FACTORS INFLUENCING THE SELECTION OF DECISION SUPPORT SYSTEMS FOR EMERGENCY MANAGEMENT: AN ANALYSIS OF EMPIRICAL USE AND USER PREFERENCES

by

Trevor Manzanares

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Approved:

_____

Dr. William A. Wallace, Thesis Advisor

_____

Dr. David Mendonça, Committee Member

_____

Dr. Thomas Sharkey, Committee Member

Rensselaer Polytechnic Institute

Troy, New York

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ABSTRACT

The term Decision Support System (DSS) refers to any tool used to guide decision-makers by supporting critical decisions made in the field. This research focuses on determining specific user needs for DSSs used in the planning, mitigation, preparedness, response, and recovery from extreme events in the context of emergency management at the county, state, and local level. The extreme events that emergency managers deal with are infrequent and have the potential for disastrous impacts. This thesis will explore user preferences in the use of DSSs with a special emphasis on the three dimensions of training, planning, and an actual event. The challenge in assessing such systems is the difference in perceived utility to the end user and the one-size-does-not-fit-all reality of such systems. While validation is possible, to some degree, in the creation of DSSs by working closely with the end user, their requirements and needs are not static. This research seeks to identify which aspects of any given DSS are useful and those that are not, in an attempt to set forth an applicable methodology that can be used by system designers in matching user needs with appropriate tools and ultimately deploying DSSs that will be effective and valuable to emergency managers and other decision makers serving in a similar capacity.

1. INTRODUCTION

1.1 Motivation for research

Decision Support System is a general term for any computer application that enhances an individual's or group's ability to make decisions (Power, 2014). A typical DSS has three main components— a data component, a model component, and a user interface (Components of Decision Support Systems, 2014). DSSs are increasingly employed for guiding decision makers during extreme events where timely and effective decision making is required. However, the system developer often does not know what the emergency manager actually requires for decision support. Simply stated, the DSS does not fit the user's needs. This incongruity is seemingly all too common in the field of emergency management, and can lead to poor decision making, and ultimately, loss of human lives (Robert & Hockey, 1986). An opportunity exists to develop DSSs that more effectively meet user needs for a variety of purposes including improved decision making in the realm of emergency management.

1.2 Objective of research

The objectives of this research are twofold: One, to understand and effectively assess user needs in a DSS used in the planning/mitigation, preparedness, response, and recovery stages of emergency management, and two, to develop a list of necessary considerations in order to successfully deploy a specific DSS to the end user. Due to the differences in technical expertise between DSS developers and the end user, a DSS designed without sufficient user input can remain unused when it is needed most (Fothergill, 2000). Assessing the utility of such systems is of paramount importance for the continual improvement of the state of the art of computer-based DSSs. In addition to assessing the utility of the system itself, it is equally important to understand the needs of the user and their views on expert systems in guiding and supporting their decision making. Practitioner assessments and a very robust stakeholder involvement process are crucial to ensure that the assumptions and logic behind the inner workings of a model are valid (Little, Loggins, & Wallace, 2014). For

the purposes of this research, a computer-based decision support technology called MUNICIPAL (Multi-Network Interdependent Critical Infrastructure Program for the Analysis of Lifelines), a decision technology that supports decision makers in the restoration of critical infrastructure systems after an extreme event, was used as a case study in developing a methodology that can be broadly applied to assessing other DSSs in the field (Loggins, Wallace, & Cavdaroglu, 2013). Further, decision makers on a national level were polled regarding their use of such systems in an effort to develop a methodology and set forth a process of DSS assessment that can be adhered to during the development and deployment of any given DSS. Ultimately, even the most robust and realistic DSS can be useless in the hands of someone who does not understand or trust it sufficiently to actually use it. This research seeks to solve the problem of mismatched DSSs by aligning DSS capabilities with user needs in the context of emergency management.

1.3 Literature review and prior work

Ben-Zvi (2012) investigated DSSs by assessing the factors that enhance their perceived effectiveness and their impact on performance. The result of this research was that users who perceive the system as effective correlate to improved performance. Papamichail and French (2004) explored and classified methods of assessing DSSs in the development, operation, and evaluation phases with respect to nuclear emergencies. Mendonça et al (2006) reported on the design and use of gaming simulation as a means of assessing group DSSs for emergency response and suggested ways to improve gaming simulations for training and operations. Bharati & Chaudhury (2004) researched factors that impact decision making satisfaction in web-based DSSs and found that the primary contributing factors are the quality of information and the quality of the system itself. Wallace & De Balogh (1985) proposed a framework for the employment of DSSs in the field of disaster management. Finally, Graham et al (2008) examined the use and sensibility of two clinical DSSs designed for emergency physicians. This research was considered relevant to emergency management because emergency medicine also deals with unpredictable events and the potential for life-threatening consequences.

Using MUNICIPAL as the DSS, a brief overview of prior work will be given in this section. Loggins (2013) conducted an assessment of MUNICIPAL, which contains four components— a vulnerability simulator which predicts damage to infrastructure components given a specific disaster scenario, an optimization module which produces a restoration plan given a damage scenario, a GIS interface to visualize and manipulate the data, and a database structured to support the data needs and integration of the other three modules (Loggins, Wallace, & Cavdaroglu, 2013). As part of the database component, an artificial dataset called "CLARC" county was developed for illustrative and training purposes. The intent of CLARC County was to focus on modeling interdependencies and avoid the cost and time involved in data collection. Loggins (2013) verified the impacts of service degradation to civil infrastructures such as power, telecommunication, transportation, and water infrastructures. This assessment of MUNICIPAL was undertaken by validating: (1) the mapping and data of each infrastructure system housed in the model; (2) the solution procedures provided; and (3), assumptions made in restoration planning (Loggins, 2013). This research will explore the use and preferences of users, not just the verification and validation discussed in Loggins' paper. In addition, Loggins gathered feedback from the Director of the New Hanover County, North Carolina Emergency Management (NHCEM) about additional features that could be included in MUNICIPAL regarding an analysis of the performance of a restoration plan, being able to manipulate the results of the vulnerability simulation, and making MUNICIPAL web-based.

The major difference between prior work and this research is that the previous assessments generally focused on validating specific DSSs for different purposes, while this research focuses on establishing a generalizable process for assessment of DSSs designed to fit end-user needs in the field of emergency management. Based on this literature review, there has been little work aimed at developing such a process. The current effort will build on prior work aimed at assessing DSSs used in the field of emergency management.

2. DEFINITIONS

2.1 Decision Support System

Power (2007) defines a DSS as "…an interactive computer-based system or subsystem intended to help decision makers use communications technologies, data, documents, knowledge and/or models to identify and solve problems, complete decision process tasks, and make decisions." For the purposes of this effort, a distinction will be made between two general types of DSSs— those that are utilized by experts for the purposes of providing insight and advice to decision-makers (as a service), and those that are ultimately deployed to the end-user as a complete package (as a good). The current research focuses on DSSs that are used in the latter capacity; i.e., as a good.

2.1.1 As a service

Many DSSs are built and maintained by academics or professionals with knowledge of modeling and simulation. However, these technical specialists rarely, if ever, actually support decisions in the field. Despite this, decision makers in the field often look to the model builders for answers to their questions (A. Kelic, personal communication, June 17, 2014). Examples of DSSs employed in a service role are those housed at Sandia National Laboratories' National Infrastructure Simulation and Analysis Center (NISAC). The Department of Homeland Security (DHS) and their supporting agency, the Federal Emergency Management Agency (FEMA), regularly look to NISAC for advice during states of emergency. The DSSs utilized by NISAC don't necessarily need to be user-friendly because they will never be deployed and used by the decision maker. Most of NISAC's DSSs are highly technical and require an expert to run them and analyze the results.

2.1.2 As a good

This research effort focuses on DSSs used primarily as a good— an end-user tool. These types of DSSs must generally be much more comprehensible, user friendly, intuitive, and glitch-free because the people utilizing them for decision making are not model builders and do not generally have the technical expertise to fully understand the inner workings of the DSS and troubleshoot when something goes wrong. As a result, the DSS must be

relatively straightforward to use and understand (A. Kelic, personal communication, June 17, 2014). The vast majority of state, local, and county emergency management departments simply do not have the funding to employ an organization like NISAC to build models and analyze the results for them. Instead, they need a simple, intuitive user interface that is efficient to run and results that are easily understood.

2.2 SUMMIT

SUMMIT (Standard Unified Modeling, Mapping & Integration Toolkit) is a modeling and simulation software environment that enables analysts, emergency planners, responders, and decision makers to seamlessly access integrated suites of modeling tools and data sources for planning, exercise, or operational response. SUMMIT is being used in small and large-scale exercises to accelerate scenario planning, provide scientifically-grounded scenario data, and enhance the realism and common operating picture (Sandia National Laboratories, 2013). SUMMIT has become the most practical method of interfacing a variety of different tools, and this is why the research team undertook the task to integrate MUNICIPAL into SUMMIT.

2.3 HSIP Gold Dataset

The Homeland Security Infrastructure Program (HSIP) Gold dataset is an extensive, Official Use Only, infrastructure database assembled by the National Geospatial-Intelligence Agency (NGIA) and the Homeland Infrastructure Foundation-Level Data (HIFLD) Working Group, for the use of the Homeland Defense, Homeland Security, and National Preparedness–Prevention, Protection, Mitigation, Response, and Recovery communities. The HSIP Gold 2013 dataset is a compilation of 568 geospatially enabled baseline infrastructure datasets for all National and Defense Critical Infrastructure Sectors, and is assembled from federal, state, local, and private sector organizations (HIFLDWG, 2013). This dataset is available to members of the federal government, states with approved Presidential Disaster or Emergency Declarations[1], and non-federal mission partners operating on government-owned secure applications. The applicant nominates a federal

[1] https://www.fema.gov/declaration-process

sponsor and the request to obtain the data is approved by HIFLD Working Group. The potential for incorporation of the HSIP Gold 2013 dataset into MUNICIPAL will be explored in this paper. As will be seen in this research, current, accurate, and validated data are a significant component of the user requirements for a DSS.

2.4 Verification & Validation

As noted by O'Keefe, Balci, & Smith (1987), verification is building the system right, whereas validation is building the right system. In other words, verification is making sure the model runs correctly without bugs or glitches and validation is making sure the model accurately represents the real-life system being modeled. There have generally been three methods of verification and validation with respect to evaluation and assessment of DSSs: technical methods, empirical methods, and subjective methods (Papamichail & French, 2004). Since Loggins (2013) already performed a technical assessment of MUNICIPAL, only the latter two will be discussed further in this research. The empirical methods of assessing DSSs used in this research were questionnaires, and the subjective methods were telephone interviews.

3. METHODOLOGY

3.1 Approach and Methods of Assessment of User Needs

The approach used herein to assess user requirements for computer-based decision support systems involved direct interaction with various decision makers nationwide. These interactions were conducted via questionnaire and follow-up telephone calls with emergency managers, planners, town directors, emergency service personnel, IT managers, logistics managers, incident commanders, and training coordinators. In addition, the technical evaluation of MUNICIPAL conducted by Loggins (2013) was supplemented by empirical and subjective data gathered by way of questionnaires and expert interviews, respectively, aimed at evaluating MUNICIPAL's performance at the April 2014 workshop. A separate questionnaire was then developed and emailed to various state and local decision makers to understand their use (or lack thereof) and preferences in a DSS. The results from

this questionnaire were coded, quantified, analyzed, and finally applied to MUNICIPAL in order to assess whether or not MUNICIPAL effectively meets user needs.

3.2 Development of National-Level EM/Decision Maker Questionnaire

In order to obtain a more comprehensive, general assessment of DSSs, it was decided to poll a broader range of emergency managers. The reasoning behind this was because focusing on a single EOC could lead to skewed results and would not necessarily be representative of the state of the art of DSSs currently being used in the field (R. Little, personal communication, July 30, 2014). The comprehensive list of such EMs and other decision makers was gathered from the Emergency Management Assistance Compact (EMAC) and various other state EOC websites. EMAC is part of the National Emergency Management Association (NEMA) and offers assistance during governor-declared states of emergency, allowing states to send personnel, equipment, and commodities to help disaster relief efforts in other states (Emergency Management Assistance Compact, 2014). EMAC and various other nationwide EOCs were chosen because they include members from each of the 50 states and would therefore provide a more accurate representation of the actual use, advantages, disadvantages and potential utility of DSSs currently deployed in the field.

3.2.1 Methodology

3.2.1.1 Develop Questionnaire

Development of the questionnaire began with a set of questions aimed at gauging the current usage of DSSs by various decision makers in the field. Each question in the questionnaire was intentionally left open-ended in the interest of not leading the respondents to a particular answer or otherwise biasing the results. However, example response terms were included to ensure that all respondents answered in the same fashion and were thinking along the same lines. The first question was "*What is your specific function in Emergency Management?"* The intent of this question was to gauge the decision making power held by each individual (i.e. if the respondent was simply Chief of Staff vs Director of the entire EOC). The second question effectively broke the survey down into two sections by asking if the respondent currently employs a DSS for training, planning,

response, or recovery. If the answer was *yes*, a series of very basic questions were posed to ensure the entire audience could easily provide answers even if they weren't technically inclined: "*What do you use it for?" "Which activity is it most useful for?" "What aspects of the tool do you like?" "What aspects of the tool do you dislike?" "What improvements could be made to the tool to improve its speed/efficiency?"* If the respondent did not use a DSS, they were directed to different questions to help understand the demand for DSSs and the specific required components therein. *"Would the use of a DSS help guide your decisions faster/more efficiently?" "What specific components would you want in a tool?" "What would you use the tool for specifically?" "What is the reason your organization does not currently employ a DSS?* Once these questions were developed, they were submitted to Rensselaer's Institutional Review Board (IRB) since the questionnaire involved human subjects (Mentor, 2014). Upon acceptance, they were emailed to 1,315 emergency managers or other decision makers listed on various government, state, and local emergency response websites. For statistical significance, the goal was to obtain at least 30 responses before conducting analysis. Out of the 1,315 emails sent out, 30 responses were received from 16 different states, resulting in a 2.2% response rate. Despite the low response rate, there was no discernable majority of respondent type based on the responses.

One disadvantage of the questionnaire was the inability of the research team to ensure that the resultant distribution list did not induce bias into the process. Due to privacy and other concerns, not every state emergency management website provided email addresses for primary points of contact which limited distribution to those individuals or agencies that chose to provide their email addresses to the public. Thus, distribution of the questionnaire was not completely random. Despite this limitation, email questionnaires were still believed to be the most feasible method of obtaining information about national-level user preferences for DSSs.

3.2.1.2 Code Responses

Due to the qualitative nature of the questionnaire, the next step was to develop a set of questions to be answered from the respondents, such as: *"Does jurisdiction size affect DSS usage?" "What are the primary uses of DSSs?" "What are the*

advantages/disadvantages of DSSs?" "*What are the possible improvements?"* In order to answer these questions, the next step was to separate the responses into more general categories and attempt to classify each response into one or more of these categories. Based on the responses, DSSs were classified in one of five broad categories. The first category, *Emergency Management System*, refers to any DSS that is pre-packaged and encompasses multiple parts of the five phases of emergency management: Prevention, Mitigation, Preparedness, Response, and Recovery (Saint Louis County, 2014). The second category, *Geographic Information System*, refers to any sort of system used to analyze and store geographical data. The third category, *Information Sharing Network*, refers to any computer-based system with which information is shared within the organization or to the outside world. The fourth category, *Database Management System*, refers to any computer-based system that performs functions such as storing, retrieving, adding, deleting, and modifying data (About.com, 2014). The fifth category is self-explanatory and refers to all respondents that did not employ any sort of computer-based DSS.

