the time to create information for the various systems. Participants indicated the entry of MASAS-X information using both the Sentinel™ and CAUSE II Viewer could be improved. Because some emergencies allow little time for entering information into MASAS-X, the process could be streamlined. Ideally, each organization would use its own system to create reports, thereby eliminating any need for double entry of information into MASAS-X.

First responders on the scene need to know the security implications of sharing information. For example, first responders currently enter (i.e. write by hand) information into paper log books. The use of Sentinel™ and MASAS Mobile would enable first responders to enter information directly into the technology system, albeit with the danger that privileged information might be shared inadvertently. Measures to ensure that sharing is only done when appropriate need to be considered.
The inclusion of MRP data within the integrated SA toolset allows partnering agencies to view which resources are available in both the U.S. and Canada. In the current experiment, MEMA may request support from a Canadian region that is geographically closer to it, rather than another entity located in another part of the U.S. Further, the private sector may have more visibility during these events and may be able to provide the necessary support more easily.

Virtual Maine was the primary SA platform used by MEMA to visualize all the events of Scenario 1. Data from Sentinel™, MASAS-X, and first responders using mobile devices were visualized for the purposes of monitoring as events unfolded. When an international mutual aid request was made, vMaine monitored the activation and the movement of MRPs across the border into Saint John.

The Virtual USA library application was a key component that enabled the cross-border exchange of incident-specific information. Participants in Maine and throughout the U.S. were able to discover the MASAS-X information in the vUSA library and integrate the data into their native geospatial mapping applications to improve their situational awareness in the scenario.

The Sentinel™ application demonstrated the ease of integrating MASAS-X information and actions to the benefit of the overall functionality of the experiment. Ease of use for the operator and interpreter of the data was evident without having to duplicate entries or actions.

The ability of Sentinel™ to issue an alert based on certain criteria was a positive contribution to the potential functionality of systems integrated with MASAS-X, vMaine and vUSA.

OCIP demonstrated the value of integrating MASAS-X information within an incident management system used by a finite group of EM personnel, indicating the value of sharing information across different tools. OCIP and Sentinel™ both had the ability to archive the information created in these systems. However, concerns were raised about archiving and auditing data held in or exchanged by external systems (i.e., MASAS-X, vUSA, and vMaine). Sentinel™ had the ability to alert persons previously identified on the basis of predefined information criteria. It could also restrict who received information.

3.1.3 Scenario 2 – Calais, ME Compressed Natural Gas Explosion

This scenario demonstrated the successful flow of information from local government on the U.S. side through to the state and federal levels, all the way to Canadian agencies, and vice versa. This information flow included key information that enhanced SA and included geospatial information such as incident location, buffer zones, shelters, nearby airport landing strips longer than 4,000 feet, and a situational report generated from WebEOC™. The information sharing resulted in shared SA and a cross-border Common Operating Picture (COP) that enabled decision makers to "work from the same page." Although it focused on an event based in Maine, the second scenario replicated many of the same technology successes documented in the first scenario and further demonstrated cross-border interoperability. The U.S. agencies included the Calais Fire Department, Washington County EMA, MEMA, FEMA IPAWS TDL, and DHS S&T. The Canadian agencies included the federal, provincial and municipal government levels.

The unsecured Incident Management layer from the state of Maine, referred to as the State Wide Incident Management System (SWIMS), was accessible via the vUSA library and the CAUSE II Viewer in NB. However, the secure version of SWIMS was not accessible via the vUSA library and the CAUSE II Viewer because of authenticating problems between Maine's security architecture and vUSA. This issue highlighted the importance of designing and considering authentication in an SoS approach.

