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GeoConnections
Geospatial Return on Investment Case Study:
Multi-Agency Situational Awareness System (MASAS)

M. A. Stewart

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Natural Resources Canada
Ressources naturelles Canada

Canada

GeoConnections

Geospatial Return on Investment Case Study:

Multi-Agency Situational Awareness System (MASAS)

Developed by

New Brunswick Emergency Measures Organization

Financial analysis performed by Mary Ann Stewart, Nova Blue Inc.

Report submitted September 30, 2010

Executive Summary

In late 2009 GeoConnections commissioned a series of Geospatial Return on Investment Case Studies to add to the body of knowledge of case studies based on the GITA ROI methodology for financial analysis of geospatial projects. This study focuses on MASAS, Multi-agency Situational Awareness System, developed by New Brunswick Emergency Measures Organization. GeoConnections funded this project under a multi-agency situational awareness initiative with the intention of expanding MASAS to a national deployment.

MASAS is intended to better enable emergency management practitioners in preparing for and mitigating the impacts of emergency incidents through timely sharing of geospatially-referenced information. The New Brunswick MASAS implementation provides situational awareness data aggregation, as well as connection to the national MASAS.

New Brunswick MASAS was developed following an unusually large 2008 spring flood event, which resulted in damage claims in excess of $22M and required support from organizations outside the province. MASAS addresses the need to automate the information distribution and communication process during an emergency and to allow visual presentation of this information on maps. MASAS also provides for the use of shared tools by adopting open standards for application development.

This study includes benefits to staff at: Prince Edward Island Emergency Operations Center, Royal Canadian Mounted Police, Communications New Brunswick, Regional Health Offices, New Brunswick Department of Transportation, City of Edmundston, Policing Services, and New Brunswick Emergency Operations Center.

Forward-looking five-year analysis of New Brunswick MASAS: Cumulative benefits are $1.006M. Cumulative costs are $552K. Net Present Value (benefits minus costs in 2008 dollars) is $454K with an annualized Return on Investment (ratio of Net Present Value to cumulative costs) of 16.42%. Payback period is three years, showing a break-even point in 2011. This study uses a scaling factor based on average annual disaster claims over fifty years, taken to 2008 dollar values. The analysis reflects costs required for a Communications New Brunswick interface in order to realize public health benefits.

Alternate scenario: As many of the benefits of the study come from time savings to public health staff working routine events such as boil water notification, an alternate scenario omitting benefits to health staff was created. Cumulative benefits are $668K. Cumulative costs are $481K. Net Present Value is $187K with an annualized Return on Investment of 7.76%. Payback period is four years, showing a break-even point in 2012.

Conclusions: Estimated benefits begin to accrue midway through the five-year analysis, leaving only 2 ½ years for benefits to accrue. A longer study would permit the collection of more benefits over time, yet this technology is evolving so rapidly that a longer study was considered inappropriate. Many potential benefits come from routine activities rather than disaster-driven activities. Expanding to daily use would serve to reinforce staff familiarity with the tool set and increase their effectiveness during a disaster.

Résumé

Vers la fin de 2009, GéoConnexions a demandé la réalisation d'études de cas sur le rendement du capital investi dans la technologie de l'information géospatiale, selon la méthode que la GITA utilise pour l'analyse financière des projets géospatiaux, afin d'ajouter au savoir en la matière. La présente étude met l'accent sur le SICS, soit le Système interorganisationnel de connaissance de la situation, élaboré par l'Organisation des mesures d'urgence du Nouveau-Brunswick. GéoConnexions a financé le projet dans le cadre d'une initiative en vue d'étendre le SICS à l'ensemble du pays.

Le but du SICS est de mieux préparer les praticiens à gérer les urgences et à en atténuer les impacts par un partage d'information géoréférencée en temps opportun. La mise en oeuvre du système au Nouveau-Brunswick permet la prestation de données regroupées de connaissance de la situation et assure l'interconnexion au système national.

Le SICS du Nouveau-Brunswick a été élaboré à la suite des crues printanières sans précédent de 2008 qui ont entraîné des demandes d'indemnisation de plus de 22 M$ et exigé l'aide d'organismes à l'extérieur de la province. Le SICS répond au besoin d'automatiser la diffusion et la communication de l'information en cas d'urgence et à celui de reporter l'information sur des cartes. Il permet également le partage d'outils grâce à des normes ouvertes de développement des applications.

L'étude est avantageuse pour le centre des opérations d'urgence de l'Île-du-Prince-Édouard, la Gendarmerie royale, Communications Nouveau-Brunswick, les organismes régionaux de santé, le ministère des Transports du Nouveau-Brunswick, la ville d'Edmundston, les corps policiers et le Centre des opérations d'urgence du Nouveau-Brunswick.

Analyse prospective quinquennale du SCIS du Nouveau-Brunswick : Les bénéfices cumulatifs s'élèvent à 1,006 M$ et les coûts cumulatifs, à 552 K$. La valeur actualisée nette (soit les bénéfices moins les coûts en dollars de 2008) est de 454 K$, et le rendement du capital investi calculé sur une année (soit la valeur actualisée nette par rapport aux coûts cumulatifs), de 16,42 %. La période de récupération est de trois ans, et le seuil de rentabilité devrait être atteint en 2011. L'étude utilise une échelle basée sur une moyenne annuelle des demandes d'indemnisation en cas de désastre établie sur 50 ans et calculée en dollars de 2008. L'analyse tient compte des coûts de l'interface avec Communications Nouveau-Brunswick en vue d'assurer la santé publique.

