USER ACCEPTANCE OF TECHNOLOGY: AN EMPIRICAL EXAMINATION OF FACTORS LEADING TO ADOPTION OF DECISION SUPPORT SOFTWARE TECHNOLOGIES FOR EMERGENCY MANAGEMENT

Eliot A. Jennings

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APPROVED:

Sudha Arlikatti, Committee Chair
Simon Andrew, Committee Member
James Kendra, Committee Member
David McEntire, Committee Member
Robert Bland, Chair of the Department of Public Administration
Thomas Evenson, Dean of the College of Public Affairs and Community Service
Mark Wardell, Dean of the Toulouse Graduate School

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This study examines factors that influence the intent to use and actual use of decision support software (DSS) technology by emergency management officials to facilitate disaster response management. The unified theory of acceptance and use of technology popularized by scholars from the field of information sciences (IS) for the private sector is adapted and extended to examine technology use in the public sector, specifically by emergency managers.

An e-survey was sent to 1, 452 city and county emergency management officials from FEMA region VI and complete responses obtained from 194 were analyzed. Findings suggest that social influence is the strongest predictor of intent to use DSS technology by emergency managers, unlike private sector studies where performance expectancy was the strongest predictor. Additionally, effort expectancy, collaboration, social vulnerability, professionalism, performance expectancy, and gender explained 40 percent of their intent to use DSS technology. Factors explaining actual use of technology were intent to use technology, having an in house GIS specialist, and age of the emergency manager.

This research successfully closes the gap in IS and disaster literature by being the first to focus on factors influencing technology use by emergency managers for decision making in disaster response. It underscores the importance of collaboration not only for post-disaster activities but also as a precursor to better disaster preparedness planning that calls for information sharing and technology acceptance and adoption across partnering jurisdictions.

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CHAPTER 1

INTRODUCTION

Background and Rationale

A defining characteristic of the twentieth century, in particular, the latter half of that century, was technology use (Babaian, 2005). This trend has solidified even more in the 21st century. Technological historians comment that we utilize technology in virtually every application of our lives in our jobs, at home, and our leisure activities and are completely dependent on technology to make our communities livable (Franklin, 1999; Postman, 1995; Schatski, 2003). In recent years, government organizations have extended the application of technology to governmental functions in their desire to be more efficient, quicker and more accountable (Babaian, 2005). As we continue to expand our use of technology in all aspects of our lives, it is important to understand how this increased dependence has impacted disaster management. Technology plays an important role in all phases of emergency management at all levels (Pine, 2007), and yet perhaps the most visible application is during the response phase to disasters at the local level (Phillips, Neal, & Webb, 2012; Reddick, 2011).

McEntire (2007) defines response as actions directed towards saving lives and protecting property. These can include pre-impact activities such as hazard detection and warning, and post-impact activities such as search and rescue and medical services. It is also recognized that information management and coordination are critical elements of any disaster response. Technological advancements have had a significant impact on hazard detection. Officials now have access to data on potential and existing hazards from a multitude of sources. Direct and remote sensing capabilities provide multiple perspectives on hazards (Pine, 2007;

Reddick, 2011). Direct sensing devices include local and distant weather stations, water level and stream gauges, and air quality sensors. Remote sensing applications include satellite, radar and aerial photography.

Technological advancements have also created new means of warning the public. Emergency management officials now have access to notification systems that can incorporate telephones, radios, pagers, and e-mail systems to notify both officials and the public (Pine, 2007). Reverse 911 systems and vendor call-down systems now have the capability to simultaneously call thousands of phones to provide warnings. Officials also have access to cable override systems and remote dynamic message signs on highways. Finally, increased use of social media can provide a means of informing the public of impending hazards (Merchant, Elmer, & Lurie, 2011; Sutton, Palen, & Shklovski, 2008).

Technological enhancements have also influenced post-impact activities involving information management, communications and coordination in managing disaster response. This is most evident with the emergence of the high-tech emergency operations centers (EOCs) with integrated communications systems, visual displays and decision support software (DSS) programs. The EOC serves as the master control and coordination center from which local communities mount their disaster response. In addition to providing a place from which to manage the local response, EOCs serve as the communications center for communicating with other government entities and the public (Perry, 1995). Technological advancements have impacted communication systems. Today, computer controlled trunked radio systems allow for increased talk group capacity on a radio system. Interface devices have the capability to link virtually any communications mediums to one another. Interface devices can enable satellite, cell or land phones to communicate with UHF, VHF or trunked radios (McEntire, 2007).

Communications and coordination is critical to disaster response due to the multitude of actors involved in responding to disasters. The U.S. Federal Emergency Management Agency (FEMA) maintains that emergency management is primarily a local responsibility (FEMA, 2007). However, disaster scholars have shown that disasters often overwhelm local communities and require a collaborative response effort from multiple stakeholders from government agencies as well as the non-profit and private sectors (Buck, Trainor, & Aguirre, 2006; McEntire, 2007; Waugh, 1994; Wenger, Quarantelli, & Dynes, 1990). More recently, events such as Hurricane Katrina and the 9/11 attacks have also highlighted the importance of collaboration or lack thereof in responding to disasters (Banipal, 2006; Wise, 2006).

DSS technology is one technological tool that can enhance disaster response management and facilitate communication and coordination. Wallace and De Balogh (1985, 134) defined a decision support system as the "integration of computer hardware and software that is designed to complement the cognitive processes of humans in their decision making". They suggested that the development of decision support systems for emergency managers would enhance the ability of disaster managers to manage disasters, particularly by meeting the information needs of emergency managers.

Such decision support systems have recently emerged in the emergency management arena as technological tools to assist in managing disasters. (As the hardware component of computing systems has improved tremendously since Wallace and De Balogh's (1985) definition including both hardware and software components), the decision support systems presently created for use by emergency managers typically focus on software as an electronic technology that can run on a variety of computing system platforms. For example, NC-4™ situational readiness solutions markets NC-4 Risk Center™ information analysis services, a situational awareness program which notifies government agencies of events world-wide which could threaten local or national security. NC-4 also provides Eteam™ emergency management software, a DSS program designed for incident management (NC-4, 2009). ESi® crisis solutions markets WebEOC® emergency management and public safety software as an incident management system (WebEOC, 2013).