Once the DSSs had been differentiated into their respective categories, further categories were created in order to answer the initial questions of interest. For jurisdiction size, each of the respondents was classified into one of three categories, depending on the population size of the jurisdiction for which they were in charge of making emergency management-related decisions. Due to the low response rate of the questionnaire and the minimal data, population thresholds were based on the definitions of the United Nation's *Population Density and Urbanization* definitions (United Nations, 2013), but were broadened to include several of their size classes in one size category. The final size categories can be seen below in Table 1.

Table 1. Jurisdiction Population Categories

Jurisdiction Size	**Population**
Small	0-49,999
Medium	50,000-999,999
Large	1,000,000 or more

For primary uses of a given DSS, eight main categories were assembled based on the responses as follows: preparedness, planning, response, recovery, communication, resource/asset tracking, daily operations, and training/exercises. Further, if the respondent did not utilize any sort of DSS, categories were included to gauge if they could potentially use a DSS and what those specific uses might be.

For specific advantages of a given DSS, seven main categories were also created based on the responses as follows: everything, single platform, resource/asset tracking, common operating picture, interface, communication, and none/not many. As with primary uses, these same categories were included for non-DSS users as well to understand what the potential advantages of employing a DSS could be.

For specific disadvantages of a given DSS, ten main categories were created as follows: data requirements, requires multiple platforms, connectivity requirements, lack of resources/training, not user friendly, technology unreliable, rigid structure, financial, infeasible/impractical, and none. These categories were also included for non-DSS users.

Moreover, the largest benefit of not pre-naming rigid categories for each section in the questionnaire was the wide variety of unbiased responses received as a result. One potential disadvantage, however, was the likelihood of a respondent to simply respond with "buzz" words regarding the *ideal* (vs. actual) uses, advantages, benefits, etc. of a DSS. For example, a respondent could indicate that a primary use for WebEOC™ is resource and asset tracking, when in fact they do not necessarily use the DSS for such a purpose. Moreover, DSS capability and actual use are often not synonymous.

3.2.1.3 Quantify Responses

The final step was to simply tally the number of responses for each category under each topic and attempt to capture any obvious trends or relationships in the data. One important assumption of this methodology was the potential for each respondent to be included in more than one category for any topic. For example, a user could utilize more than one type of DSS (i.e. geographic information system and database management system) or they could enjoy more than one advantage of each tool (i.e. interface and communication). This distinction is important because for each research question, the totals

likely sum to more than the number of responses and could potentially be misleading to the reader.

3.2.2 Analysis of Results

Based on the responses received from 30 emergency managers and other decision makers representing 16 states[2], there appears to be considerable demand for a decision support technology like MUNICIPAL. While about half of the respondents already employed a decision support system such as WebEOC[3], many did not utilize any such computer-based DSSs. Other tools used by respondents include ArcGIS[4], Google Earth[5], HSIN[6], WISER[7], WHAM[8], SQL Server[9], Everbridge[10], E-Team[11], CAMEO[12] (including MARPLOT and ALOHA),

[2] MA, NM, OR, ID, OH, NJ, IA, WA, WI, AK, MT, CA, NC, OK, AR, SC

[3] WebEOC™ is a web-enabled crisis information management system that provides real-time information sharing. It is web-based allowing for users to log on from any computer connected to the internet. It is a method for real-time information sharing between organizations, within and across disciplines and geographic regions. https://www.intermedix.com

[4] ESRI's ArcGIS™ is a geographic information system for working with maps and geographic information. It is used for creating and using maps, compiling geographic data, analyzing mapped information, sharing and discovering geographic information using maps and geographic information in a range of applications, and managing geographic information in a database. www.esri.com/software/arcgis

[5] Google Earth™ is a virtual globe, map and geographical information program, which maps the earth by the superimposition of images obtained from satellite imagery, aerial photography, and GIS 3D globe. https://earth.google.com/

[6] Homeland Security Information Network (HSIN) is the trusted network for homeland security mission operations to share Sensitive but Unclassified information. Federal, state, local, tribal, territorial, international and private sector homeland security partners use HSIN to manage operations, analyze data, and share information. www.dhs.gov/homeland-security-information-network

[7] WISER (Wireless Information System for Emergency Responders) is a system designed to assist emergency responders in hazardous material incidents. http://wiser.nlm.nih.gov/about.html

[8] WHAM is a mobile application that allows emergency managers in Wisconsin to electronically record damage assessment information via mobile device. http://www.ncwrpc.org/WHAM/

[9] Microsoft SQL Server™ is a relational database management system whose primary function is to store and retrieve data as requested by other software applications. www.microsoft.com/en-us/server-cloud/products/sql-server/

[10] Everbridge™ is an emergency communication systems tool that sends messages to key personnel during a critical event. http://www.everbridge.com/

[11] E-Team™ is a web-based collaborative, electronic emergency management software package that provides information reporting and resource management. www.dhsem.wv.gov/pages/eteam.aspx

[12] Computer-Aided Management of Emergency Operations (CAMEO™) is a system of software applications used to plan for and respond to chemical emergencies and can access, store, and evaluate information critical for developing emergency plans. Components include MARPLOT™ and ALOHA™. www.epa.gov/cameo

Pictometry[13], and HURREVAC[14]. Many of the respondents often utilized more than one of the above tools in concert, each for a very specific purpose.

It is interesting to note that all of the respondents that do not currently use any sort of DSS to guide their decisions were from jurisdictions with a population less than 1million (50% from small jurisdictions and 50% from medium jurisdictions). As seen in Table 2, 28% of all DSSs used by respondents were from small and medium size jurisdictions, while 44% of DSSs were used by decision makers from large jurisdictions.

Table 2. Number of Jurisdictions by DSS Category

Population of Jurisdiction	Emergency Management System [WebEOC, E-Team, CAMEO (MARPLOT, ALOHA), HURAVAC]	Geographic Information System (ArcGIS, Google Earth, Pictometry)	Information Sharing Network (HSIN, WISER, WHAM, Everbridge)	Database Management System (SQL Server)	No DSS Utilized	**Total # Tools Used**	DSS User	Non-DSS User
0-49,999	3	5	2	0	5	**10**	28%	50%
50,000-999,999	2	5	2	1	5	**10**	28%	50%
1,000,000 or more	9	7	0	0	0	**16**	44%	0%
Total Users/Tool Type	**14**	**17**	**4**	**1**	**10**	**36**	100%	100%

In order to answer the question about the relationship between jurisdiction size and DSS usage, the three population groups were consolidated into two groups: *small* (0-1,000,000) and *large* (>1,000,000). A chi-squared test was then conducted to test whether DSS usage depends on jurisdiction size (Stangroom, 2014). It was determined that DSS usage is not independent of jurisdiction size, assuming a 5% significance level (*p=.00904*). While small jurisdictions may not have as much influence in the field of emergency management, one must be reminded that the vast majority of natural disasters have a higher impact at the local level simply due to the lack of resources (i.e. funding, manpower, non-redundant infrastructure). Because of this, it is paramount to emphasize the importance of local governments in the preparedness, response, and recovery process (Col, 2007).

[13] Pictometry™ is a patented aerial image capture process that produces imagery showing the fronts and sides of buildings and locations on the ground. *www.youtube.com/user/Pictometry*

[14] Hurrevac™ is the primary decision support tool used by the National Hurricane Program, FEMA, USACE, and NOAA. www.hurrevac.com

With respect to the actual primary uses (if any) of each category of DSS, responses fell into 8 different groups. In sequential order, the most common uses were *response*, *communication*, and *recovery* at 24%, 20%, and 15%, respectively. Other significant uses were *planning* and *training/exercises* at 14% and 13%, respectively. Of the respondents that did not utilize any form of DSS, 75% said they could benefit from such a system, while 25% admitted that a DSS would not help support their decision making ability. Of the non-DSS users who said they would benefit from utilizing any sort of DSS, benefit would be derived in the following areas: *planning* (27%), *response* (23%), *recovery* (23%), and *training/exercises* (23%). Table 3 shows that the largest difference between actual DSS users and respondents that *said* they would use a DSS was *communication* and *planning*, with deltas of 16% and 13%, respectively.

Table 3. Primary Actual and Hypothetical Uses by DSS Category

	Emergency Management System [WebEOC, E-Team, CAMEO (MARPLOT, ALOHA), HURAVAC]	Geographic Information System (ArcGIS, Google Earth, Pictometry)	Information Sharing Network (HSIN, WISER, WHAM, Everbridge)	Database Management System (SQL Server)	No DSS Utilized	**Total # of Uses**	DSS User	Non-DSS User
Preparedness	1	1	0	0	0	**2**	3%	0%
Planning	5	6	0	0	7	**11**	14%	27%
Response	9	8	1	1	6	**19**	24%	23%
Recovery	6	6	0	0	6	**12**	15%	23%
Communication	6	6	3	1	1	**16**	20%	4%
Resource/Asset Tracking	5	2	0	0	0	**7**	9%	0%
Daily Operations	0	2	0	0	0	**2**	3%	0%
Training/Exercises	5	4	1	0	6	**10**	13%	23%
Potential Use					6	**6**		75%
No Potential Use					2	**2**		25%
Total Users/Tool Type	**37**	**35**	**5**	**2**	**26**	**79**	100%	200%

In order to further explore the question about the various uses of DSSs, the eight usage categories were consolidated into two main uses: *event-based* (preparedness, response, recovery, communication, resource/asset tracking) and *non-event-based* (planning, daily operations, and training/exercises). A chi-squared test was then conducted to test if DSS usage depends on main use type (Stangroom, 2014). It was determined that DSS usage is independent of main use type (event-based vs. non-event based), assuming a

5% significance level (*p=.0516*). Note, however, that DSS usage *would* depend on main use given a 10% significance level.

When addressing specific advantages of DSSs, responses were categorized into 7 sections. The largest advantages were *interface* (29%), *communication* (21%), and *common operating picture* (21%). Other responses included *everything* (13%), *single platform* (8%), and *resource/asset* tracking (8%). Out of the respondents that did not utilize a DSS, 60% were unsure what the specific advantage would be and 20% said they would find every aspect of a given DSS advantageous for their individual needs. Other responses from non-DSS users included *resource/asset tracking* (10%) and *communication* (10%) as seen in Table 4.

Table 4. Specific Actual and Hypothetical Advantages by DSS Category

	Emergency Management System [WebEOC, E-Team, CAMEO (MARPLOT, ALOHA), HURAVAC]	Geographic Information System (ArcGIS, Google Earth, Pictometry)	Information Sharing Network (HSIN, WISER, WHAM, Everbridge)	Database Management System (SQL Server)	No DSS Utilized	**Total # Advantages**	DSS User	Non-DSS User
Everything	2	1	0	0	2	**3**	13%	20%
Single Platform	1	1	0	0	0	**2**	8%	0%
Resource/Asset Tracking	2	0	0	0	1	**2**	8%	10%
Common Operating Picture	4	1	0	0	0	**5**	21%	0%
Interface	0	4	2	1	0	**7**	29%	0%
Communication	1	2	1	1	1	**5**	21%	10%
None/Not Many	2	2	1	0	6	**5**		60%
Total Users/Tool	**12**	**11**	**4**	**2**	**10**	**24**	100%	100%

One interesting observation is that given the open-ended nature of the questionnaire, non-DSS users weren't even aware of some of the potential advantages enjoyed by DSS users. Further, every DSS user listed some sort of advantage. No statistical tests were used here to further explore the question about specific advantages because categories were not able to be readily placed into more generalized bins.

For the specific disadvantages of DSSs, 10 unique categories were formed based on the responses. The responses highlight the fact that the primary cause of not using a computer-based DSS for decision making is due to seemingly obvious factor limitations such as *data requirements* (18%), *connectivity requirements* (13%), and *lack of resources/training* (13%). However, 15% of DSS users indicated that they saw no disadvantages in their respective DSS. Other negative aspects of users' DSSs included *not user-friendly* (10%), *requires multiple platforms* (8%), *rigid structure* (5%), and *financial* (3%). Of the respondents not using a DSS, *financial* accounted for 53% of the reason for not using a DSS, while *lack of resources/training/staff capability* composed 42% of the whole and *infeasible/impractical* constituted a mere 5%. As with the DSS advantages section, while most of the non-DSS users seemed to be aware of just two main disadvantages of having a DSS (likely due to the open-ended nature of the questionnaire), they grossly over reported these two categories compared to the actual DSS users (Table 5). In order to confirm this difference statistically, specific disadvantages were consolidated into *common disadvantages* (lack of resources/training, financial, infeasible/impractical) and *other disadvantages* (data requirements, requires multiple platforms, connectivity requirements, not user friendly, technology unreliable, rigid structure). A chi-squared test was then conducted to determine if DSS usage depends on disadvantage type (Stangroom, 2014). It was confirmed that DSS usage depends on main disadvantage type (common disadvantages vs. other disadvantages), assuming a 5% significance level ($p<.0001$). Simply stated, DSS users were familiar with more disadvantages, while non-users were not.

Table 5. Specific Actual and Hypothetical Disadvantages by DSS Category

	Emergency Management System [WebEOC, E-Team, CAMEO (MARPLOT, ALOHA), HURAVAC]	Geographic Information System (ArcGIS, Google Earth, Pictometry)	Information Sharing Network (HSIN, WISER, WHAM, Everbridge)	Database Management System (SQL Server)	No DSS Utilized	**Total # Disadvantages**	DSS User	Non-DSS User
Data Requirements	3	3	1	0	0	**7**	18%	0%
Requires Multiple Platforms	1	2	0	0	0	**3**	8%	0%
Connectivity Requirements	1	2	1	1	0	**5**	13%	0%
Lack of Resources/Training	2	3	0	0	8	**5**	13%	42%
Not User Friendly	3	1	0	0	0	**4**	10%	0%
Technology Unreliable	1	1	1	0	0	**3**	8%	0%
Rigid Structure	1	1	0	0	0	**2**	5%	0%
Financial	0	1	0	0	10	**1**	3%	53%
Infeasible/Impractical	0	2	1	1	1	**4**	10%	5%
None	3	2	1	0	0	**6**	15%	0%
Total Users/Tool	**15**	**18**	**5**	**2**	**19**	**40**	100%	100%

Based on the large difference between percentages of reported actual disadvantage reported by DSS users versus postulated disadvantage by non-DSS users, it is entirely plausible that the reason for not employing a DSS may lie in preconceived notions and overestimation of the negative aspects of what it takes to successfully employ a DSS to guide decision making.

Due to the extremely diverse background of each respondent and varying user needs, it was difficult to categorize the wide variety of possible improvements to the tool(s) used by each DSS user. While responses ranged from minute improvements to seemingly infeasible changes to an entire network, Table 6 shows several common responses.

Table 6. Desired Improvements to Current Decision Support System

DSS	Desired Improvement
WebEOC, ArcGIS	Create mobile apps
WebEOC	Continual updating of data
Google Earth, HSIN, SQL Server	Better internet connection
Google Earth, ArcGIS	More user friendly
ArcGIS, WebEOC	Improve network redundancy, better filtering of noise and unverified information, more commonality
ArcGIS	Ability to customize
ArcGIS, WebEOC	Integrate tools, make tools cheaper, easier to use
ArcGIS, Everbridge	Validate map information/data

Overall, it was observed that national-level decision makers utilized a wide variety of DSSs to support their decision making or used none at all. The open-ended design of the questionnaire led to a wide variety of answers and exploratory data analysis of these answers helped to provide answers to several interesting questions, including *"Does jurisdiction size effect DSS usage?" "What are the primary uses of DSSs?" "What are the advantages/disadvantages of DSSs?"* "*What are the possible improvements?"* Several conclusions were made based on the data and particular aspects of DSSs were identified that were critical to the decision making process. Based on these responses from users in the field, several suggestions are proposed (Chapter 5) that can be applied to MUNICIPAL in order to assure a smooth deployment process where the DSS can seamlessly transition from developer to end user.