Scénario de rechange : Comme beaucoup de bénéfices mis au jour par l'étude concernent le temps économisé par le personnel de santé publique dans l'exécution de tâches courantes comme la diffusion des avis d'ébullition de l'eau, un autre scénario a été créé omettant ces avantages. Les bénéfices cumulatifs y sont de 668 K$, et les coûts cumulatifs, de 481 K$. La valeur actualisée nette de 187 K$ affiche un rendement du capital investi calculé sur une année de 7,76 %. La période de récupération est de quatre ans, et le seuil de rentabilité sera atteint en 2012.

Conclusions : Les bénéfices estimatifs débuteront vers le milieu de la période d'analyse de cinq ans, ce qui ne laissera que 2 ½ ans pour les accumuler. Une étude de plus longue durée permettrait une augmentation des bénéfices avec le temps, mais la technologie évolue trop vite pour que la période soit allongée. Un grand nombre de bénéfices potentiels sont associés aux activités courantes et non à celles qui découlent de désastres. Si le système était utilisé au quotidien, le personnel pourrait se familiariser avec ses outils et en accroître l'efficacité en cas de désastre.

Introduction

GeoConnections has been a partner in the development of the GITA Return on Investment methodology, sponsoring a portion of the original case studies, three of which were conducted in Alberta in early 2006. As the methodology continued to develop and more U.S. case studies were conducted, GeoConnections became interested in sponsoring additional case studies suited to its mission in Canada. It issued an RFP in August, 2009, for consulting services to create a Geospatial Return on Investment Project and awarded a contract to Mary Ann Stewart at Nova Blue Inc. of Kansas City, MO, to perform this work. The first case study, for the City of Quinte West's PRISM-GIS and PRISM-911 applications, was delivered on March 31, 2010. The contract was extended on April 2, 2010, to include four additional case studies to be completed by March 31, 2011.

The New Brunswick MASAS case study is the first of the contract extension studies and was authorized on April 27, 2010. A kickoff phone conference was held April 30, with participation from Tim West and Ken Marshall of GeoConnections and Ernie MacGillivray, Director of Emergency Services, New Brunswick.

Preliminary phone interviews were conducted with MASAS stakeholders, including participants in the Federal MASAS implementation. Ms. Stewart made a three-day site visit to Fredericton, New Brunswick, June 1 through 3, 2010, to conduct on-site interviews and a stakeholder meeting to facilitate metrics collection for the financial analysis.

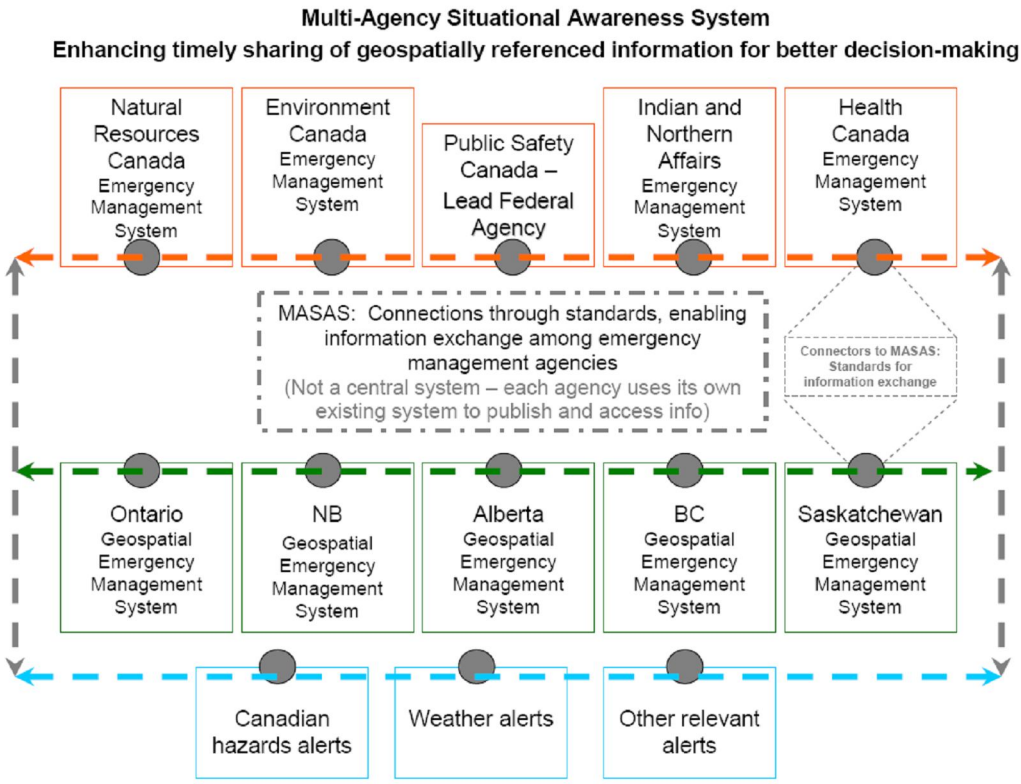
On-site interviews were held with: Lisa Munn, NB EMO; Ernie MacGillivray, NB EMO; Greg McCallum, Deputy Director, NB EMO; John Langille, Roy Hillier and Greg Lawlor, RCMP; Dave Macfarlane, NB Department of Transportation; Paul Ouellette, Public Safety Canada; Sandy MacKinnon, NB Department of Natural Resources; Bonnie Buckingham Landry, Communications NB; and Joey Babineau, Policing Services. The stakeholder meeting was held the afternoon of June 2, with attendees Andy Morton, Director of New Brunswick EMO; Jacques Doiron, City of Edmundston; Dave Macfarlane, NB Department of Transportation; Lisa Munn, New Brunswick EMO; Mel Vance, Public Safety Canada; John Langille, RCMP; with Ernie MacGillivray joining the meeting by mid-afternoon.