Project Ensayo (Becerra-Fernandez et al., 2008) is pushing EOC technology use further in the development of a virtual EOC incorporating decision-making software with knowledge and social networking models. Project Ensayo's virtual EOC is being modeled after Miami-Dade county's physical EOC but provides an interface for remote users to share information through an open source environment. Remote users of the system will utilize a desktop virtual reality interface to make interactions more intuitive and natural (Becerra-Fernandez et al., 2008). However, Project Ensayo's use so far has primarily been as a training tool for emergency managers and as a research tool for scholars studying decision making under emergency conditions (Nicolai, Beccera-Fernandez, Prietula, & Madey, 2009).

Theories that lead to understanding factors that influence the adoption of technology have been developed in psychology, sociology and the information sciences (IS) fields (Ajzen, 1985; Bandura, 1977; Fishbein & Ajzen, 1975; Rogers, 1962; Triandis, 1977). Numerous models of technology acceptance have been developed and applied to research focused on enhancing our understanding of the factors that lead to acceptance of technology (Davis, Bagozzi, &

Warshaw, 1989; DeLone & McLean, 2003; Thompson, Higgens, & Howell, 1991; Venkatesh, Morris, Davis, & Davis, 2003). However, the vast majority of the technology acceptance literature has emerged from the IS field with an emphasis on technology acceptance by private individuals or individuals employed in private sector organizations. Limited research has focused on technology acceptance in the public sector with even less focused on technology acceptance for emergency management technologies.

Lee and Rao (2007) point out that technology research oriented to public sector organizations is inherently different in that government organizations utilize technology to generate public goods such as public safety and national security rather than to maximize individual organizational profits. Moreover, Thomas (2009) argues that most studies on technology acceptance do not consider differences in application which limits one's understanding of the success of its use. Following this line of thought, it is worthwhile to examine the intent to use and actual use of technology in a disaster response environment so distinct from normal day-to-day operations, even for emergency managers.

Therefore, from both a public sector perspective and a functionality view, this research aims to address the acceptability and use of DSS technology by emergency managers. This will provide additional insights into the decision-making process emergency management officials use in adopting specific technologies that serve as a decision support tool for emergency management during disaster response even though the adoption of technology is typically an activity undertaken before the disaster occurs.

There is limited research on the extent to which local emergency management agencies and officials are participating in the use of such DSS and other emergency management information technologies. Although Nehnevajsa's (1990) extensive survey of local emergency management officials' preparedness activities for the FEMA included a section on EOCs, it failed to include questions related to technologies utilized therein. Green (2001) assessed local government EOCs while focusing on the physical characteristics and concluded that EOCs were well equipped with communications technology, and yet the findings reported that only a quarter of the EOCs used even basic emergency management software. Lindell, Sanderson, and Hwang (2002) compared technology usage between local land use planners and emergency managers and found that local land use planners used computer applications to access hazard information consistently while emergency managers relied more on printed hazard information. In particular, land use planners used geographic information systems (GIS) and mapping programs significantly more than emergency managers while their use of the EPA's computer-aided management of emergency operations (CAMEO®) chemical emergency software program and hazard modeling applications were similar. They suggested that emergency managers would be more likely to access more sophisticated technology if they increased their use of basic computer applications or partnered with land use planners that have already mastered the sophisticated technology.

Of note is that most of these studies were conducted over 10 years ago and much has changed in the types of technologies developed and factors facilitating or hampering their use. Consequently, it is important to determine the extent to which local emergency managers are using DSS technology to expedite incident management and the factors influencing this decision.

Problem Statement

While an abundance of literature from the information sciences domain have explored technology acceptance in the private sector (Davis et al., 1989; DeLone & McLean, 2003; Thompson et al., 1991; Venkatesh et al., 2003), there appears to be no application of this literature to examining the acceptance of DSS technologies in emergency management. Failing to understand the decision making process utilized in acquiring and using DSS technology could result in product development and implementation that fails to sufficiently support EOC operations, and consequently incident management. The proposed research is aimed at filling this gap in literature and expanding our understanding of the use of DSS technologies by emergency management officials for disaster response management. Thus, the primary research questions are: 1. What factors influence local emergency management officials intent to use DSS technologies in EOCs? 2. What factors influence the actual use of DSS technology by local emergency management officials?

Organization of the Dissertation

The ensuing sections of the dissertation are organized into four chapters. Chapter 2 describes the complexities of disaster response management, tragic choice, fuzzy decision making and the need for accurate and timely situational awareness for successful response operations. Then a review of relevant literature from multiple disciplines including emergency management, public administration, psychology, sociology and information sciences related to the acceptance and use of technology is provided. This is followed by an overview of the unified theory of acceptance and use of technology (UTAUT) model advocated by Venkatesh et al.

(2003) which is used as a framework for this study and supported by other moderating factors relevant to the public sector and emergency management arenas. The chapter concludes with the development of research hypotheses.

Chapter 3 details the research methodology used to examine the factors that explain the intent to use and actual use of DSS technology. It describes the unit of analysis, development of the survey instrument and administration of the survey. The operationalization of variables and statistical analyses to be conducted are also described.

Chapter 4 presents the results by showing the descriptive statistics and intercorrelations and regression outputs. The results of the multivariate linear regression specifically explain factors that facilitate the intent to use DSS technologies while the binary regression results predict DSS technology use.

Chapter 5 provides a discussion of the findings including limitations of this study as well as the theoretical and practical contributions of this study. Finally, suggestions for future research to overcome limitations of this study and further our knowledge beyond what is provided by this study are also offered.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Introduction

Disaster response can be simply defined as actions taken to save lives and protect property when a hazard impacts a community (McEntire, 2007). While seemingly a simple definition, disaster response requires the interaction of multiple stakeholders undertaking numerous activities. It is well recognized that responding to disasters effectively, requires multi-sectoral and multi-agency coordination and collaboration (Buck et al., 2006; McEntire, 2007; Waugh, 1994; Wenger et al., 1990). However, the number of actors involved can quickly become overwhelming (Comfort & Haase, 2006; Scanlon, 1991). While citizens and traditional first responders from established government agencies such as police, firefighting and emergency medical services are first to respond, other government agencies, the private sector, volunteer organizations and emergent groups are also integral to effecting response (Dynes, 1970). These stakeholders may already be in the hazard impacted area while others may converge upon the scene as returnees, the anxious, helpers, the curious, exploiters, supporters and mourners (Kendra & Wachtendorf, 2003). Thus, those that desire to help can range from professionally trained responders to untrained volunteers (Barsky, Trainor, Torres, & Aguirre, 2007) all of whom need to be appropriately managed in order to streamline the response phase.