3.3 Questions Regarding Infrastructure Interdependencies

One of the largest deficiencies in the HSIP Gold 2013 dataset, or any infrastructure dataset for that matter, is the lack of identified interdependencies among critical infrastructures. Because MUNICIPAL's main purpose is to focus on these interdependencies, it was prudent to develop a list of questions for Emergency Managers and other decision makers addressing these interdependencies as part of the model assessment. While it may be possible to develop a very effective DSS without the user having to know specific infrastructure interdependencies, these questions will ideally make decision makers more cognizant of the complex and often hidden relationships between infrastructure systems (W. Wallace, personal communication, July 18). From the model development standpoint, it was imperative to ensure that the model accurately depicted these multiple interdependencies as well as the geographic coordinates thereof. The formulation of these questions will help validate the mapping of interdependencies for any given model, not just MUNICIPAL. For the purposes of this research, only the 5 civil infrastructure types housed in MUNICIPAL, along with the other infrastructures dependent on them, were addressed. Aside from these 5 main civil infrastructures, 15 other infrastructure types from the HSIP Gold dataset were addressed and served as the basis for questioning their dependency on the initial 5 civil infrastructures. These five main civil infrastructures included Power, Water, Wastewater, Communications, and Transportation. For simplicity's sake, the assumption was used for the basis of these questions that the Power infrastructure was not dependent on any other infrastructure systems (W. Wallace, personal communication, July 18, 2014). While it may seem intuitive that the majority of these interdependency questions may be answered in the affirmative, the most important question is *where* specifically they are dependent on each of the above listed civil infrastructures. The entire list of questions can be seen in Appendix C, and would ideally serve best as an appendix to the MUNICIPAL user guide as a reminder to the user about the potential infrastructure interdependencies existing in their jurisdiction.

4. CASE STUDY

4.1 Description

Rensselaer Polytechnic Institute (RPI) has been working with New Hanover County Emergency Management (NHCEM) for several years during the development of MUNICIPAL and will continue to partner with them during the deployment of the DSS. It is for this reason that NHC was selected as the test case for research on assessment of user requirements for DSSs. Although NHCEM represents just a single agency within the nationwide emergency management community, its familiarity with MUNICIPAL gained through the existing working relationship provides it with a unique perspective to provide input regarding its utility to the EM community.

4.2 Background

During development of the DSS, the research team worked closely with the primary stakeholders of NHCEM in an effort to make the DSS as useful and relevant as possible. Close ties were maintained with key members of NHCEM and their direct input during development of the DSS was critical in establishing relationships and helping ensure NHCEM would get the most out of the DSS. One of the primary benefits of this close working relationship was that the research team was able to avoid any tensions inherent in a typical client-contractor relationship (Little, Loggins, & Wallace, 2014). This was due in part to the fact that the incentive structure for the researchers was aligned with the goals of NHCEM and typical hindrances to accomplishing R&D (excessive bureaucracy, funding, etc.) were avoided due to the academic nature of the research team.

4.3 Data summary

Aside from information gleaned from literature on disaster management and emergency response, the bulk of the data for this case study was obtained from the questionnaire and telephone calls with decision makers in the field and at NHCEM. Due to the nature of expert interviews and the format of the questionnaire, the data are almost

entirely qualitative. In addition, extensive notes were taken during the workshop, including questions and comments from the audience about the DSS. These specific notes will be detailed below in the results section.

4.4 Stakeholders

For the purposes of this research, a stakeholder will be defined as any individual, or any group, that could use MUNICIPAL to guide their decisions related to emergency management. Ultimately, it is necessary to identify and categorize each stakeholder because each will have different requirements and uses of the DSS. Also, it will benefit each stakeholder more if they are differentiated in the assessment by their differing needs.

4.4.1 Actual and Anticipated Stakeholders

The actual and anticipated stakeholders as they pertain to direct use of MUNICIPAL are discussed in this section. NHCEM, Onslow County, and the University of North Carolina at Wilmington are the three current and anticipated direct stakeholders. These organizations are named as primary stakeholders because at the April 2014 workshop, they expressed the most interest in learning MUNICIPAL and utilizing it for guiding decision making during an extreme storm event. Since RPI has been working with NHCEM from the beginning stages of development of MUNICIPAL, they will be the initial primary users once MUNICIPAL has been deployed via SUMMIT.

4.4.2 Potential Stakeholders

The foreseen potential stakeholders include the National Weather Service (NWS), the National Oceanic and Atmospheric Administration (NOAA), the Red Cross, and the Army Corps of Engineers. These four organizations attended the workshop in Wilmington and are categorized as potential stakeholders because they did not express the same level of interest in utilizing MUNICIPAL to guide their decision making. Aside from these four separate participants at the workshop, there are numerous potential state and local stakeholders as identified in the national-level questionnaire that could benefit from MUNICIPAL. Once MUNICIPAL is deployed within the SUMMIT framework, the list of stakeholders will be much larger since more emergency managers will have access to it.

4.5 Questionnaire

The questionnaire format was the primary data gathering vehicle for this research, completed in accordance with expert advice provided by Dr. William Wallace and Mr. Richard Little, of Rensselaer Polytechnic Institute. Typically, questionnaires are used to measure perceived usefulness and ease of use of DSSs (Papamichail & French, 2004). The objective of the questionnaire was to develop a fuller understanding of the advantages and disadvantages of each component of MUNICIPAL, as well as to gain a clearer understanding of the user requirements and daily roles of decision makers in the field. In order for the various national-level decision makers and professionals to rate several aspects of a DSS, open-ended questions were used in order to allow the respondents to expound on a simple yes or no answer. This questionnaire format was used in lieu of more rigid, online formats such as SurveyMonkey[15] because it was decided that a check-the-box questionnaire would introduce bias by leading the respondents to artificial conclusions. The questions actually used (seen in Appendix A) included specific queries about the various parts of the DSS (vulnerability simulator, GIS interface, etc.), as well as more general questions about the decision maker's job (*How are the impacts of extreme storm events on infrastructure considered in planning, preparedness, and recovery?*). Separate email questionnaires were distributed to attendees prior to and following the MUNICIPAL assessment workshop in April 2014, as well as national-level EM professionals.

The primary advantage of using email to distribute the questionnaires is that it can quickly reach a very wide audience and respondents have time to give thoughtful answers, to look up records, or consult with others (Fowler, 1988). The questionnaire aimed to measure the utility of the system to the users, to evaluate if the DSS satisfied the needs of various users, and to see if the results were commensurate with the results from the national-level questionnaire. Another goal of the questionnaire was to help the research team determine the extent of potential usefulness of the DSS to each of the stakeholders at the workshop and to gather individual feedback in hopes of improving MUNICIPAL so that it can provide consistent, reliable support in their decision making activities.

[15] SurveyMonkey is an online questionnaire development company providing free, customizable surveys.

The feedback from this questionnaire can be used to make adjustments to MUNICIPAL so that it can better serve the user, as well as function as a benchmark for other DSSs in different realms of disaster management and modeling. Continual review, assessment, and adjustment is imperative for advancement of the state of the art of decision support systems and their ability to contribute valuable information in the planning, mitigation, response, and recovery to natural disasters.

4.6 Expert Interviews

The secondary method for gathering input on what decision makers require in a DSS was expert interviews, conducted via telephone, with representatives of NHCEM and other organizations in attendance of the MUNICIPAL assessment workshop held in April 2014. Results from the NHCEM workshop interviews were also compared with results from the national-level questionnaire to see if MUNICIPAL fits user needs as understood by feedback from national-level emergency managers. One of the primary benefits of telephone interviews is that they generally elicit a higher response rate than mail or other procedures (Fowler, 1988). A limitation of this method includes the potential for the respondent to make hurried statements in the interest of time. Nevertheless, such empirical methods help to measure the actual and hypothetical performance of a DSS and its users. These expert interviews helped the research team to understand the extent to which Emergency Managers and other decision makers could potentially make significantly better and faster decisions (the two are not mutually exclusive) with the use of MUNICIPAL.

4.7 Dimensions of assessment

After an involved discussion with the Director of NHCEM and his deputy, Mr. Steven Still, it was determined that the assessment would be most useful if MUNICIPAL was evaluated along the dimensions of planning, training, and an actual event (S. Still, personal communication, May 20, 2014). By doing so, the utility of the DSS was able to be broken down into separate categories and it was easier to understand where the DSS was sufficient and where it needed improvement. The above listed dimensions of disaster management at

NHCEM were also chosen because they constitute the entirety of the 5 phases of disaster management for the purposes of DSS-based decision making.

4.7.1 Planning

Planning encompasses any and all activities involved in preparing for the training events which are conducted several times a year. There are typically 4 planning meetings prior to the training events (S. Still, personal communication, May 20, 2014). While assessment of the DSS for its use in the planning stage will be useful, we hypothesize that the most useful assessment will stem from those activities involved in the training stage. This is due, in part, to the fact that the DSS will not be used as much in this stage compared to the training stage. It is possible, however, for the DSS to be used to determine some part of the logistics and information to be used in the training events.

4.7.2 Training

Training involves exercises in preparation for real-life events, where the Emergency Operations Center (EOC) is activated and various personnel from across the county participate in simulated scenarios. We foresee the bulk of the assessment to be derived from the training exercises because they closely resemble an actual event without having the added stress involved therewith. The downside to this approach is that it may not be entirely realistic and may yield excessively favorable or unfavorable results.

4.7.3 Actual Event

Due to the sporadic and untimely nature of hurricanes and other actual events for which the EOC is activated, it will be difficult to conduct an assessment of the DSS in real-time. If the opportunity arises, however, it is entirely plausible to retrospectively assess the DSS by working with the decision makers at NHCEM. While an actual event would render the most useful assessment, the downside of this approach is that it may be difficult for the users of the DSS to remember the specific decisions they made and why they made them (Ben-Zvi, 2012).

4.8 Analysis of results

4.8.1 Conclusions from Results

This section will provide a listing of the significant results from the workshop held in April 2014 in Wilmington, NC, along with an analysis of the pros and cons of MUNICIPAL as understood by the demonstration to potential users. In addition, an overview of the responses to the questionnaire and phone interviews will be given. Because the majority of the audience at the workshop was not intimately familiar with MUNICIPAL, most of the questions were simply asked in the interest of trying to understand the DSS. Regardless, these simple questions, and the answers thereto, will still be provided in helping the reader gain a fuller understanding of MUNICIPAL. First, a member of the National Weather Service (NWS) asked, "Is there any interface between the existing tools?" The answer, of course, is SUMMIT. SUMMIT is a framework for housing multiple DSSs for ease of use. Another Emergency Manager from Onslow County asked, "How is damage assigned to infrastructure?" In short, HAZUS-MH® was used as a foundation for assigning various probabilistic damage functions to each building type. In order for MUNICIPAL's vulnerability simulator to be able to use these functions, they must be fitted to a known probability distribution, which in this case was the lognormal distribution (Loggins, Wallace, & Cavdaroglu, 2013).

Further questions included several more from Onslow County emergency managers, such as "What do you see as the problems of keeping your data up to date?" While the proverbial data question is one that is not easy to answer, a feasible response is to eventually incorporate the HSIP Gold dataset into MUNICIPAL since it is updated on a yearly basis. However, as with the NHC dataset, infrastructure interdependencies would have to be found manually by visual observation and other means. Another consideration is the additional level of security associated with HSIP Gold data. As long as the requester has the appropriate credentials for obtaining the data (i.e. has a supporting federal sponsor, etc.) then security would be no issue. Another decision maker commented, "It would be a good idea to have input directly from the utility company regarding damage. It would be useful to be able to pool maps and collect data from multiple utility companies." In response to this,

one of the primary benefits of the damage assessment model is that it can be manually updated given new information from utility companies or other sources. For example, if the DSS shows a given arc as damaged when in fact the organization in charge of that arc attests that it is not, the DSS output can be adjusted based on the new information.

Other suggestions for improvement were from NHCEM's Director, Warren Lee. "It would be nice to have a spreadsheet that does a side-by-side comparison of what the group says and what the algorithm computes because all people are making decisions independently." During the restoration activity (described later in this section), the audience was asked which damaged arcs they would prioritize during the restoration phase given specific resource requirements. These results were then compared to the output of MUNICIPAL's restoration solver and the results were almost exactly the same. While MUNICIPAL currently does not include a built-in method for capturing the un-aided decisions in parallel with MUNICIPAL's restoration plan, it would not be difficult to maintain a simple spreadsheet comparing unaided decisions to MUNICIPAL's restoration plan.

Regarding the outage model, it was noted by a decision maker from Onslow County that the model would be "…most powerful in the incipient phases of a disaster when estimating the damage. Usually when repairing damage, trucks are just sent out in a helter-skelter fashion." While this response is a good start, MUNICIPAL would ideally be used not just for the incipient phases of a disaster, but during every stage (planning, training, response, and recovery).

The initial test conducted during the demonstration was the panel-based evaluation of MUNICPAL's restoration solver. When shown a specific portion of the simulated outage map displayed by MUNICIPAL, the audience was asked to make decisions about which damaged arcs they would hypothetically repair first in order to restore service to an arbitrary critical facility. Each arc was assigned a value based on the time and resources requirements (work crews) it would take to be repaired. Once a restoration plan had been developed and agreed upon by the audience, MUNICIPAL's restoration solver was run for the entire artificial community and the results for the given critical facility were mostly commensurate with the unanimous decision from the audience. The idea behind this

exercise was to emphasize the speed and efficiency with which MUNICIPAL can help guide decision making without the EM's having to meticulously and painstakingly choose a restoration plan manually (Loggins, Wallace, & Cavdaroglu, 2013). Steven Still of NHCEM states, in regard to MUNICIPAL's restoration solver, "We can make operational decisions and would have a better idea of what we're looking at, the type of resources we will need, and what we will need to start ramping up." It was also noted by several members of the audience that the ability to manually change the damage map based on updated real-time information was a huge advantage of MUNICIPAL. Figures 1 and 2 below depict the damage and restoration maps generated by MUNICPAL (Loggins, Wallace, & Cavdaroglu, 2013). In the legend, F represents *Functioning* infrastructure, whereas NF represents *Nonfunctioning* infrastructure.