The mobile On-The-Go Alerting™ iPad application was successfully used to create and publish alerts and warning information aggregated through IPAWS TDL to the CAUSE II constituents. In order to visualize the alert and warning data from IPAWS TDL, a .php script that generated a KML data layer was created, which successfully rendered alerts via vUSA to both vMaine and MASAS-X. The application also demonstrated that an alert can be published to a specific geographic region and targeted to a specific agency. The scenario successfully demonstrated the integration of the EDXL-HAVE standard into vUSA and MASAS-X. This standard provides hospital status for day-to-day use and during crises; it also includes capacities (e.g. bed counts, utilization), services offered, and ambulance status (i.e. off-load times for air and land). Hospital information was provided for ME and NB hospitals; however, problems were encountered accessing EDXL-HAVE information in the CAUSE II Viewer which were attributable to browser caching issues.

3.1.4 Scenario 2 – Summary

Information for the CNG truck trailer explosion incident was successfully created by ME participants leveraging WebEOC^{TM}, MASS, On-the-Go Alerting^{TM} and the CAUSE II Viewer application. Information was viewed in vMaine and the CAUSE II Viewer and then exchanged using vUSA, IPAWS TDL and MASAS-X. MEMA provided shared SA through vMaine to locals in Calais and Washington County, as well as to national and international partners. MEMA also published and shared an unsecured version of SWIMS data for use throughout the scenario with Canadian officials through vUSA.

MEMA successfully achieved the longstanding goal of integrating Canadian MASAS-X data into the vMaine globe, thereby allowing all SA data created in Canada to be monitored by state officials via vMaine throughout the scenario.

The alerts and warnings (test alerts) were sent via IPAWS TDL, leveraging a commercial off-the-shelf On-The-Go Alerting^{TM} mobile publishing application. A map service was created to automatically populate geospatial viewers in Maine and Canada with a visual depiction of the alerts—the first time such integration occurred, showing the ability to visualize test alerts in Virtual Maine.

The scenario included the request and acquisition of international and cross-domain (i.e., EMA to military) mutual aid. The Kentucky-based Mutual Aid Support System was used by Maine, New Hampshire and New Brunswick to create ambulance and fixed-wing MRPs for the experiment. MASS data was visualized on both sides of the border leveraging the MRP geospatial toolbox. In this experiment, mutual aid resources were identified on the map and then requested and authorized via phone.

Supporting SA data were leveraged in the scenario. ME was able to consume and visualize National Shelter System data provided from FEMA and the American Red Cross for the very first time. In the second scenario, these data provided useful context, including shelter location, bed counts, and operational status.

The experiment included the use of readily available operational data as well as artificial datasets. Prior to the experiment, WebEOC^{TM} was integrated into vMaine to link incident management system records to the state SA viewer. ME also published incident impact zones for the accident as well as airfield data. The implementation of the HAVE-EDXL standard was a proof of concept. It is important to note that not all information would normally be shared in SA systems tested in the experiment. Specifically, some security information related to critical infrastructure would not be shared across the border through these systems. Although certain data may not be classified, their distribution may need to be limited to a select audience.

In Canada, the Canadian Emergency Management Symbology Version 1[7] and the associated taxonomy are widely used. MEMA has also adopted the Canadian Emergency Management Symbology and uses the associated taxonomy information; MEMA used these during the experiment. However, during the experiment the symbology and/or taxonomy across all the systems were used inconsistently, creating confusion among participants. The use of symbology must be addressed to ensure effective interagency information sharing.

Some ME Emergency Alert System (EAS) alerts are received by Canadian radio stations and communities that are within range of the transmissions. Proactive alerts sent via IPAWS TDL can be directed to Canadian government officials who then may republish alerts to the public (if desired). Although the process is straightforward, the protocols for sending and receiving alerts between Canada and the U.S. require further refinement.

[7] http://emsymbology.org/EMS/ , accessed April 08, 2013.