While every disaster is unique, commonalities in response functions are observed and necessary. Perry (1991) identified six generic functions that have to be attended to in most disasters such as warning the public, evacuating those in danger and then providing shelter, conducting search and rescue operations, providing emergency medical care, and protecting property. Additional generic functions including assessing the damage, coordinating the response and restoring essential services have also been identified (Kreps, 1991). In order to carry out these response activities, both the responders in the field as well as those charged with managing the overall response from emergency operations centers (EOCs) need real-time up-to-date information. Without some knowledge of what has taken place, and the degree of impact (i.e., situational awareness) officials would be unable to focus their response efforts and serve their communities effectively.

Recently, the National Response Framework (Department of Homeland Security, 2008) has emphasized the importance of situational awareness to respond effectively, calling for a quick and timely assessment of the disaster situation as it unfolds, and the need to provide accurate information to decision-makers in a user friendly format. Quarantelli (1997, 45-46) noted that although the adequate processing of information was critical for the effective management of disasters, there was a tendency for this information flow to often disintegrate due to several reasons including:

- Volume of information increased overwhelming day-to-day communication systems.
- Staffing requirements expanded for extended response operations resulting in multiple individuals holding a position that during non-disaster times would be held by one individual.
- Responders were often faced with performing non-routine tasks, making them unsure of the information necessary to complete the task.
- Individuals were temporarily assigned to responsibilities they were unfamiliar with.

Militello et al. (2007) argue that maintaining mutual awareness in the EOC breaks down during response as a core group of more experienced personnel take on an uneven workload distribution. This work overload leads to communication breakdown which inhibits maintaining mutual situational awareness among others in the EOC. Others have pointed out that obtaining situational awareness is difficult due to the variety of organizations involved in disaster response (Comfort, Dunn, Johnson, Skertich, & Zagorecki, 2004) and recommend information fusion from numerous sources as a key component of improving situational awareness and disaster management (Rao, Eisenberg, & Schmitt, 2007).

Responding to disasters creates demands on emergency managers to effectively mobilize personnel and resources, prioritize and delegate tasks, divide labor, execute decision-making and develop overall coordination (Quarantelli, 1997). These demands rely on obtaining situational awareness reports.   In most U.S. disasters, the necessary resources are often available, but to effectively utilize personnel and resources decision makers must have an understanding of what resources are available, where those resources are located and what can be accomplished with these resources. While some tasks may be more routine for some organizations, the disaster environment often creates tasks that did not lie within the normal domain of any organization (Quarantelli, 1997) further complicating decision making. It is also possible that a task that might be perplexing during normal times becomes even more complicated during disaster response. For example, Arlikatti, Kendra and Clark (2012) find numerous inter-organizational challenges arise for emergency managers in dealing with evacuating and sheltering registered sex offenders during disasters.

Dror (1988) noted that decision making under disaster conditions was inherently bounded (i.e., not fully rational in that a complete search for alternative solutions and selection of the best does not occur) for several reasons. The first was that while the demands for decision making in disaster situations are created by the disaster, those that must make decisions are faced with the adversity of the disaster environment. A second bind is produced by the "images" created by the disaster. These representations of what is taking place, often created by the media, may not be accurate and yet influence decision making. In this context, a false situational awareness may be produced. A primary feature of decision making in the disaster environment is "intense time pressure." (Dror, 1988, 259). While there may be information available for developing situational awareness, limited time may preclude the opportunity to analyze and synthesize that information. Another factor is the notion of "tragic choice" which suggests that any decision made is likely to have a negative impact. Dror (1988) explained that tragic choices were often based on the questions that are asked which require decisions to be made. These questions are often shaped by the perceived situation. Tragic choices are also influenced by the attention events receive, which are often determined by information flow. Furthermore, decision makers cannot work indefinitely or in isolation. Adequate situational awareness needs to be relayed to new personnel or those on new shifts so they can make better decisions (Quarantelli, 1997).

Under these circumstances, decision support software (DSS) technology use in EOCs is encouraged for their ability to generate timely and accurate situational reports, fuse data from multi-sector organizations, and help limit tragic choices or fuzzy decision-making. Therefore, their acceptance and use by emergency managers is indeed important to understand.

While arguments for technological applications in emergency management are plentiful, little is understood about actual use and the factors that influence the decision to use those technologies. In order to develop an emergency management DSS technology adoption model, a review of the technology in emergency management, studies of technology acceptance in emergency management and the literature on development of technology acceptance models is essential.

Technology in Emergency Management

To further adapt the unified theory of acceptance and use of technology (UTAUT) model to understanding intent to use and acceptance of technology in emergency management, an overview of technological applications in emergency management is necessary. One area in which technology is playing an increasing role in emergency management is through the use of GIS which has grown tremendously since the late 1980s and early 1990s (Cutter, Emrich, Adams, Huyck, & Eguchi, 2007). The first integrated application of GIS in responding to a disaster was in the response to Hurricane Hugo (1989) followed by increased visibility of the potential for GIS applications with Hurricane Andrew (1992) and the Northridge earthquake (1994). While geographers were some of the first scholars to study disasters by examining where people choose to live, they have also utilized GIS to provide visual information, and threat mapping to facilitate responding to disasters (Kendra, 2007). The integration of social and geographic data in GIS provides for further understanding of disasters as socially constructed events (Dash, 1997) while Morrow (1999) contends that GIS that incorporates high-risk sectors in communities into maps and spatial analysis provides another tool for emergency managers to better prepare for and respond to disasters. Another application of GIS incorporates spatial optimization methods to determine constrained egress routes for evacuation planning (Cova, Theobald, Norman III, & Siebeneck, 2011). Furthermore, geographers have helped incorporate GIS into other technologies such as decision support systems to further enhance disaster response (Thomas, Kivanc, & Kemec, 2006).