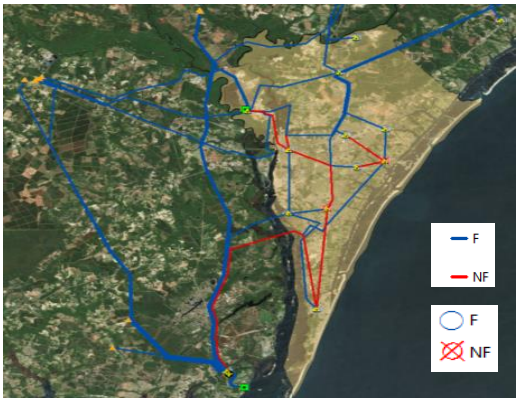

Figure 1. Power Infrastructure Damage

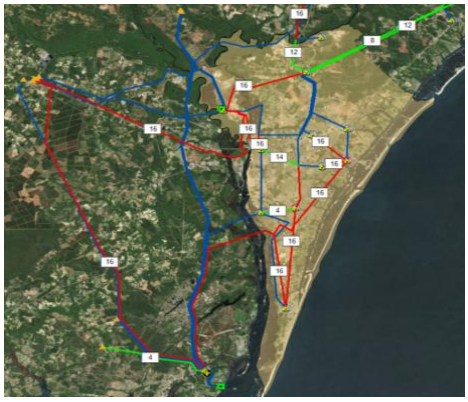

Figure 2. Power Infrastructure Restoration

Based on the demonstration, the various features of MUNICIPAL (vulnerability simulator, GIS interface, etc.) would be extremely useful to infrastructure service providers and emergency managers. Mr. Still states that "MUNICIPAL would be of great value to emergency managers, especially when looking at ice storms and during hurricane exercises. Using MUNICIPAL, we could anticipate the number of [repair] crews, especially with the GIS interface. [MUNICIPAL] would mainly be used for training purposes" (S. Still, personal communication, May 20, 2014).

While going through the section regarding integration into SUMMIT, a concern was raised about redundancy. A member of the NWS asked, "In emergency situations, is there

redundancy built into SUMMIT?" As SUMMIT is moved from exercise support to planning and response, more redundancy functions will be worked in. There are a number of requirements and capabilities on the developer's R&D strategy, which will be implemented over the course of the next 12-15 months (N. Teclemariam, personal communication, July 24,2014).

The final section presented was a review of the HSIP Gold 2013 dataset and the potential for its incorporation into MUNICIPAL. One concern raised by the University of North Carolina Wilmington's (UNCW) Mr. Stan Harts was, "How do you prevent unauthorized disclosure of sensitive information about vulnerabilities?" Due to the somewhat proprietary nature of this dataset (Unclassified, Official Use Only), users would be required to gain access from a federal sponsor to help ensure unauthorized disclosure does not happen (Homeland Infrastructure Foundation-Level Data Working Group, 2013).

Extraneous comments regarding the DSS also tended to come from audience members unfamiliar with MUNICIPAL or the research team's future intentions of integrating the tool into SUMMIT. Mr. Harts commented, "How would distribution of MUNICIPAL work? Have you thought about integrating these features into a local web-based service? If integration is possible for multiple models, there's only going to be a few people who can run it." Plans for integration into SUMMIT will effectively address all of these questions and comments. Ideally the user interface would allow any given decision maker to be able to use it with minimal training. Harts went on to say,

> "It would be beneficial to have a state and local centralized location where you can consume the results. People want information on a more basic level. If you coupled damage with anticipated resources, from an exercise point of view, it would allow you to create scenarios to [estimate] when [a given infrastructure system] could be back online. It could be used extensively for advance planning (i.e. ice storms and hardening of resources). It appears [MUNICIPAL's] biggest value is in preplanning, where it can confirm vulnerabilities that you did or didn't know about and to check expectations. Anything that we can do to regionalize this effort will help, and to bring

expertise into a small group that can serve a larger audience will help with mitigation and hazard analysis" (S. Harts, personal communication, April 28,2014).

While the April 22nd workshop in Wilmington proved to be a success for MUNICIPAL and the research team, a formidable amount of work remains to be competed. There is still plenty of room for improvement, and it is crucial to remain objective and not get caught up in *groupthink* – the tendency to believe that a DSS is completely adequate simply due to the fact that the feedback was almost entirely positive. This is not to say, however, that the assessment of MUNICIPAL did not yield very favorable results and feedback from the people that will ultimately use it in the field during planning, preparedness, response, and recovery from extreme events.

4.8.2 Verification and Validation

In this section, an overview of the analysis of the technical verification and objective validation performed by Loggins et al (2013) will be given, as well as a review of prior work conducted in New Hanover County, North Carolina. It is crucial that the user is very familiar with the various components of the DSS; in particular, the user interface and the data requirements. Furthermore, the user should also be familiar with the model component insofar as the output makes sense given the input. As stated previously, throughout the development of the tool, the research team maintained close communication with the decision makers of NHCEM, helping provide valuable input during construction of the model to help assure that the assumptions and logic behind the model were sound (Little, Loggins, & Wallace, 2014). The development of a close relationship with NHCEM was crucial to obtain unbiased and constructive critiques of MUNICIPAL for NHCEM's decision making activities.

The most critical factor to address during the development and validation of the DSS was to assure that it accounted for the highly complex nature of the five primary civil infrastructures considered by the model and the interdependencies between them. Recognition of these complexities was a major focus point during the stakeholder involvement process (Little, Loggins, & Wallace, 2014). MUNICIPAL addresses these

interdependencies by proposing a rapid, optimal restoration plan for critical facilities (i.e. optimal from the standpoint of all critical facilities), not just one particular infrastructure system. The team confirmed the importance of a universal optimal restoration plan during continual reviews with NHCEM. The largest benefit of this facet of MUNICIPAL is that it can help prove to independent infrastructure operators that cooperation among independent decision makers can lead to higher overall community resilience (Little, Loggins, & Wallace, 2014).

Validation of the data mapping was another crucial step completed previously by the research team in assuring that the model reflected reality to the highest degree possible. Since HSIP data were not available during the development of the prototype model, the dataset created during this phase was mostly complete but the granularity was somewhat lacking. As an example, locations and capacities of power transmission lines were based on actual observation in the field, whereas data on the distribution system were estimated (Little, Loggins, & Wallace, 2014). While these estimations were validated to some extent by the organizations responsible for them, accuracy could not be absolutely guaranteed. Further assumptions were made regarding the interdependencies between infrastructure systems because the data did not explicitly show them. It was the initial hope of the research team that the addition of the HSIP data to the model would solve this interdependency problem, but ultimately while HSIP did exhibit a very fine level of granularity, it also failed to show interdependencies. As with the initial data, discovering interdependencies within the HSIP data would require working with service providers, public safety officials, and emergency management officials.

4.8.3 Challenges in Assessment

There were and will continue to be a multitude of challenges in fine-tuning MUNICIPAL and deploying it within the SUMMIT framework, including the challenges encountered in the review and demonstration of the DSS at the workshop and other current challenges in getting the product to the end user.

The greatest challenge in assessing the actual and perceived utility of MUNICIPAL from the user's viewpoint lies in the assumption that they fully understand the components

and capabilities of a DSS. It is difficult to ascertain the user's true understanding of the DSS from just a simple demonstration, especially when the research team is running the DSS. In order to gain a better assessment of the DSS, the user must fully understand the input and output of the interface and the data requirements. Furthermore, they must be familiar with the model component of the DSS to the extent that given an input, the output makes sense. A feasible direction for future research would be to attain an empirical assessment once the user has been fully exposed to the DSS during training, planning, or an actual event. This would ensure user familiarity with the DSS and help provide more accurate results.

Another challenge in assessing the perceived utility of the DSS lies in the disparate nature of the national, regional, and local stakeholder groups that will ultimately use MUNICIPAL. Even if such groups are not disjoint, goal incongruity between these groups is a foreseeable challenge when dealing with organizations having separate initiatives and incentives (Scholand, Linebarger, & Ehlen, 2005). This difference in goals can often lead to a lack of cooperation during the restoration phase of emergency management, when complete cooperation is of paramount importance (Comfort, 2002). Because many infrastructure systems are privately owned and not subject to government regulation, information sharing and other joint cooperation is not regulated by government mandate. Moreover, noncooperation between managers of infrastructure systems remains a formidable obstacle for the assessment of DSSs used in the restoration of critical services and recovery from extreme events.

Yet another significant and wholly plausible challenge was the potential for the workshop attendees to tell the research team what they wanted to hear instead of being constructively critical. One of the problems with focus groups or workshops is the potential for *groupthink* (Hagglund, 2009). The vast majority of the feedback gleaned from the workshop in Wilmington was very positive. This may be a result of a very successful developer/user relationship, or it could be that the users didn't want to stand out by offering constructive criticism or other non-positive feedback. The issue of *groupthink* was partially addressed by having other disparate EMs lend their opinions via the national-level questionnaire.

A final challenge is that of delivering the DSS to the user on time and within budget. Scarcity of government funding, especially in the realm of the Department of Homeland Security's (DHS) Office of University Programs, poses a very real challenge. This is especially true when working with highly skilled and not inexpensive technical labor (i.e. Sandia National Laboratories and independent contractors). Further, the deployment and maintenance of the DSS must be cost effective; for example, some of the biggest costs involve training of eventual users (via the user guide or otherwise) and acquiring the data. If training costs or data acquisition costs exceed the potential benefit derived from using the DSS, it will be cost prohibitive. One aspect that minimizes the training costs is the fact that the user does not necessarily need to know the math or logic in the model component of the DSS, which will help reduce the cost of training. However, the organization and individual user must know their data needs and the requirements for the DSS to run effectively. One of the largest maintenance aspects of any DSS lies in the data requirements, where keeping the data inputs current and updated is essential to the utility of the DSS. Lastly, security concerns are a potential hindrance to deployment of the DSS. Working with governmental organizations operating on secure servers poses access issues, especially to those without the proper clearance level. In order to successfully deploy MUNICIPAL, developers and users alike will need some level of access to DHS' SUMMIT server.

5. PROPOSED CONSIDERATIONS FOR THE DEPLOYMENT OF MUNICIPAL

Based on the assessment of user needs from the national-level questionnaire, we suggest an iterative approach to assess and modify MUNICIPAL so that it can deliver the utmost utility once deployed via SUMMIT. Several things must be completed before MUNICIPAL can effectively meet a variety of unique user requirements. These suggestions include: First, further development of the user manual must be undertaken so that decision makers (or a single decision maker, in the case of a small town) in the field who are unfamiliar with decision support systems can readily adopt and use the technology; second, data requirements must continue to be addressed (including the potential for incorporation

of the HSIP Gold Dataset and the identification of infrastructure interdependencies therein); third, MUNICIPAL must remain available not only in an on-line format in SUMMIT, but also as a self-contained off-line package that can operate in the absence of broadband or Wi-Fi connectivity; fourth, users must be made aware that such a capability exists in MUNICIPAL at virtually no financial cost to their organization; and lastly, MUNICIPAL must be guaranteed to function properly not only for planning and training purposes, but during an actual event. Activities such as development of the user manual must be undertaken with a high degree of user involvement in order to assure the instructions are clear, succinct, and generally easy to follow.

In order for MUNICIPAL to be useful to emergency managers and other decision makers, it needs to be integrated into the SUMMIT framework in order to be readily accessible to the users that need it most. This section will discuss the political and technical implications of what it will take to fully integrate MUNICIPAL into the existing framework and deploy it to the end user.

5.1 Political aspects

Political aspects of integrating MUNICIPAL into SUMMIT include several challenges and potential ramifications. Because this research involves multiple large entities, governmental and otherwise, there are inherent challenges involved in navigating the various layers of bureaucracy at the county, state, and local levels. Several organizations have already interfaced with SUMMIT to integrate their DSSs into the framework, including DSSs housed within Sandia National Laboratories' NISAC. The major difference between RPI's MUNICIPAL and the DSSs housed within NISAC is the proprietary nature of the NISAC modeling environment. Because of such, NISAC completed the integration wholly in-house because they did not want to reveal the sensitivity of their model components to anyone outside Sandia (A. Kelic, personal communication, June 17, 2014). With MUNICIPAL, however, the intent of the DSS is to completely deploy the tool to the end-user and not to maintain any part of it locally. With a DSS designed as a good and deployed to the user, considerations include the proprietary nature of the software as well as the security of the

data. For example, MUNICIPAL requires proprietary software and a user can only currently access the artificial dataset, CLARC County.

5.2 Technical aspects

This section will discuss the technical details and requirements of the integration of MUNICIPAL into the SUMMIT framework. Previous steps as well as future steps will be detailed, along with suggestions for improvements.

5.2.1 Developer

Aspects of integration from the point of view of the developer or programmer will likely be more technical in nature than those aspects from the point of view of the end user because they will entail more aspects of how the DSS is built and how it works. The ultimate goals for integration of the DSS into the existing framework, as taken directly from the MUNICIPAL-SUMMIT Integration Proposal (Uffer, 2013), are as follows:

1. Extend the MUNICIPAL effort to interoperate with the other models and datasets through integration with SUMMIT
2. Create an abstraction of the MUNICIPAL models so they can be used for modeling the effects and remediation efforts that are part of other similar natural disasters.
3. Provide a query able database of infrastructure components and their attributes for various localities.
4. Create a system which can be used by Emergency Response Agencies in planning and training.

5.2.2 End User

This section will discuss the aspects of integration from the point of view of the end user. These aspects will likely be less technical in nature than those aspects from the point of view of the developer, as they will entail more aspects of application and less of theoretical details. One of the main integration activities will be development of on-line documentation (user guide) describing the use MUNICIPAL as part of the SUMMIT

framework. This documentation will describe exactly how the tool can and will be used for training and exercise purposes with the datasets that already exist inside the model (NHC and CLARC county). This user guide will give each potential user the necessary information to access and effectively use MUNICIPAL (Loggins R. , 2013).

While there are several action items that must be completed before the successful deployment of MUNICIPAL, the DSS already has many of the desired features listed in Table 6. One of these features was to have a better internet connection, but this is irrelevant because there is a version of MUNICIPAL that can be run locally without an internet connection. Further, internet connection depends on the local broadband network, not the DSS itself. Another desired feature was for a DSS to be user friendly and customizable. Based on feedback from the workshop and questionnaires, MUNICIPAL was rated as very user friendly and customizable. Further, it satiates another desired improvement in that it will be integrated into SUMMIT to more readily reach a wider array of users. Lastly, MUNICIPAL satisfies another desired improvement based on the user survey, validation of map information and data. During development of MUNICIPAL, these aspects were validated with NHCEM.

Many of the proposed improvements listed previously in Table 6 will continue to be issues not specific to MUNICIPAL, but to DSSs in general. For example, data will likely continue to be a concern in every DSS because the model component of a DSS can only be as accurate as the data it is based on. However, this paper presents the potential for incorporation of the HSIP dataset into a DSS, and since this dataset is revised yearly, it is a feasible solution for this concern. Another possible area of improvement would be to create a mobile app for MUNICIPAL for better portability in disaster areas. Ultimately, while there is potential for marginal improvements to MUNICIPAL, the DSS satisfies user concerns and suggestions for improvement.

6. PROPOSED METHODOLOGY FOR ASSESSING DSSs TO BE DEPLOYED AS GOODS

1. Develop pre-workshop questionnaire

The questionnaire should be aimed at gauging the usage of DSSs by various decision makers that will attend a demonstration workshop. An overview of the DSS under examination should be given by providing a link to a video in the questionnaire, or providing a description as an attachment. Pre-workshop questions should include general queries about the specific functions of the emergency manager's job as well as several questions about how the DSS pertains to these functions. The reason behind this is to make sure the respondent has, at a minimum, a basic understanding of the DSS before attending a workshop. After finalizing these questions, they should be submitted to an Institutional Review Board to assure they conform to requirements regarding research dealing with human subjects.

2. Develop program for workshop

The program or agenda should include a detailed breakdown of the entire workshop during which the DSS will be demonstrated. Critical parts of the agenda include an overview of the research, an overview of the software, an interactive demonstration, and a high-level explanation of each of the components of the DSS. At the end of the workshop, key points should be reviewed and logistics for actually deploying the DSS should be explained. Further topics that can be explored include data requirements and how the audience currently uses DSSs. Most importantly, there must be room in the agenda to pause after any given section to assess specific components of the DSS (i.e. interface, data, model). Furthermore, it is a requirement that specific dimensions of assessment be developed in order to maintain a cohesive, uniform perspective on the goals of the assessment.