4 LESSONS LEARNED

The findings from this work will inform the Canadian and DHS S&T community with respect to the application of integrated tools that will enhance shared SA across the border. Future efforts to improve the coordination of responses during cross-border events should consider the following lessons learned, observations, and technology breakthroughs achieved during CAUSE II:

- A range of technologies can be employed to build an integrated SA toolset. These tools can include emerging and mature technologies. Operational personnel in different roles (e.g., EM organizations including fire, EMS, police) may need very different tools, but information exchange needs to be considered in all of them. In all instances, operational personnel will require adequate training and experience using technology.
- The adoption of technology is likely to shift the reliance from voice/e-mail communications to information exchanges facilitated through integrated SA tools. Although certain decisions will never be made in isolation, the speed for integrating information relevant to them can be dramatically reduced. This acceleration of process will include the initial notification of the event as well as the coordination of responses throughout the duration of the event. Therefore, updates to the technology system should accommodate these anticipated changes in use.
- Operational personnel can gain much from practicing the actual tasks that would be executed in the event of a cross-border incident.
- Usability of the system must be optimized for users; such optimization would include developing a clear, concise governance framework for cross-border activities, policies, and standard operating procedures on how the systems are to be used and when information is to be shared. Further, all parties should use symbology consistently when exchanging information.
- The strength of existing partnerships among EM organizations on both sides of the border will determine the likelihood that operational personnel will rely on and trust shared information. MASAS-X is only populated with unclassified authoritative information and is accessible only by authorized public safety officials. Therefore, it will not include information that is deemed to be unsuitable for widespread sharing. To support this trust, a consistent Identity (authentication) and Access Management (authorization and audit) System should be considered.
- Integrated SA may support the enhanced quality of decision making and risk management processes, but will not necessarily reduce the time required to complete these activities. Decisions often must be made based on exigencies beyond the mandate of the operational personnel using the integrated SA tools.
- The production-level integration of IPAWS and MASAS must continue to be considered a high priority. Currently, other than agreements between FEMA and CSS for exploratory work, there is no signed agreement between the U.S. and Canada to allow for sharing of operational incident alerting information. The

information exchanged during the experiment was created using the IPAWS TDL service. The workflows achieved in the TDL environment can be easily replicated in the production environment, provided an agreement is in place.

4.1 CAUSE II Technology Breakthroughs

The following technology breakthroughs were achieved during CAUSE II for the very first time:

- **MASAS-X integration** – Model tools and workflows now exist for U.S. agencies to consume/publish Canadian MASAS-X data from within their native geospatial applications (e.g., Google™, Flex, Incident Management Systems).
- **IPAWS TDL integration** – Capabilities were developed to integrate alerts and warnings aggregated by IPAWS TDL into the native geospatial application of any U.S. state or local agency.
- **Virtual USA integration –** The vUSA library use was extended to include Canadian participants for the very first time and integrated map services from MASAS-X, IPAWS TDL, and state and provincial incident management systems.
- **International mutual aid** – Cross-border mutual aid resource requests were accelerated through the MRP geospatial tool, which enabled U.S. and Canadian systems to directly access and query available resources from MASS.
- **Local, municipal, state, provincial, and federal interoperability** – Integration of 12 systems and toolsets was achieved at various levels of government across the border.
- **Mobile integration** – The use and integration of MASAS Mobile and the On-The-Go Alerting™ applications by first responders was achieved to support creation and sharing of SA and alert and warning information across the border through enhanced field to headquarters reporting.

5 RECOMMENDATIONS

CAUSE II demonstrated that the use of integrated SA tools provides the capability to share and view geospatial information in near-real time. This S&T-based capability facilitates the development of shared situational awareness among the partnering EM organizations and enhances the planning, coordination and delivery of cross-border responses.

The following recommendations address opportunities for the progressive development and implementation of this technology.

5.1 People-Focused Recommendations

5.1.1 **Recommendation 1 – Define Training Requirements.** Identify and develop training to ensure that operational personnel acquire adequate levels of familiarity and expertise with using integrated SA tools. This training will address the increased demands (i.e., mental and performance dimensions of the NASA TLX) that are associated with the use of these tools. In addition, the training should improve the users' understanding of the information that is exchanged within the shared system. This level of expertise will be essential during high-stress and time-critical situations and will reduce the likelihood that data are interpreted incorrectly or are entered ambiguously.