The importance of GIS is being recognized by academic programs as well. Cwiak (2012) reports that 22 of 45 emergency management higher education programs indicated they offer GIS as a technology-based instruction. GIS-based instruction was offered more than any other type of technology-based instruction. Blanchard (2005) identified GIS technical skills as one of the top ten competencies for successful emergency managers.

Technological advancements are clearly evident in the initial step of disaster response (i.e., conducting a damage assessment). Much of the technology being applied to hazard detection such as satellite imagery can quickly provide visual representation of damages (Pine, 2007). Additional concepts being explored include the use of remote controlled drone aircraft mounted with video surveillance. This potential application could be critical in providing damage assessments following storms (EPRI, 2012).

In addition to the enhanced visual capabilities for damage assessment, technological applications of GIS provide the ability to monitor and track damage assessment in a map format. GIS has the capability to utilize geo-coding in addition to physical address systems to develop a database of damaged structures as well as recovery support facilities. Maps can be created to show the location of damages, impacts on infrastructure and utilities, critical facilities and shelters (Cutter et al., 2007; Pine, 2007).

Global position system (GPS) was developed to provide input to navigation systems, but has been incorporated into disaster response through several applications including being combined with GIS to generate detailed and quicker damage assessments (Cutter, 2003). GPS has been installed in vehicles and equipment to allow for tracking of resources and resource dispatching, and combined with remotely sensed data to provide for quicker development of situational awareness (Ramsey et al., 2001). GPS can be valuable following a disaster as street signs and identifying landmarks may be missing or unrecognizable. Agencies which provide response services may need an alternative means for knowing where they are or need to go.

Technological advancements in warning systems have been implemented in disaster response. While emergency managers utilize a complete tool box in warning the public, many of these tools are technological in nature. For example, emergency management officials may have the capability to activate warning sirens, override cable systems and call thousands of citizens simultaneously (Pine, 2007). In addition, they have the ability to transmit warnings through dynamic traffic messaging displays which can be utilized to warn the traveling public. However, fragmentation exists in the warning technologies available and developing a common alert protocol is essential to facilitate warning system development and implementation (Botterell, 2006).

A major push emerging from the 911 Commission report (Department of Homeland Security, 2011) has been on the development of interoperable communications systems which refers to the ability to communicate across jurisdictions and disciplines as necessary to support incident management. Attention has been given to improving emergency communication systems infrastructure (Turoff, Chumer, Van de Walle, & Yao, 2004) and interoperability (Bell & Cox, 2006). While much of the focus on interoperable communications has been on the implementation of 800 MHz trunked radio communications, others have looked to interface devices that allow for communications between all types of phone systems and radio systems (McEntire, 2007).

Often overlooked as an emergency management technology, use of the internet is also being advanced. Through their study of Hurricane Katrina survivors, Bertot, Jaeger, Langa, and McClure (2006) demonstrate that community residents located missing family members and friends using public library internet access. They also found that internet access in libraries provided a means for residents to communicate with evacuated and displaced family members. Evacuees also used this access to check for information on conditions in the communities they had evacuated from.

Using social media through the internet is also a relatively new technology for emergency management agencies. Palen, Hiltz, and Liu (2007) found that citizen led online forums emerged following Hurricane Katrina and the 2003 San Bernardino, CA wildfires. Citizens developed these forums as a means of sharing and learning from each other's experiences. They suggest that emergency management officials need to become involved in these citizen generated information systems. White, Plotnick, Kushma, Hilts, and Turoff (2009) point out that social media can be another tool emergency management officials use to disseminate information quickly and inexpensively to large audiences. Flicker, an online photo sharing program, is another form of social media that has been tapped by emergency management officials as a means of providing eyewitness accounts of the impact of hazards (Liu, Palen, Sutton, Hughes, & Vieweg, 2008).

Decision Support Software.

More recent technological advancements in emergency management have focused on the development of DSS programs such as HazusMH® loss methodology software, Cameo, Marplot® mapping application, Aloha® modeling program, WebEOC and Eteam. The federal emergency management agency (FEMA) developed HazusMH as a standardized methodology tool for estimating potential physical, economic and social impacts due to earthquakes, floods and hurricanes and provides it free of cost to local jurisdictions (FEMA, 2012). While initially utilized as a tool during the assessment phase of mitigation planning, its use has been expanded to all phases of emergency management. Particular uses during the response to disasters are the ability to support rapid impact assessments and the program's mapping capabilities to facilitate routing of critical resources during response.

Computer aided management of emergency operations (CAMEO) is a computer software suite developed by the Environment Protection Agency (EPA) and National Oceanic and Atmospheric Administration (NOAA) for use in responding to chemical incidents which they provide at no cost to local officials. CAMEO provides emergency responders with information on nearly 5,000 hazardous materials as well as data on chemical inventories and hazardous material transportation routes. Additional tools have been developed by the EPA and NOAA to work with CAMEO such as the aerial locations of hazardous atmosphere (ALOHA) dispersion model and mapping applications for response, planning and local operational tasks (MARPLOT). In combination, CAMEO, ALOHA and MARPLOT provide valuable information in a hazardous material release on the chemical involved and appropriate response protocol for that particular chemical as well as a means to model the plume from the chemical plotted on maps showing vulnerable downwind locations (Environmental Protection Agency, 2012).

Other DSS programs focus on obtaining and maintaining situational awareness and then managing multiple aspects of the response. Programs such as Eteam and WebEOC provide a means of documenting the response. For example, WebEOC markets itself as a program to assist emergency management officials to manage multiple incidents by utilizing its web-based information sharing programs in order to coordinate tasks, manage resources and provide situation updates (WebEOC, 2012). Similarly, Eteam promotes its product as facilitating coordination across all levels of government by providing a common operating picture and resource management (Eteam, 2012). These types of decision support programs provide a tool for emergency management agencies to gather situational awareness information from multiple sources in order to provide information to better manage personnel and resources and delegate responsibilities and tasks in dealing with disaster response. The breakdown of information flow during disaster response leads to numerous challenges in coordinating the response (Militello, Patterson, Bowman, & Wears, 2007), and decision support technologies have been publicized as tools that allow for sharing of real time information between emergency management agencies.