3. Hold DSS demonstration workshop

The workshop should be held at a time and date mutually convenient for all attendees. The list of attendees should be picked by the lead emergency managers who are familiar with relevant stakeholders in the region and personnel that will benefit most from the workshop. In addition, a sign-in sheet should be available to record attendee contact information in case follow-up questions are necessary. During demonstration of the DSS, the questions and comments by the audience should be recorded with audio and manual recording. Contributors of these questions and comments should also be identified. As each of the three main components of the DSS is explained (i.e. user interface, database, and model), the dimensions of assessment should continually be voiced to the audience so they can think in those terms as they evaluate the potential utility of the DSS.

4. Develop post-workshop questionnaire/conduct follow-up interviews

Once the workshop has been conducted and the DSS demonstrated to users, a list of questions should be developed specifically related to the DSS in order to ascertain specific user feedback such as realism of scenarios, ability of the DSS to support decision making prior to and following an extreme event, ability of the staff to operate the DSS, suggested changes to the DSS, and what additions and changes would make the user more confident in basing their decisions on the DSS. The research team should be ready to conduct telephone interviews with specific individuals as a contingency in case the response rate from the questionnaire is insufficient. These interviews should also be based on the questionnaire in order to maintain continuity among responses.

5. Develop national-level questionnaire

After the workshop is held, a generic DSS questionnaire should be developed for a national-level audience. This is necessary to obtain a more general consensus from a broader range of emergency managers. Email addresses from various emergency managers and other decision makers can be obtained from state EOC websites. Potential respondents should be chosen from as many states as possible in order to provide a truly representative

look at the actual use and user preferences of DSSs in the field of emergency management. This questionnaire should include questions about whether a respondent uses a DSS, what type of DSS they utilize, what specific purpose(s) they use it for, advantages and disadvantages of the tool, and potential improvements to the tool. There should also be questions for respondents that do not employ a DSS, such as the potential for a DSS to help improve the speed and efficiency of decision making, specific components that would be helpful in a DSS, hypothetical uses, and reasons for not utilizing a DSS. Since respondents are not likely to be familiar with the project, it is helpful to introduce the research team and the objectives of the research. Furthermore, individually addressing each potential respondent by name in the email, while tedious, can help to improve response rates to the questionnaire.

6. Determine requirements for implementation of the DSS

Based on the workshop for the specific DSS and the responses from the generic DSS national-level questionnaire, suggestions and user requirements for deployment can be developed. Information from the national-level questionnaire should be contrasted against the DSS of interest in order to understand advantages, deficiencies, and potential improvements to the current system. Necessary considerations should include data sources (with locations of infrastructure interdependencies), user interface (including development of a straightforward user guide), and requirements for housing and access to the DSS (where the DSS will eventually reside and the appropriate security level for access to it). After applying the results from the workshop and the national-level questionnaire to the specific DSS, recommendations can be made to appropriately adjust the DSS so that it better fits user needs.

7. SUMMARY AND CONCLUSION

7.1 Future work

There are many potential research directions for MUNICIPAL once deployed, but the largest opportunity appears to exist in simply informing the various local emergency response communities about MUNICIPAL. Many of the local emergency managers polled in the national-level questionnaire did not use any sort of DSS, and most of the time the reasoning was due to lack of knowledge about DSSs or misconceptions about the cost or ease of operation. If a simple demonstration about MUNICIPAL could be conducted for each local emergency management agency that does not employ a DSS (this would obviously be impractical), negative perceptions about using DSSs would likely be changed. Another area for further development of MUNICIPAL would be the creation of a mobile app for use in field. This would increase the ability for users to readily make decisions on the fly without having to confer with the state or even local EOC. Furthermore, the generalized methodology suggested in this effort remains to be tested for a separate DSS in order to demonstrate reproducible results. One additional step in the validation effort of MUNICIPAL is to conduct a thorough assessment once it is successfully deployed within the SUMMIT framework to ensure the DSS continues to fit user needs once in use. Empirical and subjective methods similar to the ones employed in this effort can be used to assess MUNICIPAL once deployed.

7.2 Conclusion

The research objectives of this effort were addressed, in part, by surveying the emergency management personnel to determine the actual and potential use of DSSs employed in the mitigation, planning, preparedness, response, and recovery stages of emergency management. Several conclusions were drawn from the results of the national-level questionnaire, including type and number of DSSs used to guide decision making, DSS use by jurisdiction size, primary actual and hypothetical uses, advantages, and disadvantages for users and non-users alike, and areas for possible improvements. MUNICIPAL was demonstrated to several potential user groups at the stakeholder workshop

in Wilmington, NC, in order to ascertain opinions and feedback on the DSS. Research objectives were additionally met by comparing and contrasting the results of the national-level questionnaire against MUNICIPAL in order to develop a list of necessary considerations for the successful deployment of MUNICIPAL to the end user so that it is used effectively for training, planning, or decision support during an actual event.

The above listed research objectives and the results thereof are important to the field of disaster management because they will help align future development of DSSs with actual user requirements. A DSS that is mismatched with user needs can lead to poor decision making, and is entirely too prevalent in today's decision making environment of emergency management. This research strives to improve decision making by creating a framework for assessment of any given DSS by understanding the empirical use and preferences of DSSs by emergency managers and other individuals serving in a decision making capacity.

Once MUNICIPAL has been fully integrated into the SUMMIT framework, it will be able to be used in tandem with a wide array of different models, data sources, and users with differing goals. Once deployed, users will be able to modify MUNICIPAL depending on their own specific needs (Little, Loggins, & Wallace, 2014). While integration into SUMMIT technically constitutes the last step in the development process, it is just the beginning for users that will enjoy its full utility in helping to support decision making at the county, state, and local levels. While development of MUNICIPAL was undertaken with a high degree of stakeholder involvement, the independent assessment of DSS use and the considerations developed in this study can help to further supplement the final stages of integration into SUMMIT by highlighting strengths, deficiencies, and potential opportunities for improvement and eventual use. Furthermore, development of a generalizable methodology for assessing DSSs proposed in this study can help others assess and successfully implement other DSSs used in the field of emergency management. Results from this specific assessment, however, show that MUNICIPAL already contains a large majority of user requirements and has the potential to demonstrate a high degree of utility for a myriad of purposes in the field.

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APPENDIX A: Questionnaire Data for NHCEM Workshop April 22, 2014

This questionnaire involves research with the purpose of helping us better understand the degree of potential usefulness of the decision support tool (MUNICIPAL) as it might apply to each of your positions in the emergency response community. This questionnaire is completely voluntary and should take about 30 minutes to complete. Refusal to participate will involve no penalty or loss of benefits to which you may be entitled as a result of this research. We want to help make the best use of your time at the April 22nd workshop in Wilmington, North Carolina, and gather your individual feedback in hopes that we can improve MUNICIPAL so that it can provide consistent, reliable support in your decision-making activities. Your answers to these questions will be kept confidential, and should you choose to revise any of your answers, you may do so at any time by notifying the primary contact listed below. Should you have questions regarding this research, please contact Trevor Manzanares (505-991-0548 or manzat@rpi.edu) or Dr. William Wallace at wallaw@rpi.edu). If you have any questions about your rights as a research participant, please contact Rensselaer's IRB Chair (518-276-4863; IRB@rpi.edu).**The following questions can be answered after viewing the video on** MUNICIPAL.

1.) How might the various features of MUNICIPAL (vulnerability simulator, GIS interface, etc.) be of value to infrastructure service providers and emergency managers?

In mitigation planning and preplanning (scenario). If someone wants to take a look at hazards and vulnerabilities, what can we do about addressing certain isolated groups of folks. Can be more useful as preplanning than as response.

2.) How do you consider the potential vulnerability of critical infrastructure components in your planning and preparedness operations? (ie. How is potential vulnerability considered in the siting and design of infrastructure components and preparing for and recovering from extreme storm events?)

They look at critical facilities ahead of time and identify potential hazards, will take down information and run different scenarios. Knowing how vulnerable a critical facility is

important and being able to weight that hazard (and to whom ie retirement homes, hospitals, pump stations).

3.) How are the impacts of extreme storm events on infrastructure considered in planning, preparedness, and recovery?

See above.

4.) How often, per year, do you conduct exercises of any sort regarding extreme storm events, as they directly affect your operations? Do other non-operational personnel participate in these exercises? (planners, elected officials, etc.)

1 or 2 times a year, different EM planning events. One nuclear and one hurricane. Elected officials, planners, local municipalities, EM agencies, civil groups (Red Cross), corps of engineers.

5.) What would you estimate as the annual time and resources expended in conducting various types of preparedness, response, and recovery exercises?

Can't say.

6.) How do these exercises contribute toward ensuring the continuity or restoration of services following an extreme storm event?

They expose potential risk and other issues to different agencies. Progress Energy, At&T are present, sheriffs dept, fire dept. Depending on how well exercise is run, agencies get familiar with responsibilities. Contribute toward faster response. Depending on who organizes event, and what scenarios are presented, gives us an opportunity to understand if information is in order and who to contact. With exercises like this over time, response is strengthened.

7.) Are there communication protocols/agreements with other agencies that you activate when an extreme event occurs? If yes, with which agencies? If not, is it because of the following? (Check all that apply).

- Liability concerns____
- Proprietary information____
- Other_____

Cooperative agreements between power agencies, all telecom agencies are actively participating and sharing information. AT&T would be able to bring mobile equipment in and they would be able to set up communications readily. Verizon and AT&T are only two com providers in county. Hasn't seen many barriers to communication between agencies. County doesn't have telecom network. County has radio, cellular, internet capabilities, most of which is exposed during storm that would be first to come down.
Water authority has folks in county office, so there are no issues with communication there.

Questions for Participants after the workshop:

1.) Does MUNICIPAL develop and portray realistic scenarios of damage and recovery? Were you satisfied with the user interface?

Power company has own Emergency response center. NHC doesn't have a lot of information on damage to infrastructure. Not shared with NHC. NHC only reports outages to an area/region. Can model run on other GIS platforms? Most counties will have ESRI products.

2.) How could MUNICIPAL support your decision making prior to and following an extreme storm event? What about for training purposes?

Answered before.

3.) Could MUNICIPAL be effectively utilized by your existing staff or would it require a specially trained individual to operate the system?

Most folks in NHC are very well versed in GIS. But model would need to be run by a specifically trained individual, someone comfortable with interface and idea of model. A lot of folks are still operating from a three ring binder for extreme storm events. Much of emergency planning is done ahead of time wrt analysis and model results. Still going to need techie to perform analysis and results are what are important to EMs. Don't see them using this tool in real time. During a real event, folks familiar with GIS and modeling were brought in, live webmap was made available that selected events both inside EOC and to the public, geolocated and attributed. Ended up having to hunt for events. Tried to create interest in webmap, wasn't successful.
Existing staff might like to have the tool but would likely not use it. Would call in a trained person to operate the system, but folks would not be going to this person asking questions. EOC too busy responding to small crisis, not available to use model.

4.) What specific changes would you make to MUNICIPAL to improve its usefulness to your specific responsibilities?

We should think about centralizing model, rather than locally running it. Create operations or analysis center, a better model would be to create a regional or statewide dataset, standardize it, update it, and run the model as hurricane approaches, have information and results available for operations centers to consume. If we had a website of results of analysis (forecast windfield, areas more vulnerable). Build a standard dataset and standard product. Convince state to create server and database. Train small group of people and it would serve whole state. Learn model and make accurate analysis, validate results by comparing results to actual storm event. Create toolkit. While some counties might have excellent EM team, others might need serious help. If state can step in a create standard products, and counties could contribute to dataset.

This questionnaire involves research with the purpose of helping us better understand the degree of potential usefulness of the decision support tool (MUNICIPAL) as it might apply to each of your positions in the emergency response community. This questionnaire is completely voluntary and should take about 30 minutes to complete. Refusal to participate will involve no penalty or loss of benefits to which you may be entitled as a result of this research. We want to help make the best use of your time at the April 22nd workshop in Wilmington, North Carolina, and gather your individual feedback in hopes that we can improve MUNICIPAL so that it can provide consistent, reliable support in your decision-making activities. Your answers to these questions will be kept confidential, and should you choose to revise any of your answers, you may do so at any time by notifying the primary contact listed below. Should you have questions regarding this research, please contact Trevor Manzanares (505-991-0548 or manzat@rpi.edu) or Dr. William Wallace at wallaw@rpi.edu). If you have any questions about your rights as a research participant, please contact Rensselaer's IRB Chair (518-276-4863; IRB@rpi.edu).**The following questions can be answered after viewing the video on** MUNICIPAL.

1.) How might the various features of MUNICIPAL (vulnerability simulator, GIS interface, etc.) be of value to infrastructure service providers and emergency managers?

Runs the EM program at the university. On ops side of university, EM works with Stan. The generation of exercises, the what-if scenarios are the most useful. Different levels of storms is best feature. Allows for preplanning regarding restoration.
Internal utilities and recovery stands up an EOC at the university, maintains services. 4,000 resident students. If there is a natural gas failure or any other failure within the campus, that is there responsibility to fix. Limited ability to interlink grids of different infrastructure. If they knew that one type was more vulnerable than others, they could make decisions prior to the storm. There could be real world applications, but pre event planning is more important and useful.

2.) How do you consider the potential vulnerability of critical infrastructure components in your planning and preparedness operations? (ie. How is potential vulnerability considered in the siting and design of infrastructure components and preparing for and recovering from extreme storm events?)

They do look at potential vulnerability, some is on-campus. Partnered with city to do substantial reconstruction of sewer lines, so in event of power failure, they wouldn't be dependent on lift stations. Number of critical infrastructure points is smaller on campus. Only a handful of critical points. There are some considerations, but not as complex as on city/county level.

3.) How are the impacts of extreme storm events on infrastructure considered in planning, preparedness, and recovery?

Two types of events, blue sky event/grey sky event. You can make preparations for grey sky event (hurricanes, etc). More planning done for grey sky events. Don't have luxury of getting students off campus, food, shelter, fire protection, sanitation for 4,000 students on campus. Impacts are huge when planning for disaster. Universities lose resources when research is lost. It is critical to plan for impacts to students and research.

4.) How often, per year, do you conduct exercises of any sort regarding extreme storm events, as they directly affect your operations? Do other non-operational personnel participate in these exercises? (planners, elected officials, etc.)

2 or 3 times a year for EM drills/exercises. 1 to 2 for extreme storm events. Look at power outage from hurricane, focus on restoration of resources.

5.) What would you estimate as the annual time and resources expended in conducting various types of preparedness, response, and recovery exercises?

If you look at emergency communication system, probably $150,000. Year-round, full time, but could easily be doubled.

6.) How do these exercises contribute toward ensuring the continuity or restoration of services following an extreme storm event?
Exercises are integral. If they aren't conducted, you can't be prepared in real life.

7.) Are there communication protocols/agreements with other agencies that you activate when an extreme event occurs? If yes, with which agencies? If not, is it because of the following? (Check all that apply).

- Liability concerns____
- Proprietary information____
- Other_____

There are a lot: Actively work with NHC EM, NWS, mutual aid agreements with police and fire in the area, relationships with other state universities to share resources, utilities (if nuclear power plant has an issue). Has been talk of working with Red Cross, but not currently. Wanted to get more integrated with plan of utilities. Could work closer with utilities.
There are liability concerns when moving students to another university in the event of a storm. Intraagency communication differences between universities. Concern about competing resources: bigger fish get resources first.