Completion of this case study was delayed pending arrival of cost details from New Brunswick Emergency Measures Organization. As these were not been delivered, Tim West, GeoConnections Project Manager, determined that this case study should be completed using cost details available through proposals and reports to GeoConnections regarding the project's original funding.

New Brunswick Emergency Measures Organization MASAS Program

MASAS, *Multi-agency Situational Awareness System*, developed by New Brunswick Emergency Measures Organization, is intended to better enable emergency management practitioners in preparing for and mitigating the impacts of emergency incidents through timely sharing of geospatially-referenced information. The New Brunswick MASAS implementation provides situational awareness data aggregation and connection to the national MASAS.

Background on development of national MASAS architecture: GeoConnections funded this project under a multi-agency situational awareness initiative with the intention of expanding MASAS to a national deployment. From the Federal perspective, such a tool would give warning of a situation that may need federal response.



Concept MASAS Network

In March, 2006, the GeoConnections Public Safety and Security Advisory Committee recommended Situational Awareness as a community priority for GeoConnections and a focus for investment in the development of national information systems. In 2007 a GeoInfoExchange pilot project was implemented between Environment Canada, the Public Health Agency of Canada and Public Safety Canada. A Public Safety project manager was appointed in March, 2008, and Federal Steering Committee was formed and project charter developed in May, 2008. An architecture development activity was initiated to develop the requirements for a national

model for Multi-Agency Situational Awareness System (MASAS). In November, 2008, version 1 of the Architecture Model was published.

The New Brunswick MASAS was initiated following an unusually large 2008 spring flood event, which required support from organizations outside the province, including other provinces, the Red Cross, and the Department of National Defense. Although developed in reaction to the 2008 flood event, this system will be used for all hazards, including nuclear accidents, chemical releases, forest fires, hurricanes, and special events. On September 16, 2008, Emergency Measures New Brunswick submitted an application to GeoConnections for $200,000 in funding, for a 10-month project to commence in the fall of 2008. Total budget for the project was estimated at $419,882.

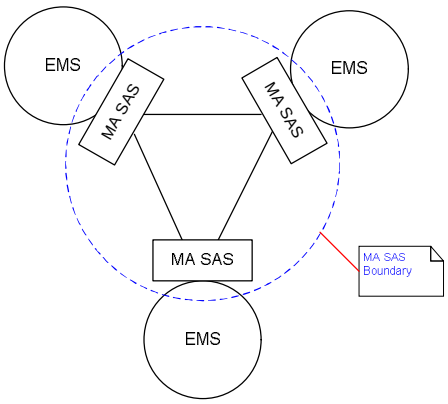
Fredericton 2008 flood photos courtesy of City of Fredericton River Watch

MASAS addresses the need to automate the information distribution and communication process during an emergency and to allow visual presentation of this information on maps. Situational awareness information will be available faster and shared more efficiently between agencies. It will reduce time lost to making information requests, sharing information with individual agencies, relaying information of other agencies, and sifting through situation reports for the bits of information of importance to operations.

MASAS aggregates incident information from diverse sources into a consolidated view made available to partners. Information is filtered through a centralized hub. Instead of pushing content to many, contributors publish it once for all with system rights. And, instead of pulling information from many agencies, information is pulled from the hub. An envelope can be created for each event so everyone who needs to respond will see the appropriate information.

MASAS also provides for the use of shared tools by adopting open standards for application development. The Common Alerting Protocol (CAP) Canadian Profile (CAP-CP) is expected to be the common denominator for all communications. Using CAP-CP to share information will allow data filtering using automated tools.

The GeoRSS standard can be derived from CAP-CP inputs. GeoRSS offers the opportunity to present situational awareness information visually, on a map, as well as in lists.



Scope of the MASAS

Stakeholders have identified their use of CARIS, ESRI, Google and Microsoft GIS applications. The content will be available in a standards based XML format, which supports filtering, routing, and geospatial presentation in layers, by event type, incident, urgency, severity and certainty.

The situational information to be distributed by MASAS will include public and official use only content, but it will not distribute restricted content. Distributing content to the needs of the emergency management community is substantially different than serving the public to their needs and demands. Thus, MASAS will not include a public interface, but rather will interface with organizations and systems which do serve the public directly, such as Communications NB.

Situational awareness information falls into two broad categories. There is dynamic event driven and event relevant information, such as weather conditions, flood levels, shelter openings, road closures, etc. Also there are static data sets, such as topographical maps, which help with understanding of the impact of the dynamic content.

MASAS will handle both static and dynamic data sets for use in situational analysis. Dynamic data sets to be used include: incident status reports; resource requests; be on the look-out (bolo) requests; areas of concern/interest identifications; public alerts and notices; officials only alerts and notices; situational modelling; preparedness reminders; location, movement, and status of resources; location, movement, and status of hazardous materials; suppliers of critical supplies, and their locations; current imagery; demographic data; institutions of interest and concern, including schools and jails; evacuation zones; sensor data.