While these DSS technologies allow for the generation of situational reports they also enable documentation of damage assessment, road closures, tasking assignments, shelter management, hospital management, critical infrastructure assessment, resource requests, volunteer management, and case management (Eteam, 2012; WebEOC, 2012). DSS technologies also allow for the sharing of information both internally within an organization and with other response organizations in the community such as other cities, counties and volunteer disaster organizations that have these programs.

Problems associated with disasters are numerous including information processing, resource management, the delegation of tasks and the overall coordination of response efforts. Solving these problems requires effective decision making (Quarantelli, 1997), relying on accurate situational awareness which DSS technologies such as WebEOC and Eteam seek to solve. Several factors influence decision making in disaster environments including the degree of uncertainty, often due to a lack of information, time constraints and impediments due to group processes as a multitude of individuals and organizations are involved in the response efforts (Dror, 1988). The use of DSS technologies such as WebEOC and Eteam is intended to help overcome these difficulties in decision making under disaster conditions.

Emergency Management Technology Acceptance Studies

The vast majority of technology acceptance research has originated in the IS field with an emphasis on the private sector or consumer acceptance of technologies. Little empirical research on technology acceptance has specifically focused on the public sector in general or on the adoption of emergency management technologies. While Bannister (2001) showed that public organizations are slower to adopt information technologies than the private sector, research is beginning to emerge which focuses on technology acceptance in the public sector. Brown and Brudney (2003) surveyed the use of information technology by police officers while Dadayan and Ferro (2005) examined technology acceptance by public education and public health employees. Recently, Thomas (2009) looked at technology acceptance by employees of one local government. Several studies are now emerging, that show acceptance of emergency management related technologies such as alerting technologies (Wu, 2009) and information sharing technologies (Lee & Rao, 2007).

One of the earliest studies on the implementation of technology in emergency management is Drabek's (1991) research on the use of personal computers (PCs) in disaster preparedness and response. This study showed that the use of PCs by cities grew tremendously in the early 1980s from 13 percent of cities owning or leasing a PC in 1982 to 84 percent by 1985. Kraemer and King (1986) further analyzed computer usage in cities finding that 100 percent of medium and large cities utilized computers with 90 percent of small cities using computing systems. While these studies examined PC usage in general in local government organizations, Bradford (1984) found that only 38 percent of government agencies used computers for emergency management purposes.

Chartrand (1985) argued that utilizing information technology for warning and notification, situational awareness, decision making and dissemination of information would be critical to improving disaster management. Others focused on specific applications such as mapping programs noting that appropriate computer support and technical expertise were critical for emergency management applications (Dobson, 1983, 1985). Furthermore, a prototype decision support system for responding to nuclear incidents was developed at the request of the New York State Office of Disaster Preparedness (ODP) (Belardo, Karwin, & Wallace, 1983). The program contained a database of available equipment and personnel qualifications as well as a plume path calculation capability that could be accessed by ODP staff using computers in order to set priorities and allocate resources. Belardo et al. (1983)

suggested that the prototype decision support system demonstrated the feasibility of utilizing such technologies in emergency management but pointed out that information and graphic quality were potential issues with using computers. They also expressed concerns over the possibility of creating information overload for decision makers. However, they point out that when the decision making processes are studied, better computer models can be developed. A primary benefit that Belardo et al. (1983) saw in using computers to aid decision making in emergency management was improved training and exercises.

The recognition of the potential for using computing systems in emergency management was verified by Bradford (1984), who suggested that over 79 percent of government agencies indicated they supported the use of computers in emergency management and 91 percent said they were personally interested in finding out how computers could facilitate managing emergency situations. Drabek (1991) found that emergency management officials specifically intended to utilize PCs for the following response related purposes: record keeping/documentation, weather data, resource management, damage assessment, status reports, shelter management, decision support systems, critical facility management, evacuation route management and horizontal networking. However, when examining actual use of computers by emergency management officials, Lindell et al. (2002) found that they did not use computers to access hazard information as extensively as did land-use planners. Nor did the emergency managers utilize geographic information systems (GIS) and mapping programs to the same extent as land-use planners.

Another area that has received attention is the utilization of GIS within local governments. Nedovic-Budic and Godschalk (1996) examined human factors in the adoption of

GIS in county government. While they concluded that GIS adoption was a complex process, factors including its perceived advantage, previous computer usage, exposure to the technology and networking were the most important determinants of employee willingness to use GIS technology. Robey and Sahay (1996) found that when GIS technology built upon existing computer competency and utilized a process that advanced the users' knowledge it was quickly adopted. In particular, they found that social influence led to a wider adoption of GIS technology.

Brown and Brudney (2003) examined the use of information technology by police officers. While they did not specifically focus on factors that influenced user acceptance of technology, they did find that 77 percent of police officers believed that multiple types of information were critical to problem solving but that only 60 percent believed their current information technology was more than effective at providing that information. Although, their study did not examine technology acceptance from a traditional IS view, the findings provided support on the importance of performance expectancy.

Utilizing a theory of planned behavior and the technology acceptance model Lee and Rao (2007) looked at technology acceptance among anti/counter terrorism agencies. Their findings suggest that in the sensitive information environment of homeland security the acceptance of information sharing technology is primarily influenced by information security concerns and standards rather than the value of information sharing. Colvin and Gho (2005) explored factors that lead to the acceptance of lap-top based mobile display within the police community. Their findings produce four factors that influenced an officer's acceptance of the technology: ease of use, utilization, information quality and timeliness with information quality and timeliness being the most important determinates of technology acceptance.

Studies have also focused on the willingness of the public to utilize alerting technology as a means of being notified in emergencies. Wu (2009) found that ease of use and social norms were more influential than perceived utility in the adoption of alerting technology among college students. Furthermore, Wu argued that the social norms provided by friends were more influential than social norms provided by university officials. He suggested that adoption can be improved if meaningful use of the technology can be applied to common purposes and acceptance is promoted through the end-users social networks.

Thomas (2009) studied technology acceptance among public employees and demonstrated that when the use of technology is mandatory, intent to use the technology is not the most important determinant of use but that attitude becomes critical to successful implementation of the technology. Furthermore, gender, age and experience had no moderating effect on either intent to use or actual usage. She concluded that technology effectiveness and efficiency are important determinants of user satisfaction.

Evolution of Technology Acceptance Models

One of the earliest explanations for technology acceptance is Rogers' (1962) innovation diffusion theory that explained the spread of technology. He posited that the adoption of innovations went through a five-step process (170).