Questions for Participants after the workshop:
1.) Does MUNICIPAL develop and portray realistic scenarios of damage and recovery? Were you satisfied with the user interface?

Loved MUNICIPAL, liked interface. Difficulty lies with scale, almost needs it brought down to lower scale. Helps you understand what you'll get from the rest of the county. Big strength is training, to run scenarios.

2.) How could MUNICIPAL support your decision making prior to and following an extreme storm event? What about for training purposes?

Remote research facility, would be useful to understand timing because facility is so electricity dependent.

3.) Could MUNICIPAL be effectively utilized by your existing staff or would it require a specially trained individual to operate the system?

Would not require someone specifically trained. EM could use it.

4.) What specific changes would you make to MUNICIPAL to improve its usefulness to your specific responsibilities?

Ability to drill down to community level.

5.) What additional features would help make you more confident in using MUNICIPAL to support your decision making?

Predictive impacts and training. To predict extent and duration of infrastructure loss. Electricity is what makes university function, but water and sewer are close seconds. Doesn't see them using it in a response framework. Maybe in long term may use it for recovery in real time.
Increased obligation to students more than communities. Must maintain more communication with constituents for universities. IT and facility people would be greatly involved.

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They look at critical facilities ahead of time and identify potential hazards, will take down information and run different scenarios. Knowing how vulnerable a critical facility is

important and being able to weight that hazard (and to whom ie retirement homes, hospitals, pump stations).

3.) How are the impacts of extreme storm events on infrastructure considered in planning, preparedness, and recovery?

See above.

4.) How often, per year, do you conduct exercises of any sort regarding extreme storm events, as they directly affect your operations? Do other non-operational personnel participate in these exercises? (planners, elected officials, etc.)

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5.) What would you estimate as the annual time and resources expended in conducting various types of preparedness, response, and recovery exercises?

Can't say.

6.) How do these exercises contribute toward ensuring the continuity or restoration of services following an extreme storm event?

They expose potential risk and other issues to different agencies. Progress Energy, At&T are present, sheriffs dept, fire dept. Depending on how well exercise is run, agencies get familiar with responsibilities. Contribute toward faster response. Depending on who organizes event, and what scenarios are presented, gives us an opportunity to understand if information is in order and who to contact. With exercises like this over time, response is strengthened.

7.) Are there communication protocols/agreements with other agencies that you activate when an extreme event occurs? If yes, with which agencies? If not, is it because of the following? (Check all that apply).

- Liability concerns____
- Proprietary information____
- Other_____

Cooperative agreements between power agencies, all telecom agencies are actively participating and sharing information. AT&T would be able to bring mobile equipment in and they would be able to set up communications readily. Verizon and AT&T are only two com providers in county. Hasn't seen many barriers to communication between agencies. County doesn't have telecom network. County has radio, cellular, internet capabilities, most of which is exposed during storm that would be first to come down.
Water authority has folks in county office, so there are no issues with communication there.

Questions for Participants after the workshop:

1.) Does MUNICIPAL develop and portray realistic scenarios of damage and recovery? Were you satisfied with the user interface?

Power company has own Emergency response center. NHC doesn't have a lot of information on damage to infrastructure. Not shared with NHC. NHC only reports outages to an area/region. Can model run on other GIS platforms? Most counties will have ESRI products.

2.) How could MUNICIPAL support your decision making prior to and following an extreme storm event? What about for training purposes?

Answered before.

3.) Could MUNICIPAL be effectively utilized by your existing staff or would it require a specially trained individual to operate the system?

Most folks in NHC are very well versed in GIS. But model would need to be run by a specifically trained individual, someone comfortable with interface and idea of model. A lot of folks are still operating from a three ring binder for extreme storm events. Much of emergency planning is done ahead of time wrt analysis and model results. Still going to need techie to perform analysis and results are what are important to EMs. Don't see them using this tool in real time. During a real event, folks familiar with GIS and modeling were brought in, live webmap was made available that selected events both inside EOC and to the public, geolocated and attributed. Ended up having to hunt for events. Tried to create interest in webmap, wasn't successful.

Existing staff might like to have the tool but would likely not use it. Would call in a trained person to operate the system, but folks would not be going to this person asking questions. EOC too busy responding to small crisis, not available to use model.

4.) What specific changes would you make to MUNICIPAL to improve its usefulness to your specific responsibilities?

We should think about centralizing model, rather than locally running it. Create operations or analysis center, a better model would be to create a regional or statewide dataset, standardize it, update it, and run the model as hurricane approaches, have information and results available for operations centers to consume. If we had a website of results of analysis (forecast windfield, areas more vulnerable). Build a standard dataset and standard product. Convince state to create server and database. Train small group of people and it would serve whole state. Learn model and make accurate analysis, validate results by comparing results to actual storm event. Create toolkit. While some counties might have excellent EM team, others might need serious help. If state can step in a create standard products, and counties could contribute to dataset.

5.) What additional features would help make you more confident in using MUNICIPAL to support your decision making?

Currently use tax records, estimate content based on half-value of home. They have information on structure and value, owners information and address info. Damage assessment allows you to calculate damage and writes records into database. Can record commercial and residential damage. We might want to look at property damage in MUNICIPAL. At a given wind speed, property damage could calculate cost of damage. From database, you can create reports. Have never been used as communications tool. (ie this region is responsible for a loss of X dollars). Could be used to make adjustments (strengthening structures, improving drainage).

This questionnaire involves research with the purpose of helping us better understand the degree of potential usefulness of the decision support tool (MUNICIPAL) as it might apply to each of your positions in the emergency response community. This questionnaire is completely voluntary and should take about 30 minutes to complete. Refusal to participate will involve no penalty or loss of benefits to which you may be entitled as a result of this research. We want to help make the best use of your time at the April 22nd workshop in Wilmington, North Carolina, and gather your individual feedback in hopes that we can improve MUNICIPAL so that it can provide consistent, reliable support in your decision-making activities. Your answers to these questions will be kept confidential, and should you choose to revise any of your answers, you may do so at any time by notifying the primary contact listed below. Should you have questions regarding this research, please contact Trevor Manzanares (505-991-0548 or manzat@rpi.edu) or Dr. William Wallace at wallaw@rpi.edu). If you have any questions about your rights as a research participant, please contact Rensselaer's IRB Chair (518-276-4863; IRB@rpi.edu).**The following questions can be answered after viewing the video on** MUNICIPAL.

1.) How might the various features of MUNICIPAL (vulnerability simulator, GIS interface, etc.) be of value to infrastructure service providers and emergency managers?
Especially to EM would be of great value, especially when looking at ice storms and hurricane exercises. “Using these we can anticipate number of crews, especially with GIS interface.”

Mainly for training purposes.

2.) How do you consider the potential vulnerability of critical infrastructure components in your planning and preparedness operations? (ie. How is potential vulnerability considered in the siting and design of infrastructure components and preparing for and recovering from extreme storm events?)

It hasn’t been considered. Too much confidence in utilities partners currently. Water, sewer, communications utility. They don’t really share data openly. “How can we help them?”

3.) How are the impacts of extreme storm events on infrastructure considered in planning, preparedness, and recovery?

Have an annual hurricane exercise. For different scenarios. Put together a POD (points of distribution). Considered in EO plan for various components (just for power). Roads are being considered currently. ESFs: 14. New org structure. ICS intimate command system: a way agencies can respond to an incident, with common terminology, command system. Most use ICS model, EOC marries the two together. ICS composed of incident commander, command and general staff, operations, planning prepared incident action command, logistics, finance/admin sections.

4.) How often, per year, do you conduct exercises of any sort regarding extreme storm events, as they directly affect your operations? Do other non-operational personnel participate in these exercises? (planners, elected officials, etc.)

Just one hurricane exercise per year, but many other exercises conducted during year.

5.) What would you estimate as the annual time and resources expended in conducting various types of preparedness, response, and recovery exercises?

As an EM, it is your job. Other agencies may have different responsibilities.

6.) How do these exercises contribute toward ensuring the continuity or restoration of services following an extreme storm event?
They don't. Rarely get an energy official into an exercise. Can get them into an event though.

7.) Are there communication protocols/agreements with other agencies that you activate when an extreme event occurs? If yes, with which agencies? If not, is it because of the following? (Check all that apply).

- Liability concerns____
- Proprietary information____
- Other_____

Briefings are conducted with power and water utilities between EOC and utilities. At most telephone calls, no information provided other than restoration time of services. No radio communication established.

Questions for Participants after the workshop:

1.) Does MUNICIPAL develop and portray realistic scenarios of damage and recovery? Were you satisfied with the user interface?

Yes. Realistic comes from accuracy of data. As long as data is updated, it will be useful. Interface was good.

2.) How could MUNICIPAL support your decision making prior to and following an extreme storm event? What about for training purposes?

We can make operational decisions, we'd have a better idea what we're looking at, the type of resources we will need, what we will need to start ramping up.

3.) Could MUNICIPAL be effectively utilized by your existing staff or would it require a specially trained individual to operate the system?

With any bit of software, someone would have to be savvy with the model. Same goes for ARC, someone has to know how to use it.

4.) What specific changes would you make to MUNICIPAL to improve its usefulness to your specific responsibilities?

Looks user friendly, wasn't a lot of fluff, gave information that would be needed.

5.) What additional features would help make you more confident in using MUNICIPAL to support your decision making?

Knowing when information was last updated, how accurate it is.

APPENDIX B: Outline for MUNICIPAL Demonstration at NHCEM Workshop April 22, 2014

1. Presentation
    1.1. Overview of Research
    1.2. Overview of Software
2. Interactive Demonstration
    2.1. Desktop Version
        2.1.1. Explanation of Datasets
            2.1.1.1. New Hanover County Dataset
            2.1.1.2. "Clarc" County Dataset
        2.1.2. Overview of Infrastructure Systems of "Clarc" County
        2.1.3. Damage Assessment Model
            2.1.3.1. Allow someone to pick Hurricane Category
            2.1.3.2. Run damage assessment for chosen category
            2.1.3.3. Show damage map
            2.1.3.4. Show how map can be changed by user
            2.1.3.5. Ask audience how it could be used
                2.1.3.5.1. For planning (How would it be useful?)
                2.1.3.5.2. For training (Was it realistic?)
                2.1.3.5.3. For actual event (What would be their primary use?)
        2.1.4. Disruption Model
            2.1.4.1. Run Disruption model on resulting damage scenario
            2.1.4.2. Show disruption map
            2.1.4.3. Ask audience to find the root cause of a power disruption
                2.1.4.3.1. The cause will be as a result of damage to a power component
            2.1.4.4. Ask audience to find the root cause of a water disruption
                2.1.4.4.1. The cause will be as a result of damage to a power component
                2.1.4.4.2. This is to demonstrate interdependencies
            2.1.4.5. Show how adjusting the damage will affect the disruption
            2.1.4.6. Ask audience how it could be used
                2.1.4.6.1. For planning (How would it be useful?)
                2.1.4.6.2. For training (Was it realistic?)
                2.1.4.6.3. For actual event (What would be their primary use?)
        2.1.5. Restoration Model
            2.1.5.1. Have audience create a restoration plan for power
                2.1.5.1.1. Give them the use of either one or two work crews

2.1.5.1.2. Use damage and disruption map with labels for restoration time
2.1.5.1.3. Create a type of Gantt chart on paper
2.1.5.2. Simultaneously run restoration model on different computer
2.1.5.3. Compare the two restoration plans without the disruption visible
2.1.5.4. Add disruption to restoration map and review the differences
2.1.5.5. Ask audience how it could be used
2.1.5.5.1. For planning (How would it be useful?)
2.1.5.5.2. For training (Was it realistic?)
2.1.5.5.3. For actual event (What would be their primary use?)

2.2. Review Key Points of Demonstration

2.3. Web-based version

2.3.1. Go through the web-based interface
2.3.1.1. Search functions
2.3.1.2. Map interactions
2.3.1.3. Running models

2.4. Review HSIP data, potential for incorporation into MUNICIPAL

2.4.1. Show screenshots of NHC
2.4.2. Review requirements for obtaining HSIP Gold

2.5. SUMMIT version

2.5.1. Go through the main reasons for SUMMIT integration
2.5.2. Give a demonstration on how to add and run models

2.6. Ask audience what tools they currently use

2.6.1. For planning (How are they useful?)
2.6.2. For training (Are they realistic?)
2.6.3. For actual event (What is their primary use?)
2.6.3.1. What aspects of these tools are useful, which are not?
2.6.3.2. Do these tools address interdependencies?

APPENDIX C: Infrastructure Interdependency Questions

1.) Does Water Supply depend (if so, at what points) on:
    a. Power?
    b. Communications?
    c. Transportation?
    d. Wastewater?
2.) Do Communications depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Transportation?
    d. Wastewater?
3.) Does Transportation depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?
4.) Does Wastewater depend (if so, at what points) on:
    a. Power?
    b. Communications?
    c. Transportation?
    d. Water?
5.) Does Agriculture depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?
6.) Does Commercial Infrastructure (grocery stores, hotels, shopping malls, etc.) depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?
7.) Does Education Infrastructure (colleges, day care, private and public schools, etc.) depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?
8.) Does Food Infrastructure (grain mills, meat packing/processing, refrigerated warehouses, etc.) depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?

9.) Does Government Infrastructure (Army National Guard, city halls, court houses, defense sites, state capitol buildings, US Army Corps of Engineers structures, etc.) depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?
10.) Does Law Enforcement (Bureau of Land Management, FBI, Fish and Wildlife, National Park Service, Border Patrol, Prisons, US District Court Jurisdictions, etc.) depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?
11.) Does Manufacturing Infrastructure depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?
12.) Do Public Venues (places of worship, amusement parks, casinos, community centers, libraries, sports arenas, museums, theatres, parks, etc.) depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?
13.) Does Chemical Infrastructure (biological products, chemical industries, explosives manufacturing, hazardous materials routes, nitrogenous fertilizer plants, pharmaceuticals, landfills, etc.) depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?
14.) Do Emergency Services (American Red Cross, FEMA, EMS, fire stations, EOCs, Hospitals, etc.) depend (if so, at what points) on:
    a. Power?
    b. Water?
    c. Communications?
    d. Wastewater?
15.) Does Finance Infrastructure (brokerages, bullion repositories, central reserve depositories and federal reserve banks, commodity exchanges, FDIC insured banks, credit unions, financial processing centers, foreign trade and international banking, insurance companies, mutual fund facilities, US Mint, etc.) depend (if so, at what points) on:
    a. Power?
    b. Water?

c. Communications?
d. Wastewater?

16.) Does Mail/Shipping Infrastructure (DHL locations, FedEx locations, general freight trucking terminals, post offices, private non-retail shipping, UPS locations, USPS, etc.) depend (if so, at what points) on:
   a. Power?
   b. Water?
   c. Communications?
   d. Wastewater?

17.) Does Mining Infrastructure depend (if so, at what points) on:
   a. Power?
   b. Water?
   c. Communications?
   d. Wastewater?

18.) Does Public Health Infrastructure (blood and organ banks, cemeteries, CDC, hospitals, nursing homes, pharmacies, urgent care, veteran's health, veterinary services, etc.) depend (if so, at what points) on:
   a. Power?
   b. Water?
   c. Communications?
   d. Wastewater?