Static information layers will be used in combination with the dynamic content. The Cities of Saint John and Fredericton have identified static geospatial content they maintain, including satellite imagery, building footprints, well locations, utilities, etc. Fredericton's list totals more than one hundred GIS layers. The province and the Canadian Geospatial Data Infrastructure offer many more.

Direct stakeholders include: Province of New Brunswick government agencies; municipalities and aboriginal communities of New Brunswick; universities and college campuses; Federal government agencies; State of Maine and the US federal government; Provinces of Canada, preferably through a national MASAS; service organizations, such as the Red Cross; utilities

serving the province; private companies serving public interests, such as the Confederation Bridge authority; private companies managing significant risk, such as hazardous materials.

Anticipated direct contributors to the data feed include: organizations at all levels of government, in New Brunswick and elsewhere; utilities; service organizations such as the Red Cross; hazardous material producers and distributors; GeoConnections Canadian Geospatial Data Infrastructure; New Brunswick Spatial Data Infrastructure; private companies providing public services, including port authorities, ferry operators and Strait Crossing Bridge Development Inc, which operates the Confederation Bridge; public transportation companies, offering bus, rail and air transportation; supply chain transportation; supply chain managers, for essential supplies such as food and fuel.

Parties whose data is expected to be validated by an organization above, before being contributed to the MASAS include: volunteers, including participants of the River Watch community; amateur radio operators; news agencies; citizens.

The New Brunswick MASAS project held a kickoff and stakeholder meeting in October, 2008. In preparation for the 2009 spring flood season, staff and contractors developed a communal user interface and the aggregator application and incorporated the CAPAN CAP-CP Geospatial Presentation Layer requirements. Development was split between outsourcing to Doug Allport for project management and fees paid to the province's crisis management system, ESSCrisis.

The 2009 spring flood season proved to be mild and as a result MASAS was not deployed. The project continued, developing system interoperability with New Brunswick's incident management system and third party incident management systems and establishment of several national sandbox instances. There is a model for integrating users of Sentinel Systems software with MASAS and integration with Prince Edward Island's Sentinel implementation was completed. MASAS moved to a production server in early 2010. Provincial, national and international exercises were conducted to demonstrate the growing support for the technology. The GeoConnections component of the project concluded at the end of March, 2010.

Fredericton 2008 flood photos courtesy of City of Fredericton River Watch

Project team members interviewed include:

NB Emergency Services
Ernie MacGillivray, Director

NB Emergency Measures / Public Safety
- Andy Morton, Director
- Greg McCallum, Deputy Director
- Lisa Munn, Operational Readiness Officer
- Lori Mofford, Geodesy & Geomatics Engineer
- Melanie Michaud, Administrative Assistant

Communications NB
- Bonnie Buckingham-Landry, Director Web Services

NB Transportation
- Dave MacFarlane, Highway Maintenance

NB Policing
- Joey Babineau, Policing Consultant

City of Saint John
- Murielle Provost, Manager, Emergency Preparedness

City of Edmundston
- Jacques Doiron, EMO Coordinator

City of Miramichi Police
- Todd Chadwick

Royal Canadian Mounted Police
- Greg Lawlor, Superintendent
- Roy Hillier, Operational Support Services
- John Langille, Communication Technology Analyst

Prince Edward Island
- Aaron Campbell, Emergency Management
- Steve Dickie, GIS Coordinator

State of Maine Emergency Management Agency
- Robert McAleer, Director

GeoConnections
- Trevor Rankin, National Systems Advisor

Allport Group Inc.
- Doug Allport

Types of disasters that could occur in New Brunswick:

Floods

Heat alerts

Ice storms with power outages

Tropical storms/hurricanes

Nuclear plant issues

Industrial issues (for example, at the Liquid Natural Gas energy hub at Port of St. John)

Minor earthquakes

Tsunamis due to climate change

Train derailments
Forest fires
Explosions with toxic fire
Pandemics

Other causes for notification:

Ambulance response
Boil water notices
Immunization clinics
Search and rescue
Large public events/sporting events

Fredericton 2008 flood photos courtesy of City of Fredericton River Watch

Model for Integration of MASAS with Vendor-specific Emergency Management Software

One benefit of the MASAS architecture is to promote alignment of different vendor-specific emergency management software products. New Brunswick uses the ESS product, which is based in Arizona. Emergency management organizations in the provinces all use different platforms. In the US, WebEOC is predominant. There is a drive toward a common North American viewing platform and MASAS is a component of that initiative.

With these issues in mind, benefits were collected from Prince Edward Island Emergency Management. PEI uses Sentinel emergency management software and participated in the first integration of Sentinel with MASAS during the winter of 2009-2010. The vision is that vendors adopt MASAS and provide support for integration with their software and PEI is the prototype for this model. The hope is that Sentinel will pave the way for open vendor architecture.

PEI is small, 5000 square kilometers, with a population of 140,000. Storm surge is possible four times a day at six locations. A unique feature of this province is the 12 mile bridge linking PEI to New Brunswick. The bridge is affected by wind and may have closures to certain types of high sided vehicles, typically during winter storm season. They see six to 12 closures a year. Typical emergencies include tropical storms and ice storms. Wildfires are also common.

PEI tangible benefits fell into the general category of savings in communication time during their typical annual events of ice storms and hurricanes. No tangible benefits were attributed specifically to the PEI Sentinel/MASAS integration. However, Sentinel will be integrated with MASAS in six to eight other areas in the province and other vendor interfaces will be created.