1. Knowledge in which a person is made aware of an innovation.
2. Persuasion in which the individual seeks out additional information on the innovation.

3. Decision in which a person evaluates the innovation and decides to either accept the innovation or reject it.
4. Implementation of the innovation.
5. Confirmation in which the individual finalizes continued adoption of the innovation and pursues implementing the innovation to a fuller potential.

While the innovation diffusion theory explained the spread of technology as a progressive process from learning of the technology to fully utilizing the technology, it simply noted that an individual made the decision to accept or reject the technology. The theory failed to explain the factors that influenced that decision to accept the said technology.

The expansion of computer and information technologies led to substantial research further seeking to explain factors that influence step 3 in Rogers' (1962) diffusion of innovation theory, (i.e., the decision to use technology). In particular, studies focused on user acceptance of technologies has become one of the most intensely researched areas within the information sciences (IS) realm with a number of models being produced which force researchers to "pick and choose constructs across the models, or choose a favored model and ignore the contributions from alternate models" (Venkatesh et al., 2003, 426). A progression of models has thus led to a more robust model development starting with early models of user acceptance of technology as suggested by Fishbein and Ajzen's (1975) *theory of reasoned action*. Theory of reasoned action (TRA) suggests that a person's intended behavior depends on the person's attitude about the behavior and subjective norms represented as:

$$BI = A + SN$$

where BI is behavioral intent, A is attitude and SN is subjective norms. Fishbein and Ajzen (1975) define attitude as an individual's belief that a behavior will lead to certain consequences along with the individual's respective perception of that consequence. Subjective norms are that person's belief that specific individuals or groups think they should or should not perform that particular behavior and the value they place on compliance with what others think. In simple terms, intended behavior can be predicted by a person's attitude toward that behavior and how they think others will view that behavior. However, attitudes and subjective norms are not necessarily equally weighted (Fishbein & Ajzen, 1975).

Ajzen (1985) extended the TRA by incorporating Bandura's (1977) self-efficacy theory. Bandura's study on behavioral change (1977) posited that self-belief in the ability to successfully perform an action is critical to a person undertaking an action. Ajzen's (1985) *theory of planned behavior* incorporated an individual's perceived behavioral control or belief that they had the resources necessary and opportunity to perform an action. Consequently, the theory of planned behavior (TPB) contended that behavioral intention (BI) is influenced by attitude (A), subjective norms (SN) and perceived behavioral control (BC) represented as:

$$BI = A + SN + BC$$

The TPB model suggested that perceived behavioral control has both an indirect and direct influence on behavior. The indirect influence assumes that perceived control influences the behavioral intention. For example, if a person believes they lack the resources to perform an action, their intent may be low even if their attitudes and subjective norms are favorable. The direct influence reflects the actual control the individual has to perform that action or their behavior.

Theory of reasoned action (TRA) was adapted specifically to model user acceptance of information systems by Davis et al. (1989) in the development of the *technology acceptance* *model* (TAM). They pointed out that the TRA, while a predictive theory, lacked the ability to explain why a particular information system might be unacceptable. Davis et al. (1989) contended that perceived usefulness and perceived ease of use are the primary indicators for explaining user acceptance of information systems technology. Therefore, they offered a better equation for explaining behavioral intention regarding information systems represented as:

$$BI = A + U + E$$

where BI is behavioral intent, A is attitude, U is perceived usefulness and E is perceived ease of use. Perceived usefulness provides an indication of an individual's belief that a specific technology will enhance their job performance while perceived ease of use represents the degree of confidence a person has that the technology will be relatively effortless.

Taylor and Todd (1995) argued that the TAM failed to incorporate the predictive elements of the TPB model and therefore was insufficient in explaining technology use. Consequently, they proposed the combined TAM and TPB model as a hybrid model incorporating the predictors of TPB and the perceived usefulness from TAM. Their equation for explaining behavioral intent is represented as:

$$BI = A + SN + BC + U$$

where BI is behavioral intent, A is attitude, SN is subjective norms, BC is behavioral control and U is usefulness.

While the models discussed have a framework derived from the TRA and subsequent extensions, Thompson et al. (1991) argued that usage of these models led to mixed results. They suggested that Triandis's (1977) theory of human behavior provided a better theoretical foundation for developing models to predict usage behavior of technologies. In particular, Triandis's addition of frequent and repetitive past behavior or habits was extremely relevant in explaning people's usage behavior. He argued that behavior is determined by attitudes (A), social norms (SN) and habits (H). From this perspective, behavior can be represented by:

$$BI = A + SN + H$$

where behavior is explained by the attitudes or feelings a person has toward a behavior, what they think they should do, what they had usually done, as well as what the expected consequences of an action were. Triandis (1977) expanded upon attitudes as having cognitive, affective and behavioral components where the cognitive aspects incorporated a person's beliefs.

Within an IS perspective, a person may believe that a technology will make their work more efficient or easier. The affective component captures their feelings. When looking at technology, one may simply like or dislike a technology. Finally, a behavioral aspect incorporates how a person would like to behave. For example, an individual might simply want to learn a new technology.

Triandis (1980) expanded his theory of human behavior by including facilitating conditions that can make a behavior impossible. For example, if one does not have access to a technology, their intention is irrelevant. He pointed out that habits both directly and indirectly influenced behavior in that behavior influenced habits which then affected intention. Thompson et al. (1991) developed a model of personal computer (PC) utilization from Triandis's work that further incorporated job-fit, complexity, long-term consequences, affect towards use, social factors and facilitating conditions. Venkatesh et al. (2003) tested the model of PC utilization to successfully predict individual acceptance and usage of a variety of technologies.

UTAUT Model

One of the most popular technology acceptance models proposed and tested in recent years is the unified theory of acceptance and use of technology (UTAUT) model developed by Venkatesh et al. (2003). Their undertaking was to empirically compare the eight predominant models utilized previously within the IS field to explain the acceptance of technology and develop a unified model that integrates the eight models they examined. The eight models they tested included innovation diffusion theory, the theory of reasoned action model, the theory of planned behavior model, the technology acceptance model, the combined technology acceptance and theory of planned behavior model, the model of PC utilization, as well as the motivational model and the social cognitive model. Their research on these models showed a range of 17 percent to 53 percent explanation in the variance of the intent to utilize technology. They then developed the UTAUT model which explained 69 percent of the variance in user intention to use technology (Venkatesh et al., 2003). The model is presented in Figure 1.