19.) Does Air Transportation (airports, FAA regions, etc.) depend (if so, at what points) on:
   a. Power?
   b. Water?
   c. Communications?
   d. Wastewater?

20.) Does Water Transportation (breakwaters, canals, channels, ferries, locks, piers, ports, etc.) depend (if so, at what points) on:
   a. Power?
   b. Water?
   c. Communications?
   d. Wastewater?

APPENDIX D: Questionnaire Data for National-Level Emergency Managers

This questionnaire involves research with the purpose of improving intelligent, computer-aided decision support systems. As part of such, we seek to understand your needs as an emergency manager or other decision maker in the emergency response community. This questionnaire is completely voluntary and should take about 10 minutes to complete. Refusal to participate will involve no penalty or loss of benefits to which you may be entitled as a result of this research. Your answers to these questions will be kept confidential, and should you choose to revise any of your answers, you may do so at any time by notifying the primary contact listed below. Should you have questions regarding this research, please contact Trevor Manzanares (505-991-0548 or manzat@rpi.edu) or Dr. William Wallace at wallaw@rpi.edu). If you have any questions about your rights as a research participant, please contact Rensselaer's IRB Chair (518-276-4863; IRB@rpi.edu).

1.) What is your specific function in Emergency Management?

I am the Emergency Management Director for the Town of North Reading, MA.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

No.

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

2.) What do you use it for?

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

4.) What aspects of the tool do you like?

5.) What aspects of the tool do you dislike?

6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

I am sure it would help, but I can not envision what the tool would look like.

2.) What specific components would you want in the tool?
I do not know.

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

Probably all of the above.

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

My budget for each year is $3500. I am the only person working in the Emergency Management Department. I would like to get free tools that are easy to use.

This questionnaire involves research with the purpose of improving intelligent, computer-aided decision support systems. As part of such, we seek to understand your needs as an emergency manager or other decision maker in the emergency response community. This questionnaire is completely voluntary and should take about 10 minutes to complete. Refusal to participate will involve no penalty or loss of benefits to which you may be entitled as a result of this research. Your answers to these questions will be kept confidential, and should you choose to revise any of your answers, you may do so at any time by notifying the primary contact listed below. Should you have questions regarding this research, please contact Trevor Manzanares (505-991-0548 or manzat@rpi.edu) or Dr. William Wallace at wallaw@rpi.edu). If you have any questions about your rights as a research participant, please contact Rensselaer's IRB Chair (518-276-4863; IRB@rpi.edu).

1.) What is your specific function in Emergency Management?

Director for the Town of Cummington, MA. As such am responsible for budget development and implementation, applying for any and all grant opportunities, working with the State Emergency Management system on training, responses to all kinds of events.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Not at the present.

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

2.) What do you use it for?
3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?
4.) What aspects of the tool do you like?
5.) What aspects of the tool do you dislike?
6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

Only if properly trained and supported.

2.) What specific components would you want in the tool?

Yet to be determined. What is available?

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

Probable uses would begin with planning, response and recovery.

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

Frankly, financial, staff training (I am a one person operation), and mostly a lack of familiarity.

This questionnaire involves research with the purpose of improving intelligent, computer-aided decision support systems. As part of such, we seek to understand your needs as an emergency manager or other decision maker in the emergency response community. This questionnaire is completely voluntary and should take about 10 minutes to complete. Refusal to participate will involve no penalty or loss of benefits to which you may be entitled as a result of this research. Your answers to these questions will be kept confidential, and should you choose to revise any of your answers, you may do so at any time by notifying the primary contact listed below. Should you have questions regarding this research, please contact Trevor Manzanares (505-991-0548 or manzat@rpi.edu) or Dr. William Wallace at wallaw@rpi.edu). If you have any questions about your rights as a research participant, please contact Rensselaer's IRB Chair (518-276-4863; IRB@rpi.edu).

1.) What is your specific function in Emergency Management?

Recovery Unit Manager

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

E Team – Web based EOC support proprietary product
ARC GIS – Network hosted GIS, proprietary product

2.) What do you use it for?

ETeam for situational awareness, resource management

ARC GIS for mapping and geographic data analysis

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

ARC GIS – planning and recovery

E Team – response and exercises

4.) What aspects of the tool do you like?

I like everything about ARC GIS!

5.) What aspects of the tool do you dislike?

E Team has a tiered approach. Incidents are attached to Events, but Incidents can't be attached to incidents. For recovery it would be helpful to have Event, Jurisdictions and Applicants, so I could use this to "cat heard" the PDA and follow on process.

6.) What improvements could be made to the tool to improve its speed/efficiency?

I think it would be helpful if E Team had, in addition to the Training and Operations radio button options it should have one for recovery, so I could use it to manage my recovery operations independent of response operations.

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

Yes

2.) What specific components would you want in the tool?

See Above

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

For my unit, Recovery

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

Obstructive Chief Information Officer

This questionnaire involves research with the purpose of improving intelligent, computer-aided decision support systems. As part of such, we seek to understand your needs as an emergency manager or other decision maker in the emergency response community. This questionnaire is completely voluntary and should take about 10 minutes to complete. Refusal to participate will involve no penalty or loss of benefits to which you may be entitled as a result of this research. Your answers to these questions will be kept confidential, and should you choose to revise any of your answers, you may do so at any time by notifying the primary contact listed below. Should you have questions regarding this research, please contact Trevor Manzanares (505-991-0548 or manzat@rpi.edu) or Dr. William Wallace at wallaw@rpi.edu). If you have any questions about your rights as a research participant, please contact Rensselaer's IRB Chair (518-276-4863; IRB@rpi.edu).

1.) What is your specific function in Emergency Management?

I am an Emergency Management Coordinator with Washington County, OR Emergency Management and Washington County Department of Land Use and Transportation. My function is to manage the emergency management program for the department, and to participate in emergency management program duties for the county (planning, incident response, training, etc.)

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery? Yes

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

ESRI ArcGIS.
DEMS (Department Emergency Management System) developed in-house
WebEOC, aftermarket software, with in-house customization

2.) What do you use it for?

ArcGIS: Mapping and conducting spatial analyses for hazards and potential exposure to hazards (homes in the floodplain for example). Hazard modeling (HAZUS). Mapping of facilities / resources. Contributing to online mapping tools.
DEMS: Asset / resource tracking. Situational awareness.
WebEOC: Asset / resource tracking. Resource ordering. Situational awareness and Common Operating Picture. Event / response coordination. Information sharing.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

The tools tend to be most useful for real-world applications (actual disaster response and recovery operations). While they contribute to planning and are used during training, the value they offer for supporting the integrations of multiple jurisdictions resources, and maintaining awareness of ongoing / evolving operations is their greatest strength and highest value.

4.) What aspects of the tool do you like?

Situational awareness and common operating picture. During any moderate scale event (and up), there are multiple response elements providing response / recovery support: incident scene-level Incident Command Post (with an Incident Management Team); city, county, state, and federal emergency operations centers; city, county, state, and city, county, state, and federal department operations centers; and numerous other on-scene type response and recovery coordination centers. All must share information about the incident and maintain awareness of ongoing operations. These tools provide a means for maintaining situational awareness, and sharing information amongst the response elements (common operating picture). Without a common operating

picture, there may be significant duplication of effort, and a lack of response to populations in need.

5.) What aspects of the tool do you dislike?

These tools are not nationally standardized, and the various tools are incompatible. Gaining a consensus on which tool to use, and getting all organizations / jurisdictions to use the tools comprehensively, is a significant challenge. Organizations involved in response and recovery operations must be able to share information and coordinate operations, and with a myriad of tools being used that are disparate, and with organization with apathy about those tools, information sharing is a major challenge.

6.) What improvements could be made to the tool to improve its speed/efficiency?

Means of integrating the tools which would be beneficial. It is extremely unlikely that all organizations involved in disaster response / recovery operations are going to come to a consensus on one tool to use; therefore, some means of connecting disparate platforms would enhance operations during large-scale nationally significant events. The development of cheap, easy to use, online tools that allow small organizations to share information, and collaborate, would provide an opportunity for more organizations to be involved in a coordinated incident response. Tools that have a broader reach to private-sector organizations and that include social media platforms would be beneficial.

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

This questionnaire involves research with the purpose of improving intelligent, computer-aided decision support systems. As part of such, we seek to understand your needs as an emergency manager or other decision maker in the emergency response community. This questionnaire is completely voluntary and should take about 10 minutes to complete. Refusal to participate will involve no penalty or loss of benefits to which you may be entitled as a result of this research. Your answers to these questions will be kept confidential, and should you choose to revise any of your answers, you may do so at any time by notifying the primary contact listed below. Should you have questions regarding this research, please contact Trevor Manzanares (505-991-0548 or manzat@rpi.edu) or Dr. William Wallace at wallaw@rpi.edu). If you have any questions about your rights as a research participant, please contact Rensselaer's IRB Chair (518-276-4863; IRB@rpi.edu).

1.) What is your specific function in Emergency Management?

    Emergency Management Director for the Town of Dalton, Massachusetts

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

    NO

    If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?
2.) What do you use it for?
3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

4.) What aspects of the tool do you like?

5.) What aspects of the tool do you dislike?
6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

I do not have enough knowledge about computer –aided support tools to answer this or the following questions.

2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?
4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

Cost

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1.) What is your specific function in Emergency Management?

Response and Recovery Branch Chief – Manage the State Emergency Operations Center

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

YES.

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

ESRI ARC GIS

2.) What do you use it for?

Planning, Response and Recovery from events

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

Especially useful for Response and Recovery. Plays into the Planning effort as it relates to identification of critical infrastructure, demographics etc.

4.) What aspects of the tool do you like? Ability for real time queries with understandable outputs.
5.) What aspects of the tool do you dislike? Can often take extensive programming for data input
6.) What improvements could be made to the tool to improve its speed/efficiency?

Ability to customize without intricate programming.

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?
4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

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1.) What is your specific function in Emergency Management?

I am the Emergency Management Director, appointed by the Board of Selectmen, for the Town of Hawley, a very small (pop 340) town in the northern Berkshires. As EMD I am responsible for developing and revising the town's emergency plans as required by state and federal law (Comprehensive Emergency Management Plan, Continuity of Operations Plan, All Hazards Mitigation Plan, Hazardous Material Response Plan, Radiological Emergency Response Plan, etc), training town officials and volunteers in the operation of such plans and the town's Emergency Operations Center, and directing the town's response to natural disasters and other emergency situations (Tropical Storm Irene in 2011, Hurricane Sandy in 2012, the 2008 ice storm, the floods in 2005, 1998, 1996, and 1987, etc)

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery? Not really. We have a map/aerial photography program provided by the state called Pictometry to aid in searches

and incident plans but we rarely have incidents that require/would benefit from its use.

If you answered yes to question 2 above:

What is the name and type of tool you currently use? Who developed it for you?

1.) What do you use it for?
2.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?
3.) What aspects of the tool do you like?
4.) What aspects of the tool do you dislike?
5.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently? I don't know. If it depends upon web-based software or data, it would basically be unusable for us as the town is in an underserved area without broadband or other high speed internet available. MEMA is always trying to get us to use WEBEOC or other programs not recognizing that they simply aren't available here in real time during emergencies.

The state fails to recognize that if any program isn't usable in emergencies, it is counterproductive to ask our volunteers to commit their limited time to practice its use because it won't help us when we need it the most.

2.) What specific components would you want in the tool?

Don't know – would need to know more about a specific tool and how it could be used to comment intelligently.

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

Probably a combination of all of the above. With just a $2,800 budget for emergency management, $1,600 of which is the cost of our emergency notification system (reverse 911), finances are a factor. Given that we depend upon volunteers with limited free time and many other commitments, staff capability is an issue. Given the lack of access to high speed internet, practicality is obviously an issue.

For us, any program must reflect the size and scale of our issues and capabilities. We keep a list of special needs residents (frail, ill, blind, language issues, etc) in Excel because we can update it easily, sort it simply and not have to invest a lot of time to input the data. We maintain hard copies because our experience is that technology often fails when we need it now, and we must plan for that. We deal with many of the same issues that larger communities do: natural disasters, pandemics, hazardous material incidents, etc. but we deal with individuals and families, not whole populations. We have no economies of scale. For us any technology must be very simple, very clear, and pretty cheap to be considered.

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1.) What is your specific function in Emergency Management?

County Emergency Management Director

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

CAMEO / MARPLOT / ALOHA – developed by US EPA

2.) What do you use it for?

Advance planning for chemical facilities, response information on specific chemicals, Mapping of plumes and threat zones of hazmat releases.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

Training, planning, and response.

4.) What aspects of the tool do you like?

Basically everything.

5.) What aspects of the tool do you dislike? N/A

6.) What improvements could be made to the tool to improve its speed/efficiency?

Recent improvements now allow for installation of electronic reports, which saves a massive amount of time on data entry.

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

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1.) What is your specific function in Emergency Management?

I am the New Jersey Emergency Management Assistance Compact (EMAC) State Coordinator / the NJ Emergency Support Function 7 (ESF-7) Resources and Logistics State Coordinator / Citizen Corps Volunteer Programs State Coordinator.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes – we use the E Team software to coordinate emergency response and recovery communications and o9perations – that is supplemented by an "in house" developed
Resource Directory Database (RDDB) that identifies and catalogs all our emergency response resources from state / county / local / private sector / volunteer agencies in an online data repository

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

E Team - purchased software package

RDDB – developed by NJ State Police technology personnel

2.) What do you use it for?

Coordination of emergency response and recovery operations - links state Office of Emergency Management (OEM) with all 21 NJ counties OEM for communications and resource requests.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

It is most useful for response and recovery

4.) What aspects of the tool do you like?

E Team is good for communications – but has shortfalls in having too many data screens – needs to be "simplified" for easier understanding

5.) What aspects of the tool do you dislike?

6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

4.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

5.) What specific components would you want in the tool?

6.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

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1.) What is your specific function in Emergency Management?

Fire Chief/Emergency Management Director

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

No

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?
2.) What do you use it for?
3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?
4.) What aspects of the tool do you like?
5.) What aspects of the tool do you dislike?

6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

Hopefully

2.) What specific components would you want in the tool?

Resource management/resource accountability

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

All of the above

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

Financial

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1.) What is your specific function in Emergency Management?

HSEMD leads, coordinates, and supports homeland security & emergency management functions in Iowa. I am the GIS/Information Technology lead and support our entire department.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

We have a variety of tools, internal and external, that are used.

- Web-mapping sites that we host – Situational Awareness Tool
- ArcGIS Online for Org sites available to internal and external users

- GIS web services (internal and external)

2.) What do you use it for?

Daily operations, response, recovery, planning, and training/exercise.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

Daily operations and response.

4.) What aspects of the tool do you like?

Our situational awareness tool mashes together data sources from federal, state, local govt., and private sector. This information along with tools in the viewer give our responders the ability to do view information and perform analysis.

5.) What aspects of the tool do you dislike?

There is no one tool, still need a tool box. ☺

6.) What improvements could be made to the tool to improve its speed/efficiency?

Just like all our applications, they are dynamic. We are always working on improvements.

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

2.) What specific components would you want in the tool?

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

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1.) What is your specific function in Emergency Management?

I administer EMPG contracts and program (Emergency Management Performance Grant)

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

Google Earth

ARC GIS

2.) What do you use it for?

Created maps of impacted areas and surrounding areas

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

Response and Recovery

4.) What aspects of the tool do you like?

Our GIS folks are the only ones to use it and distribute it. From my minimal experience with it, I like the layers and toggling from satellite to street view

5.) What aspects of the tool do you dislike?