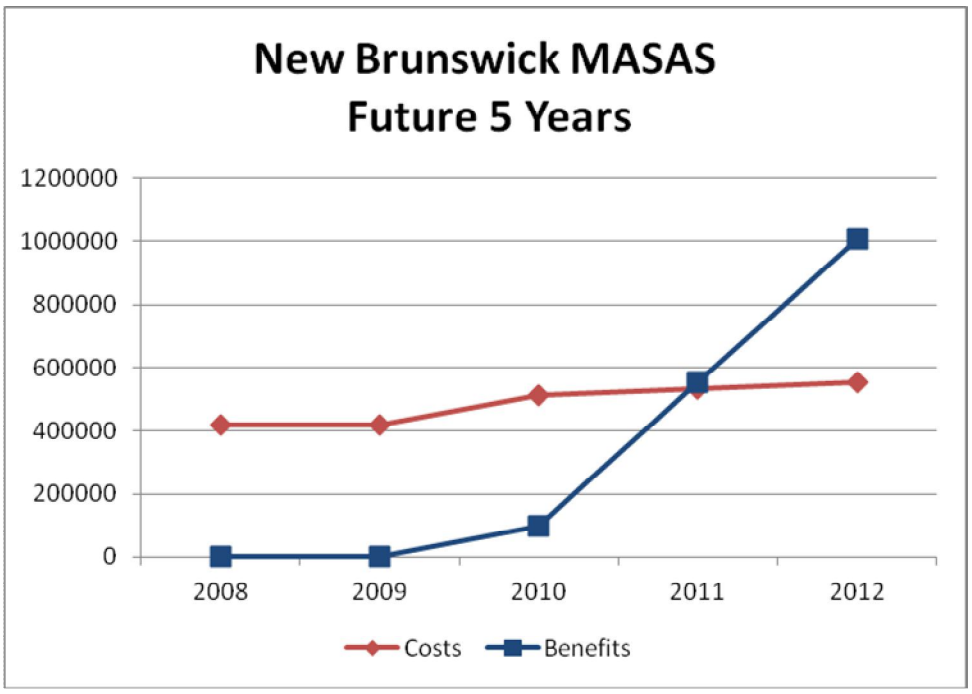
Murielle Provost of City of Saint John Emergency Management has formed an alliance of nine municipalities in her region of southern New Brunswick. Their common Sentinel implementations (including Incident Command suite, Hazard Risk Vulnerability Assessment, and Public Notification) forms the center of the alliance. Murielle envisions a MASAS integration with Sentinel as providing the greatest results and expects combined training on MASAS and Sentinel to occur in October, 2010.

The CAPAN (Canadian Association for Public Altering and Notification) business model addresses questions regarding cost recovery for the MASAS hub model. The CAPAN model would provide for an industry clearing house to collect, authenticate, validate and format official public alerts/notices, and make them available to public safety officials, broadcasters, telecommunications companies, news agencies, and internet service providers. Two of the primary processes CAPAN will oversee are member application and activation and issuing and processing alerts/notices. Members can originate notices through the system, which will be authenticated by the system.

Financial Analysis

Forward-Looking Five-Year Financial Analysis of New Brunswick MASAS

Initial startup costs to develop New Brunswick MASAS were $419,882, which includes $200,000 in funding provided by GeoConnections. This financial analysis is hindered by the unavailability of further detail for startup costs. The analysis takes the original lump sum cost projection made to GeoConnections as valid and uses this as an aggregated base cost.



Annual costs to maintain New Brunswick MASAS architecture in its current status going forward include $15,000 for ESS hosting, $7000 for customization of additional feeds and viewing applications, and $75,000 to build an interface for Communications New Brunswick. The financial analysis is hindered by the lack of cost projections for future application development, moving the hosting to a Canadian secure site, and other enhancements necessary for the MASAS user community to place their confidence in mission-critical use of this tool.

Cumulative costs for this forward-looking five-year project are $552,762. Cumulative benefits are $1,006,701. Present Value of Costs is $552,762. Net Present Value is $453,939 with an annualized Return on Investment of 16.42%. Payback period is three years with breakeven point in 2011.

Analysis of New Brunswick MASAS shows greatest benefits ($561,421, which is 56% of cumulative benefits for the study) would come from time saved for Medical Health Officers and their administrative staff by streamlining the communication of Boil Water Notices and Public

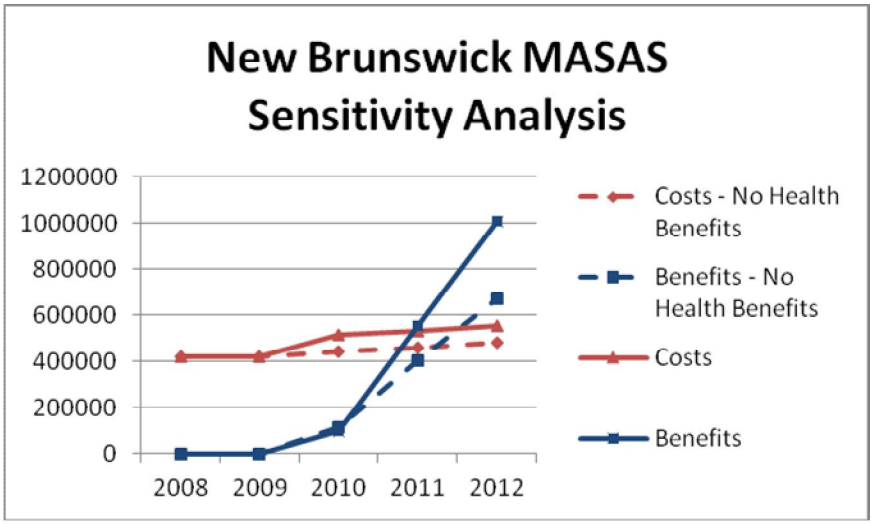
Health Notices. This benefit finding supports the concept that New Brunswick MASAS will provide the greatest benefit to the province if it is used for daily activities as well as emergency events. Stakeholders have further commented that daily use is necessary in order for them to be comfortable using the toolset for use during an emergency.