5.1.2 **Recommendation 2 – Develop and Maintain Partnerships.** The willingness to trust and rely on the information that is shared and exchanged during an event will be determined by the strength of the partnerships that exist prior to the occurrence of emergency events. Practice using integrated situational awareness tools to share data in near real-time. Operational personnel must be provided with opportunities to practice executing tasks with partnering EM organizations. This practical experience is necessary to build and maintain partnerships among partnering EM organizations.

5.1.3 **Recommendation 3 – Manage Personnel Expectations for Technology Adoption.** Develop and articulate the plan for adopting technology that facilitates the enhanced SA between EM organizations. The plan should manage the expectations of the operational personnel and provide a timeline for implementing this technology to augment their existing information exchanges during emergency events.

5.2 Process/Policy-Focused Recommendations

5.2.1 **Recommendation 4 – Define Task Requirements**: Perform a task analysis to identify the following information for each operational role in EM organizations: information required to develop and maintain shared SA and support decision making and risk management and critical tasks and workflows (e.g. existing new and obsolete workarounds). This analysis will address the anticipated changes to the roles and responsibilities for operational personnel, as demonstrated through the development of use cases, as a result of adopting integrated SA tools. This task analysis should consider tasks within and among EM organizations and the information that is required to support these tasks. These changes will necessitate updates in the SOPs that are currently used within each EM organization.

5.2.2 **Recommendation 5 – Establish Governance and Guidance**: Identify the requirements for governance and guidance that can be used within the EM community to develop consistency in the use of the technology. Governance should include the policies, procedures, and information exchange requirements that support the mandate of each organization participating in information exchanges. Due to the nature of interagency information sharing, guidance is required to provide recommendations to the EM community about how technologies may be implemented in an organization's system. This guidance could include establishing user controls and access requirements, user guide documentation, and publishing criteria. Where capabilities are pan-Canadian in nature (i.e., apply to local, P/T, federal, and other levels), pan-Canadian guidance should be issued. Where guidance is focused on a particular community of practice (e.g., EMS information sharing and visualization guidance), it should be issued at the appropriate level with a focus on that community.

5.2.3 **Recommendation 6 – Generate Relevant Architectures:** Develop and communicate architecture framework products (e.g., Public Safety Architecture Framework (PSAF), DoDAF, Government Accountability Office Enterprise Architecture Maturity Model Framework (GAO EAMMF)) depicting real-time, interagency information that is shared in integrated situational awareness systems. This recommendation includes developing and communicating business continuity processes, SOPs, and interdependencies between partnering EM organizations and technology system designs. These tools are used to address the development of shared SA between Canada and the U.S. and to identify the work that still needs to be completed. While such an architecture is developed, the long-term creation and maintenance of a cross-border incident management information sharing technical architecture also should be considered, as very few EM organizations have the funding and capacity to create and maintain such a system.

5.2.4 **Recommendation 7 – Develop & Implement Applicable Standards:** The EDXL-HAVE standard, which provides hospital and ambulance information, offers many benefits to the EM community. Although this standard has seen limited implementation, existing country pilots—followed by a CANUS pilot—should be conducted that incorporate and test it. Where applicable, Open Geospatial Consortium (OGC) standards should be used.

5.2.5 **Recommendation 8 – Adopt Common Symbology Framework:** In Canada, efforts have been made to develop the Emergency Management Taxonomy and Symbology. However, integration with the US efforts is required to enable the development of a North American Emergency Management Taxonomy and Symbology standard. Maine has already adopted this standard, but broad-based adoption across the CANUS border is recommended.

5.3 Technology/Tool-Focused Recommendations

5.3.1 **Recommendation 9 – Role-Based Information:** A task analysis should be conducted to identify Essential Elements of Information (EEIs) relevant to the roles and responsibilities for each operational user (see Recommendation 1 Section 5.1.1). As organizations adopt more advanced tools and systems, they will need to consider how they can support the role(s) of their operational and other staff and how their information needs change by role. An advanced system may consider using an information layer in its architecture. This information layer would allow a role-based filter and set of data to be applied and enable users to tailor the information they see by the role(s) they fulfill. The information that is presented may range from GIS data layers, SA information, systems that are active and tailored notifications and alerts, all depending upon active roles.