Can be cumbersome to use and training is not always available

6.) What improvements could be made to the tool to improve its speed/efficiency?

Make it more user friendly

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

Our end users do not have any control on identifying what software to use or any decision making authority regarding purchasing

2.) What specific components would you want in the tool?

Our end users do not have any control on identifying what software to use or any decision making authority regarding purchasing

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

Response and recovery

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

NA

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1.) What is your specific function in Emergency Management?

At this time, my primary function is to obtain certification for the LEPC. But for long term, I act as the emergency director for the town during emergencies, which includes maintaining a relationship with the Town officials, public relations officer and emergency services.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

WISER, Cameo/Marplot/Aloha, Fire/EMS has additional support systems.

2.) What do you use it for?

WISER and Cameo are primarily used for haz mat situations.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

We have not participated in training since I took the position.

4.) What aspects of the tool do you like?
5.) What aspects of the tool do you dislike?
6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?
4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

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1.) What is your specific function in Emergency Management?

I am presently assigned to the State Emergency Operations Center as a Sergeant and coordinate everyday activities. In the event of an emergency I will be working out of the Operations room assisting with real time information tracking and addressing resource requests.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

YES…

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

- ETEAM
- CAMEO

- Digital Sandbox
- HURAVAC

2.) What do you use it for?

All of the listed programs are utilized regularly except for CAMEO. ETEAM and Digital Sandbox are regularly utilized for resource tracking and creating a timeline of events. Both programs allow the user to query info and track multiple requests and/or events.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

It is useful for all of the above listed items. My unit specifically utilizes it for training, planning and tracking of response related items.

4.) What aspects of the tool do you like?

I like the ability to track ongoing events and resource tracking. This is most useful to get an overall view of a catastrophic event.

5.) What aspects of the tool do you dislike?

Computer aided tools tend to crash. Computer aided tools must also be easy to learn and operate. Because of staff turnover and/or new persons operating in unfamiliar roles during a disaster makes it very difficult to train them when an event is ongoing.

6.) What improvements could be made to the tool to improve its speed/efficiency?

Create a tracking program for EOC's which doesn't crash….

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?
4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

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1.) What is your specific function in Emergency Management?

    Public Health Emergency preparedness and Response and coordination of public health issues with the county Office of Emergency Services

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

    No

    If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?
2.) What do you use it for?
3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?
4.) What aspects of the tool do you like?
5.) What aspects of the tool do you dislike?

6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

Yes it could be very beneficial

2.) What specific components would you want in the tool?

Mapping and GIS interface with multi layers

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

A combination of all of the above and to coordinate our efforts with other agencies that currently have this type of capability

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

Cannot afford the technology nor the staff to support it

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1.) What is your specific function in Emergency Management?

I am the Emergency Management Director. My involvement during any particular event depends on the event. I have served mainly as the public information officer for most events. I am also the main person to update emergency plans within the town.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

Pictometry. This program has been provided to towns within the Franklin County Regional Emergency Planning Committee.

2.) What do you use it for?

This program provides the ability to track wind directions, provide satellite imaging, determine evacuation areas by a circumference around an event plus various other GPS related functions.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

All of the above. I could not identify one activity.

4.) What aspects of the tool do you like? I like the fact that you can set it on satellite imaging and determine perimeters for an event. I also like that you can determine which direction a plume of smoke or chemical would go based on wind speed and wind direction.

5.) What aspects of the tool do you dislike?

It needs to be updated on a regular basis. I would be great to have something that updates automatically.

6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

2.) What specific components would you want in the tool?

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

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1.) What is your specific function in Emergency Management?

Part-time Emergency Management Director for Pepin County (other responsibilities of the Land Management Department include Zoning Administrator, GIS Manager, and oversight of the Recycling/Solid Waste, Economic Development, and Tourism offices at the county, total staff of two people). I view my role as the Emergency Management Director as a planner and advocate for emergency preparedness on a day-to-day basis, but as a manager/organizer in the event of an emergency/disaster.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

ArcGIS and CAMEO are the only decision making tools currently utilized; we do not use the ALOHA or MARPLOT products associated with CAMEO. (We realize that there are mobile applications that cater to emergency response, however we are still looking into these products due to limited wireless service in our geographic area.)

2.) What do you use it for?

Both programs are used for planning purposes for HazMat facilities. Eventually we like to use ArcGIS for modeling flooding scenarios; which is one of our common natural hazards.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

Training and Planning

4.) What aspects of the tool do you like?

ArcGIS enhances our ability to map out different scenarios and visually see the potential impacts of an emergency event. We also utilize the software for dispatching emergency services throughout the county. In general, it has a lot of utility and we wish we could exploit its full potential, but unfortunately that is not possible in our organization due to limited staffing, time, and money constraints. (We will get there eventually.)

5.) What aspects of the tool do you dislike?

I am personally not a fan of CAMEO, it isn't very user friendly. I generally have difficulties developing screening and scenarios and call for assistance from someone at the state. The steps are simply counter-intuitive; it would just be easier if they had an instruction manual. (Or alternatively, I guess I could write down the steps while I still remember them since I probably only use the program once a year.)

6.) What improvements could be made to the tool to improve its speed/efficiency?

All improvements that need to be made are internal; the GIS component of the Land Management Office is probably the most neglected – files for Emergency Management tend to be made on an "as needed" basis; it would be useful for us to integrate this data into ArcGIS Online so that we can use the data points remotely if needed in an actual emergency. Increased capabilities to ArcGIS Online (so individuals aren't tethered to a particular computer/office that may not be accessible in an emergency) might be useful for response and recovery operations.

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?
4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

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1.) What is your specific function in Emergency Management?

Agency Director

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

No

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?
2.) What do you use it for?
3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?
4.) What aspects of the tool do you like?
5.) What aspects of the tool do you dislike?
6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

Yes

2.) What specific components would you want in the tool?

Not sure.

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

All of the above

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

Lack of funding/staff

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1.) What is your specific function in Emergency Management?

    Manager of State Emergency Operations Center. Serve as Incident Commander, Operations Section Chief, Planning Section Chief during incidents.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

    Yes

    If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

    Google Earth.

    HSIN.

    Sequel server tool developed in house

2.) What do you use it for?

Common Operating Picture
Mapping Damage
Tsunami community status

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

Response

4.) What aspects of the tool do you like?

Visuals and ease of transmission via email and HSIN

5.) What aspects of the tool do you dislike?

Time it takes to input, need for internet connection and bandwidth

6.) What improvements could be made to the tool to improve its speed/efficiency?

See #5

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

2.) What specific components would you want in the tool?

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?
4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

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1.) What is your specific function in Emergency Management?

Primary: Training Coordinator. Coordinate and deliver upper-level Emergency Management Training to state, Tribal, and local jurisdictions.
Secondary: Perform as one of three State Emergency Duty Officers. 24-hour on call to respond to any jurisdiction who has a request for state and/or federal assistance, e.g. flooding, National Guard resources, search & rescue, HAZMAT Team assistance, etc...Also perform as an EOC Manager or Section Chief

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes.

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

ArcGIS, WebEOC, Situation Analyst

2.) What do you use it for?

All platforms contribute to building a common operating picture of incidents. WebEOC also serves as a documentation platform for unit logs, event reporting, etc. Situation Analyst is in beta-testing but is a GIS-based cloud system that can help get an overview of current incidents.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

Response and recovery

4.) What aspects of the tool do you like?

Ability to project a common operating picture.

5.) What aspects of the tool do you dislike?

With the exception of ArcGIS, all these tools are dependent on an Internet backbone. With a widespread network outage, we would go from 21st century operations to early 20th century operations (HF, hard-wired telephone, and runners). Most civilian managers of Command, Control, Communications, and Intelligence systems have a poor understanding of 'redundancy' and 'resiliency' recent outages at YouTube, E-Bay are a good illustration. Also user training is challenging, especially when the tools are used infrequently.

May not have the resources to build a COP during the initial response (< T + 2 hours)

6.) What improvements could be made to the tool to improve its speed/efficiency?

Improve network redundancy and resiliency

Better filtering of 'noise' and unverified information

More commonality, e.g. APIs, among varying operating systems and file types

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?
4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

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1.) What is your specific function in Emergency Management?

I am the Emergency Management Program Manager. I am responsible for all phases of emergency management for my county. Everything from planning, response, mitigation, and recovery falls under my umbrella. I have a director above me, (county Sheriff) but mostly, I am on my own to perform my normal job functions. Much of my work is in planning—making sure adequate response and recovery plans are in place.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?
Not at the present time. We have limited GIS capability, but it is internet based, and when needed, it will go away with the rest of our infrastructure.

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

2.) What do you use it for?
3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?
4.) What aspects of the tool do you like?
5.) What aspects of the tool do you dislike?
6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?

I believe computer aided decision support would be helpful and make decisions more thorough and "better considered." We would like to be able to implement a locally hosted solution so we would be able to ensure it was available to us when needed the most. If we can't assure that, it would be better to remain without so we don't become dependent on something we can't depend upon!

2.) What specific components would you want in the tool?

I would like to see mapping ability such as ArcView or something similar. We need to be able to generate accurate maps of an impacted area, and put meaningful information on those maps. Being able to generate and modify maps "on the fly" would be important to us. Asset tracking would be helpful as well. Knowing where your resources are located, and whether they can get where you want them is pretty critical to any response effort. Some form of asset tracking (police cars, fire trucks, even personnel potentially) would prove invaluable.

3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

All of the above. You fight as you train, so we would need to use the tools in training, exercises, and practice events so that we would use it "for real."

4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

Financial mostly. Staff capability could be part of the picture, as is the lack of familiarity with the tools out there. The "we have always done it this way" mantra is quite pervasive, and difficult to break down, especially when there is no funding to do anything differently.

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1.) What is your specific function in Emergency Management?

My function in emergency management is mostly in a grant and training capacity. I help manage the Homeland Security Grant and the Emergency Management Performance Grant. As for training, I help bring in consultants and State sponsored trainers to teach the community and EOC staff various emergency management strategies.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

As a county entity, we have access to our Information Services Department that has a GIS function. We also have two working plotters and an overhead projector in the EOC just for mapping.

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

The County of Mendocino uses the company ESRI and mostly uses ARC Mapping.

2.) What do you use it for?

On the emergency response side of GIS, we use it for: Search and Rescue mapping, communications mapping, disaster zones, and training.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

It is most useful in response because it enables the EOC to see where things are happening in a more overview capacity.

4.) What aspects of the tool do you like?

I personally do not use any of the GIS programs.

5.) What aspects of the tool do you dislike?
6.) What improvements could be made to the tool to improve its speed/efficiency?

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

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1.) What is your specific function in Emergency Management?

Assistant Director for Logistics, EMAC, Training and Exercises

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

YES

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

NC Emergency management uses WebEOC for its primary crisis management software. It is used to track/route resource requests from local government; to share significant events and situational awareness products to local, state and federal players; to create a common operational picture; to manage commodity distribution operations by listing all commodity points of distribution and county

logistics staging area; and to disseminate products from other systems like flood warning models, storm surge predictions. Most of the WebEOC modules and functions listed above were developed in house to meet our management needs. We have risk analysis systems developed in house. We have the best flood mapping system in the US which we have extended to several other states and manage for them. We have an internally developed logistics management system that integrates inventory management at multiple warehouses and staging areas with transportation and emergency purchasing management.

All of the above can be mapped via GIS. Example: Storm surge analysis is provided to local emergency managers to show them areas that will be flooded. Our flood mapping combines elevation data obtained thru aerial radar systems with GIS information that includes all building in NC over 500 sq. ft. (with their first floor elevations and property values). So we can predict the areas that will flood and the damage that will result. On scene damage assessment uses the same GIS information to rapidly compute actual damage costs.

The National Emergency Management Association (NEMA), the proponent for the Emergency Management Assistance Compact (EMAC) uses an automated EMAC Operating System (EOC) to facilitate mutual aid among the 50 states during disasters. It facilitates brokering of disaster requirements with offers of assistance and tracks all mutual aid resources nationwide.

2.) What do you use it for?

See above.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

WebEOC, the GIS products and flood prediction models, and the logistics management system are used for command and control during response and recovery. They require training for users and operators. The storm surge models and flood mapping products are used for planning and during response/recovery. The risk analysis products and methodology are used for planning and mitigation.

4.) What aspects of the tool do you like?

All of these systems and products are essential to effective crisis management. You can't manage what you can't see. In the logistics areas, one cannot function effectively without asset visibility throughout the logistics organization. In all of our systems, all players do their work in the same system using forms/products designed to facilitate their work requirements. Their work is captured and the consequent information shared by extracting information and tailoring it to meet the information needs of the players in the processes. The database structures the various processes and disciplines them because it structures the way people do their work. It also provides the metrics managers need to assess effectiveness and apply resources where they are needed. Walmart's system illustrates the point: customers' products are scanned at the cash register (structured/disciplined input) and the information is feed to Accounting and to Inventory; and purchase orders are automatically generated if inventory balances drop below reorder points. The same principles are applied to emergency management.

5.) What aspects of the tool do you dislike?

None.

6.) What improvements could be made to the tool to improve its speed/efficiency?

We are continually updating and developing all of these systems/tools and developing new ones.

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?
4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)

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1.) What is your specific function in Emergency Management?

EOC Manager – IT, communications (ESF2), facilities management, and meteorology.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

WebEOC Mapper – Powered by ESRI ArcGIS Server Standalone

2.) What do you use it for?

Not commonly used but can be for shelters, generators, etc.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

Response however we are working on a recovery tool. We have RFB back for the recovery tool and are evaluating.

4.) What aspects of the tool do you like?

Not many.

5.) What aspects of the tool do you dislike?

Tough to update, add new layers, do GIS on the fly (quickly), slow, and overall not user friendly.

6.) What improvements could be made to the tool to improve its speed/efficiency?

Complete rewrite of the code and use newer tools.

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?

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1.) What is your specific function in Emergency Management?

Development of an Emergency Response Program for the Stockbridge-Munsee Community. Training the Incident Command on ICS dictum and disciplines for response preparedness during an emergent event. Preparedness-Response-Recovery-Mitigation.

2.) Do you or your agency currently employ any sort of computer-aided decision support tool (model, GIS interface, other mapping software, etc.) for training, planning, response, or recovery?

Yes

If you answered yes to question 2 above:

1.) What is the name and type of tool you currently use? Who developed it for you?

Google Earth, Google Maps, ENKETO-WHAM damage assessment, CD's covering emergency response, ARCGIS systems.

2.) What do you use it for?

Pre-mapping of evacuation sites, tornado shelters, sheltering, staging access points, fire hydrants, critical infrastructure identification.

3.) Which activity (training, planning, response, recovery, or any combination thereof) is it most useful for?

Exercises, Drills, e-mail blasts from latest Emergency Management information, outreach training programs.

4.) What aspects of the tool do you like?

User friendly

5.) What aspects of the tool do you dislike?

Data entry must be kept up to date and changes. Very time consuming.

6.) What improvements could be made to the tool to improve its speed/efficiency?

If the tools can be shared with mutual aid responders who will be coming cold to the area with knowledge of the area.

If you answered no to question 2 above:

1.) Would the use of a computer-aided decision support tool help guide your decisions faster/more efficiently?
2.) What specific components would you want in the tool?
3.) What would you use the tool for specifically (training, planning, response, recovery, or any combination thereof)?
4.) What is the reason your organization does not currently employ a computer-aided decision support technology? (financial, staff capability, geographic, lack of familiarity, or other infeasibility)