Venkatesh et al. (2003) identified seven factors that were significant in explaining the intent to utilize technology in one or more of the models evaluated. According to their study the direct determinants of user acceptance in previous studies were performance expectancy, effort expectancy, social influence and facilitating conditions.

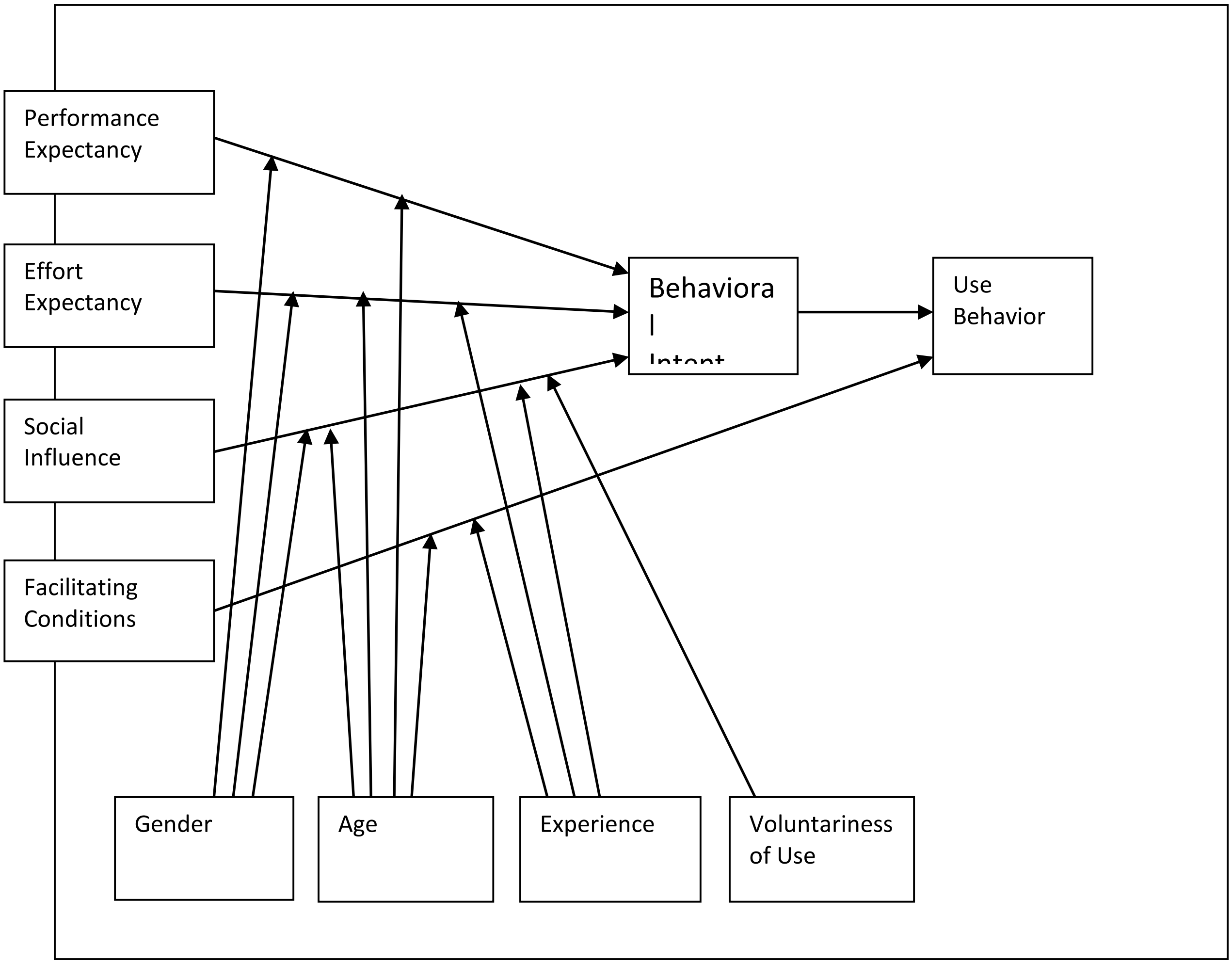

Figure 1. UTAUT model (Venkatesh et al., 2003).

Performance Expectancy

Venkatesh et al. (2003) defined performance expectancy as the “degree to which an individual believes that using the system will help him or her to attain gains in job performance” (447) and developed it from constructs in the eight models they evaluated. These constructs included extrinsic motivation related to improved job performance, increased opportunity for job promotion or better pay. Additional constructs incorporated job-fit factors related to increased quality of job outputs and more effective job tasking. Further constructs integrated perceived usefulness aspects of increased productivity and effectiveness and timely task completion.

Effort Expectancy

They defined effort expectancy as “the degree of ease associated with using the system” (450) which was derived from constructs associated with ease of use and complexity in the other models. These constructs included items pertaining to ease in learning the system, flexibility in operating the system, the ability to become skillful in using the system. Additional constructs addressed the time taken to learn how to use a system and the time to input data into the system. Other constructs incorporated perceptions on how clear and understandable the system is or how complicated the system is to operate.

Social Influence

*S*ocial influence was defined as “the degree to which an individual perceives that important others believe he or she should use the new system” (451) and captures the subjective and social norms offered in other models. Constructs to determine social influence included people who are important to the user and people who influence their behavior. Social influence also addressed the degree to which the technology is perceived to enhance one’s status in a social system. Another aspect of social influence included perceptions on the proportion of coworkers that use the system.

Facilitating Conditions

The last factor with direct influence on user acceptance of technology was facilitating conditions defined as “the degree to which an individual believes that organizational and technical infrastructure exists to support use of the system” (453). This is related to constructs of perceived behavioral control, facilitating conditions and compatibility offered in previous models on technology acceptance. These constructs included the availability of resources necessary to use the system, technical support and instruction in using the system and compatibility with other systems currently used. Another construct addressed the availability of specific groups or persons that could provide assistance with using the system.