5.3.2 **Recommendation 10 – Generate Usage Reports:** The integrated SA technology should generate usability reports that reflect the frequency of usage for each information type. These reports should be available and used to guide future development to ensure that features/functionalities that are frequently used are easily accessible to the users and are modified, as required, to ensure optimal usability. In addition, unused features/functionalities should be evaluated to determine whether modifications are needed to address usability issues or if they can be eliminated to reduce maintenance and/or future development costs. These usage reports should also be used to test the availability of features/functionalities and whether integrated systems exhibit any redundancies.

5.3.3 **Recommendation 11 – Resolve Authentication Issues:** In CAUSE II, technical problems were experienced with the vMaine and vUSA that were mainly due to an authentication problem. Study and technical investigations are required to address authentication among interagency situational awareness systems.

6 THE WAY AHEAD

The experiment successfully integrated MASAS-X, IPAWS TDL, Virtual USA and a number of systems at the provincial, state and local levels.[8] However, although the BTB CIWG Action Plan objective of harmonizing these systems was realized in the experiment, additional work is required to further test, evaluate and validate the SA and the alert and warning solutions.

The next steps will include strategic planning for the subsequent CAUSE Resiliency III Experiment and follow-on experiments to further refine cross-border voice and data interoperability capabilities until the conclusion of the CIWG Action Plan in 2017. This work will require appropriate outreach,[9] communications[10] and coordination with relevant BTB constituents, the CIWG and future CAUSE participants. It will also require focused attention and definition of scope based on compelling reasons for cross-border collaboration (i.e., shared SA, mutual aid, geographic threat, etc.).

Last, the way ahead must include the development of a strategic roadmap outlining ways to operationalize the various tools validated in CAUSE II and conduct future experiments. Some of the technologies used to exchange information in the experiment were prototypes. A comprehensive approach should be developed to implement the recommendations of this report, transition the information exchange technologies to fully operational status, and sustain desired cross-border capabilities through appropriate governance frameworks.

[8] CAUSE II video http://www.firstresponder.gov/Pages/FRMediaGalleryDisplay.aspx?eventid=13&gallery=video

[9] CAUSE II Article http://www.dhs.gov/interoperable-communications-across-borders

[10] CAUSE II Press Release http://www.marketwatch.com/story/technology-demonstration-focuses-on-harmonizing-cross-border-emergency-communications-efforts-2013-03-06

7 CONCLUSION

This report presents the work performed in designing, conducting and analyzing a data collection task during the experiment. This experiment was the second cross-border experiment in support of the BTB Action Plan and focused specifically on sharing information by applying interoperable technology.

The feedback gathered during the course of this study was obtained from experienced operational personnel who are generally accustomed to rehearsing emergency procedures on a regular basis and responding to and/or monitoring cross-border events. The feedback is relevant and generalizable to the EM organizations that respond to multi-agency emergency events whether these events occur within a single nation or across the CANUS border.

Continued development of the integrated SA tools should be founded upon a consistent governance and SoS approach. As Canada and the U.S. advance further towards achieving a binational capability that enables the seamless exchange of SA information for the EM community, it is hoped that the results of CAUSE II can be used to inform and achieve this vision.