The second largest category of benefits would come from time saved for RCMP field staff in response to disasters ($436,513, which is 43% of cumulative benefits for the study). RCMP management estimated 220 staff members would have saved 100 hours each if MASAS had been available for use during the 2008 flood. Applying the 16.1151% scaling factor to estimate the likelihood of annual damage comparable to the 2008 flood provides a potential 3545 staff hours saved annually. This benefit finding demonstrates the value of MASAS to field staff and supports the concept that the tool will achieve maximum benefits if its use is expanded to include stakeholders outside of emergency operations centers.

Alternate Scenario: Omitting Public Health Benefits

An alternate scenario was created to show the effect of omitting benefits to Medical Health Officers. The rationale for performing this analysis was to demonstrate the profound effect of a single example of daily use of New Brunswick MASAS.

The forward looking five-year analysis showed Net Present Value of $186,851, which can be compared to the $453,939 of the analysis that includes public health benefits. ROI for this analysis is 7.76%, which contrasts sharply with the 16.42% ROI of the analysis that includes health benefits. Present Value of Costs for this analysis is $481,291, contrasted with $552,762 for the analysis that includes health benefits. This difference in costs is due to the requirement to establish a link to Communication New Brunswick in order to realize public health benefits as well as other public communication benefits not yet quantified.



Estimating the Effect of New Brunswick Natural Disasters

The primary event for determining potential MASAS benefits for emergency response was the 2008 flood of the St. John River. Although New Brunswick MASAS was not used for this event, it was developed in response to this event and the event remained fresh in the minds of those interviewed to collect potential benefits.

Collecting potential benefits based on the 2008 flood presented an issue in scaling 2008 flood benefits to other years of the study. This required estimating the probability of a flood or other disaster in those years as the study looks forward from the initiation of the MASAS project rather than looking backward at disasters already experienced.

Several approaches were considered to estimate the probability of disasters in New Brunswick and the relative benefit from a future response as compared to potential 2008 flood response benefits. Many interview subjects stated that the 2008 flood was a 30-year flood, so the initial impulse was to determine probability of a recurring flood of similar magnitude based on this metric. However, with repeated mentions of 2008 as a 30-year flood it became clear that what was actually meant was that 2008 presented the most serious flooding in the past 30 years. This does not align with the technical definition of a 30-year flood but is rather anecdotal evidence regarding the history of flood severity.

Searching for New Brunswick flood expertise ultimately led to Brent Newton, P.Eng., Flow/Flood Forecasting Engineer, Department of Environment, New Brunswick. He determined the 2008 St. John River flood at Fredericton to be a 161-year flood as follows: *"Based on the report, 'Hydrotechnical Studies Of The Saint John River – From McKinley Ferry To Lower Jemseg' prepared for the Canada – New Brunswick Flood Damage Reduction Program the 100 year water level at Fredericton was deemed to be 7.82m. From the 1979 flood report the 1973 flows below Mactaquac were estimated to have a 190 year return period which resulted in a water level of 8.61m at Fredericton. My best estimation using the water level at Fredericton (8.36m) in 2008 with a linear interpolation is 161 year return period."*

It would be possible to scale the potential benefits from the 2008 flood to an annual probability of such an event using the equation $\mathbf{P_t = 1-(1-P_e)^n}$ where P_t is the probability of occurrence over the entire time period, n, and P_e is the probability of occurrence in any year.The result of this exercise is that there is a 0.6211% chance of a repeat of the 2008 St. John River at Fredericton event in any future year.

This result presents several problems. It does not account for the probability of other size floods that might occur in any given year or provide a method of scaling benefits to floods of other sizes. It also does not account for the use of MASAS in response to other natural disasters with potential benefits similar to those estimated for the 2008 flood response.

Fortunately, Andy Morton was able to provide a table of total claims for disasters in New Brunswick from 1959 through 2010. The table lists year, type of disaster and total claims. Using this table, it was possible to calculate average annual disaster claims over this 50 year

period of time. Each year's disaster claim was taken to a 2008 dollar value. Average annual hazard claims were calculated to be $3,565,636 in 2008 dollars. Claims for the 2008 flood were $22,126,031. Thus the ratio of average annual hazard claims to 2008 flood claims equals 0.161151. This becomes the scaling factor for benefits going forward from the 2008 flood. This approach solves the problem of scaling multiple disaster types to the one example of disaster response where staff were able to project potential benefits from using New Brunswick MASAS.

Strategic Benefits

Based on the experience of ROI case studies using the GITA methodology, a strategic benefit is any benefit not yet quantified. Strategic benefits may become quantifiable benefits once suitable metrics are discovered or further experience has been gained with the application under analysis. It may never be appropriate to quantify certain types of public benefits, but it is useful to take note of strategic benefits in anticipation of their quantification in the future.

MASAS was developed to improve communication between agencies based on experiences during New Brunswick's 2008 flood. Noteworthy organizational strategic benefits, appropriate for flood response or any emergency, include:

Promotes efficiency, leading to faster awareness, notification and response -- Provides for single entry of situational information in a standards-based format for distribution to many. The architecture reduces three operations – receive warning, put on system, send it out – to one step. The architecture can take what's now only available on one manager's desk and make it available to all. Breaking down information silos allows faster broadcasting of information. One-off map requests could be directed to MASAS, thus reducing time lags to produce maps during emergencies. The architecture could result in reduced time to notification, which is essential for Amber Alerts delivering urgent bulletins in child abduction cases.

Graphic display of location information – Provides a GIS emergency management system to display content graphically and allowing the user to select what to view. Having the event location component is a key feature, as is the ability to display time and location. Graphic display reduces misinterpretation of information and makes for faster comprehension.

Open standards reduces software needs -- A web browser alone may suffice for many organizational needs. This would be particularly helpful for smaller organizations that can't afford software. In the future, provinces may have the ability to use the Federal system rather than individual provincial systems. MASAS can serve as a bridge between existing and future tools. Increases in interoperability will drive down costs. Interoperability between provinces such as New Brunswick and Prince Edward Island will promote sharing beyond jurisdictions.

Provides real-time reporting capabilities –The architecture can be used to provide documentation of an event's evolution hour by hour and inform the province of what's going on during a major event. This allows the province to predict better, and thus assign appropriate resources. It increases the likelihood that smaller or remote communities will get help. Real-time information can also be provided to the media.

Improved decision making – Improved decision making is the anticipated outcome for both internal agency and public decisions. Output from MASAS can be used for briefing to ministers and other high level decision makers. The architecture provides added value to decision support and adaptive risk management.

Reliable information more readily available – Provides authenticated, reliable information during a disaster through use of approved inputs. The public will be able to access certain tiers of this information through the web. MASAS could be used to provide an authorized information protocol of the Communications New Brunswick public feed. Quote from Ernie MacGillivray:

"The biggest benefit of MASAS is risk communication to the public." Use of the tool will temper the overwhelming involvement of the media during an emergency. General as well as restricted information can be handled. The architecture provides the opportunity for communication within the emergency management community before making public announcements.

Assists in response – The architecture will assist the EOC in apportionment of resources during an event, allowing decisions to be made based on information submitted from the field. It can be used to coordinate resource allocation during a disaster; to plan evacuation routes and provide metrics regarding the cost of evacuation; to provide information on evacuation centers, their location and percent full; and to provide information on road closures, keeping up with constantly changing conditions and eliminating lag time between DOT and the EOC. Response times from ambulance service during events could be improved. The architecture could be used to assign resources by function rather than agency, working as a catalyst to help the province bring departments together.

Assists in recovery -- Recovery time following a disaster will be reduced as information feeds assist in scheduling home inspections prior to reinhabitation. MASAS can be used for tracking teams and their progress and estimating time remaining for the recovery effort. The agency could tag data and related events and thus be provided with a digital record of financial transactions playing out for five to ten years following a major event. Currently, Public Safety doesn't have a system to monitor progress once resources are dispatched to the province.

Assist in formation of public policy – The EOC has a vision of using MASAS to show layers of imagery, claims, and damage reporting, and thus influence public policy regarding flood risk and building in the flood plain. As Ernie MacGillivray said: *"The second greatest benefit of MASAS is its ability to influence public policy regarding events such as floods."*

Promotes government credibility – As Ernie MacGillivray said: *"MASAS is not about resource management but rather about maintenance of government credibility."*

Provides hub architecture – Focuses on hub architecture, allowing users to develop interfaces to suit their needs. This change in architecture allows individual offices to cease being a hub and save on the associated overhead, based on a model of shared data rather than shared systems. Use of hub publishing technology saves on bandwidth by eliminating queries to see if there is anything new published (RSS with polling would be eliminated).

Miscellaneous benefits –

- Provides a platform for managers and directors without specialized GIS knowledge to query for information.
- Addresses problems with stakeholders running different tools by promoting alignment of products.
- Functions as a data aggregator, a bucket to collect data.
- Getting smaller communities connected through MASAS will assure they are included in regional situation reports.

- Provides a model for vendors adapting their software using open architecture. Increasing the number of participating vendors increases value for all stakeholders.
- Advances trust in technology. The more the government puts technology up front, the more it will be taken forward under succession planning.
- Reduces the need to take hard copy maps to the field.
- Provides the capability for individual organizations to customize their alerting system.
- Knowing the location of assets improves worker safety.
- Makes DNR's network of 28 remote weather stations available to the public.

Flood benefits – The ability to provide real-time situation reports during a flood or other natural disaster, versus a daily information feed, was the original objective of MASAS. The majority of flood response comes from local resources rather than provincial resources and MASAS assists in essential cross-agency coordination. Real-time mapped data during flood or fire events is a critical need in addition to modeling. Providing data on conditions at tributaries would improve flood forecasting. Currently, forecasting is done for big rivers only.

Fire benefits – Sharing maps of the progression of a fire, evacuation maps based on fire perimeter, and DNR forecasts would provide many benefits. Producing map products at the scene would help manage fire evacuations. Incident action plans created in the field could be shared instantly with the EOC. Data sharing would enable a minister or fire chief to see what's going on and provide situational awareness at a fire event.