8 ACRONYM LIST

BTB	Beyond the Border
CANUS	Canada-U.S.
CAP	Common Alerting Protocol
CAUSE	Canada-U.S. Enhanced Resiliency
CIWG	Communications Interoperability Working Group
CNG	Compressed Natural Gas
COP	Common Operating Picture
CSS	Centre for Security Science
DHS	Department of Homeland Security
DHS S&T	Department of Homeland Security Science & Technology
DoDAF	Department of Defence Architecture Framework
DRDC	Defence Research and Development Canada
EDXL	Emergency Data Exchange Language
EEI	Essential Elements of Information
EM	Emergency Management
EMA	Emergency Management Agency
EOC	Emergency Operations Centre
FEMA	Federal Emergency Management Agency
FRG	First Responders Group
GAO EAMMF	Government Accountability Office Enterprise Architecture Maturity Model Framework
GeoRSS	Geographical Rich Site Summary
GOC	Government Operations Centre
HAVE	Hospital Availability Exchange
IPAWS	Integrated Public Alert and Warning System
KML	Keyhole Markup Language
KYEM	Kentucky Emergency Management
MASAS-X	Multi-Agency Situational Awareness Systems National Information Exchanges
MASS	Mutual Aid Support System
ME	Maine
MEMA	Maine Emergency Management Agency
MRPs	Mission Ready Packages
NASA TLX	National Aeronautics and Space Administration Task Load Index
NB	New Brunswick
NB EMO	New Brunswick Emergency Measures Organization
NGOs	Non-Governmental Organizations
NISC	National Information Sharing Consortium
OASIS	Organization for the Advancement of Structured Information Standards
OCIP	Operations Centre Interconnectivity Portal
OGC	Open Geospatial Consortium
ON	Ontario

P/T	Provincial/Territorial
PSAF	Public Safety Architecture Framework
PSC	Public Safety Canada
REST	Representational State Transfer
S&T	Science and Technology
SA	Situational Awareness
SMS	Short Message Service
SOPs	Standard Operating Procedures
SoS	System-of-Systems
SQL	Structured Query Language
SWIMS	State Wide Incident Management System
TDL	Test Development Lab
U.S.	United States
vMaine	Virtual Maine
vUSA	Virtual USA
WMS	Web Map Service

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

Canada–U.S. Resiliency II Experiment (CAUSE II) was jointly sponsored by the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) First Responders Group (FRG), the Defence Research and Development Canada (DRDC) Centre for Security Science (CSS), and Public Safety Canada (PSC). The experiment was conducted on March 5 and 6, 2013 and consisted of a series of simulations enabled through the use of integrated situational awareness (SA) toolsets. New technologies that were either recently operationalized or were being transitioned into operational status were employed to enhance information exchange and augment shared SA between emergency management (EM) organizations north and south of the Canada–U.S. border. The experiment included participants from the local emergency management communities within the Province of New Brunswick (NB) and the state of Maine (ME), as well as the respective supporting federal agencies and departments within each national jurisdiction. This report provides an overview of the CAUSE II experimental methodology, a summary of the key findings, and a number of recommendations for advancing the development and implementation of integrated SA tools.

Le Projet expérimental de renforcement de la résilience II (CAUSE II) du Canada et des États-Unis donnait suite à cet objectif commun et s'ajoutait à plusieurs autres initiatives. Il était financé conjointement par le First Responders Group (FRG), Science and Technology Directorate (S&T), du département de la Sécurité intérieure des États Unis, par le Centre des sciences pour la sécurité de Recherche et développement pour la défense Canada (RDDC) et par Sécurité publique Canada. Le projet expérimental s'est déroulé les 5 et 6 mars 2013 et consistait en une série de simulations rendues possibles grâce à l'utilisation d'outils de connaissance de la situation. De nouvelles technologies devenues opérationnelles récemment ou en voie de passer à l'état opérationnel ont été employées pour accroître les échanges d'information et favoriser la connaissance de la situation par les organisations de gestion des urgences au nord et au sud de la frontière canado-américaine. Le projet expérimental réunissait des participants issus de collectivités locales de gestion des urgences de la province du Nouveau Brunswick et de l'État du Maine, ainsi que les ministères et organismes des deux pays qui appuient ces collectivités. Le présent rapport donne un aperçu de la méthodologie employée dans le cadre du projet expérimental CAUSE II. Il renferme en outre un résumé des principales constatations et plusieurs recommandations visant à faire avancer l'élaboration et la mise en oeuvre d'outils intégrés de connaissance de la situation.

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
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Emergency Management, Communications Interoperability, Emergency Response, Emerging Technologies, Operational Support, Virtual USA, Situational Awareness, Resilience, Canada-U.S. Enhanced Resiliency, Multi-Agency Situational Awareness System.