Search and rescue benefits – MASAS could be used for tracking of ground search and rescue activities – to manage resources, the progress of a search, reporting at the conclusion of an event, and at year end analysis. The result would be more efficient searches. Savings from the astronomical service level contribute by volunteers could be tracked. Easing ground search and rescue stress would result in a huge savings in volunteer retention, as the current administrative burden causes volunteers to quit.

Health benefits – MASAS could be used for the management of H1N1 and other outbreaks, tracking clusters of outbreaks and showing clinic locations related to served population.

DOT benefits – Integrating MASAS with DOT's 511 service for road conditions would help address current scalability issues. Routine posting of DOT road closures saves trouble for everyone. Better communication for governing DOT response to events would be beneficial. DOT would like to use MASAS to make maintenance decisions, including contracted work with start and stop times cross referenced to costs. They would use it to track snow plows in place of a dispatch system and to coordinate joint trenching. There is great benefit to showing the road network across administrative boundaries. There is another bundle of needs for highway design as well as potential use with public transit.

RCMP benefits – Making more information available to the public could reduce the number of routine calls to RCMP regarding road closures during the winter, reduce the time RCMP spends confirming rumors during an emergency, improve the accuracy of information provided, and

reduce liability to RCMP. RCMP could use MASAS for its daily missing persons alerts. The architecture could provide better information to first responders and reduce the time RCMP staff spends calling DOT for information. Having authenticated real-time data would reduce the need to send RCMP staff to the field to confirm information.

Conclusions

The New Brunswick MASAS implementation provides situational awareness data aggregation and connection to the national MASAS. The architecture was developed quickly as a pilot project following 2008 flood events, in anticipation of similar events in the spring of 2009. However, significant flooding did not occur in 2009 or 2010 and thus New Brunswick MASAS had not been used for an event at the time benefits were collected for this study (May – June, 2010). Thus, all benefits characterized for this study are projected, based on staff experiences in response to the 2008 flood.

The areas where projected benefits were collected for the analysis are: RCMP field and senior constable savings in redundant communication during events, Communications New Brunswick staff savings in redundant communication during events, Medical Health Officer and staff savings in communication time for Boil Water Notices, DOT staff savings in communication time during events, Edmunston staff savings in communication time during events, policing services staff saving in communication time during events, PEOC staff saving in communication time during events, PECO GIS staff time saved making custom map products for events, Prince Edward Island EOC staff communication time saved for typical annual ice storms and hurricanes

The New Brunswick MASAS architecture touches on a number of important issues for emergency management, multi-agency data sharing, geospatial data standards and interoperability.

Some of the more significant areas addressed in this case study are:

- Value of using emergency response data feeds for use in routine activities as well as emergencies (benefits from routine activities comprise 56% of cumulative benefits)
- Value of using emergency response data feeds in field activities as well as in emergency operations centers (RCMP field staff benefits comprise 43% of cumulative benefits)
- Strategic advantage of providing real-time situation reports during an event, contrasted with old-style information feeds once or twice a day
- Value of reduction in phone calls to check facts (RCMP and other users project 20% to 50% time savings during events)
- Strategic advantage of promoting interoperability between provinces, such as New Brunswick and Prince Edward Island, which will promote resource sharing beyond single jurisdictions
- The analysis supports Ernie McGillivray's conviction that *"the biggest benefit of MASAS is risk communication to the public."* Public Health and Communications New Brunswick benefits comprise 57% of cumulative benefits.

The case study identified areas of strategic benefit, which would be beneficial to attempt to quantify in the future. Significant areas worthy of further examination include:

- Detail regarding cost of the New Brunswick MASAS project would greatly enhance this study. Currently there is only a lump-sum cost provided to GeoConnections in project reporting. Information on costs going forward appears somewhat inadequate and thus operational costs, as well as costs of moving to production, are likely to be underestimated.
- New Brunswick MASAS had not yet been used for response to an event at the time of this study. It would be extremely beneficial to update this analysis with actual benefits metrics collected during and after use of the architecture during a response.
- As the strategic benefits of real-time reporting were considered a primary driver in the development of the architecture, it would be advantageous to collect tangible benefits in this area (better decisions, faster response).
- Better decision making has emerged as an important strategic benefit of the architecture. To quantify even one example of the benefits of better decision making would be extremely advantageous.
- Ernie MacGillivray has stated, *"the second greatest benefit of MASAS is its ability to influence public policy regarding events such as floods."* It would be advantageous to attempt to quantify the benefits of improved public policy decisions made as a result of the architecture providing better data and viewing capabilities.
- Given the Ernie MacGillivray statement *"MASAS is not about resource management but rather about maintenance of government credibility,"* it would be advantageous to attempt to quantify the benefits of improved government credibility. This benefit topic has also been raised by users of MASAS in British Columbia.
- A number of potential users of New Brunswick MASAS were reluctant to quantify benefits prior to the architecture moving to a stabile production environment. They indicated that if their confidence in the usability of the tool set increased, they would be willing to estimate benefits. It would thus be beneficial to future financial analysis if these concerns from the user community were addressed to the user community's satisfaction.

The core level of New Brunswick MASAS benefits is driven by the level of manual communication experienced by the implementing organization. Benefits come from savings to the organizations that performed manual communication. Thus, organizations with significant manual communication requirements would be likely to have a particularly strong business case for implementation of MASAS, based on benefits collection to date.

Operations experience indicates that future MASAS benefits will come from improved service delivery to the public, better use of resources, and increased safety for emergency workers.

As New Brunswick MASAS is used by increasing numbers of organizations in the province, additional ideas for collaboration may evolve.