However, in constructing the UTAUT model, Venkatesh et al. (2003) argued that when performance expectancy and effort expectancy are included as determinants of intent to use technology, facilitating conditions no longer play a role in influencing the intent to use technology. Rather, it becomes a determinant on the actual use of technology.

Other Factors

Venkatesh et al. (2003) theorized that three of the factors utilized in previous models were not direct determinants of user acceptance: attitude toward technology, self-efficacy and anxiety. They suggested that attitude toward technology was significant only when constructs related to performance and effort were not included. They expected their model to demonstrate a strong relationship between performance expectancy and intent as well as effort expectancy and intent, believing that attitude towards technology would not have an influence on use of technology. They also believed their model would show that self-efficacy and computer anxiety did not have a significant influence on behavioral intention. Venkatesh et al. (2003) argued that these two factors were fully mediated by perceived ease of use. Consistent with many studies in technology acceptance, they included gender, age, experience and voluntary use as moderating variables. The likely relevance and impacts of these variables are detailed later in this chapter.

Additional Variables

Threat Perception

Studies on the acceptance of technologies often focus on the perceived usefulness of the technology to solve difficulties. Simply put, the technology must provide a measurable benefit in overcoming a problem. As has been noted previously, the challenges of disaster response are numerous. While little debate exists about disaster response presenting problems, one must perceive the potential for a hazard to exist in order to believe these problems will have to be solved in a timely manner by using DSS technology. Hence, threat perception is an important variable for inclusion in this study.

Disaster History

Some communities may go years without having to manage a disaster, but many communities do experience disasters. Over the last decade 651 federal disaster declarations have been issued with a high of 99 in 2011 and a low of 48 in 2005 yielding an annual average of 65 disaster declarations (FEMA, 2012). For these counties, their threat assessment is not merely subjective, but an objective reality in which they actually face the challenges in managing disasters (Krueger, Jennings & Kendra, 2009). Therefore, disaster history for a jurisdiction measured as the number of federally declared disasters for that county over the previous 10 years is included in this study.

Social Vulnerability

Vulnerability refers to the negative impact to a person from hazardous events (Bolin & Stanford, 2002) or the "susceptibility to injury or damage from hazard" (Godschalk, 1991, 132). It is widely recognized in the disaster literature that the degree of impact from disasters varies between people experiencing the same hazard event with a greater impact generally experienced by those on the lower end of socioeconomic scales (Wisner, Blaikie, Cannon, and Davis, 2004). Social vulnerability has been found to be an effective indicator of the extent of damage from hazards. Kuhnwishit and McEntire (2012) found that social vulnerability had a statistically significant positive effect on the perceived level of disaster impact for victims of Hurricane Katrina while Zahran, Brody, Peacock, Vedlitz, and Grover (2008) found social vulnerability to be a statistically significant positive indicator of flood impact.

The Social Vulnerability Index (SoVI®) 2006 – 10 measures the social vulnerability of U.S. counties to environmental hazards (Hazards and Vulnerability Research Institute, 2013). The most recent SoVI uses data from the 2010 U.S. Decennial Census and the five year estimates from the 2006 – 2010 American Communities Survey to develop its metric. While the SoVI utilizes 30 socioeconomic variables to develop its scores, race and class, wealth and age explain nearly 50 percent of the variance in the SoVI score. Adding four more variables, Hispanic ethnicity, percent of residents living in nursing or skilled-nursing facilities, Native American ethnicity and service industry employment explain 72 percent of the variance in the SoVI score. The SoVi scores for counties in the United States range from minus 10.693 for Loudon County, Virginia (as the county with the least social vulnerability) to plus 12.841 for Bronx County, New York (as the county with the most social vulnerability). On the SoVI, a minus score is less social vulnerability with a plus score representing greater vulnerability. The SoVI provides an additional objective measure of the potential impact to a community from hazards. Consequently, the SoVI is a valuable variable in this study.

Disaster Exercises

While actual disaster events provide a means for analyzing the ability to face the challenges in managing disasters, exercises provide a means to practice handling those challenges in a non-threatening environment. Exercises can assist local communities in improving interagency coordination and communication and evaluating resource management. Exercises also provide an opportunity to practice decision making and information sharing among organizations (Department of Homeland Security, 2007). In particular, exercises provide a means of evaluating inter-organizational response to disasters and bring these organizations into closer contact with one another (Perry & Lindell, 2003). Waugh and Streib (2006) suggest that exercises provide one means of developing the capacity of emergency management agencies to collaborate in responding to disasters. Furthermore, the Department of Homeland Security recommends that exercise program managers consider incorporating information technologies into exercise designs (DHS, 2013). Following this line of thought, the number of disaster exercises conducted in the previous two years is an important variable in this study.

Collaboration

Collaboration is widely recognized as an essential element of disaster management in order to overcome the complexities involved in responding to disasters (Drabek, 2007; Lindell & Perry, 2007; McEntire, 2007; McEntire, 2007a; Patton, 2007) with numerous scholars supporting the use of the collaborative model of disaster management (Buck et al., 2006; McEntire, 2007; Waugh, 1994; Wenger et al., 1990). McEntire (2007) contended that the number of agencies and entities involved requires a collaborative effort in disaster response while Perry (1991) argued that successful disaster response depended upon effective pre event inter-organizational coordination among responding organizations.

In examining coordination, Gerber and Robinson (2009) found that city and county officials perceive a greater level of coordination with state officials than federal officials in preparedness and response efforts. Their analysis of horizontal relationships reveals several factors which influence the level of coordination between county and city governments on homeland security planning. Cities with more than 100,000 residents reported greater coordination with their counterparts. They also argue that regions of the country with a history of past disasters engage in greater regional coordination in disaster preparedness.

Feiock (2004) maintained that collaboration is a strategic interaction local governments use to solve problems such as disaster response. He found that collaboration can be minimal, such as an agreement between neighboring jurisdictions to provide assistance in emergency response or on a much larger scale such as formalized regional planning efforts. Andrew (2009) examined public safety collaboration through contracting. His findings suggest that disaster response collaboration involves public safety agencies that have ties with partners seeking to expand their network by establishing ties with their partner's allies in order to broaden their resource pool.

Research indicates that agencies which create familiarity with one another prior to a disaster work together better, resulting in better emergency response. For example, Kendra and Wachtendorf (2002) attributed the successful evacuation of lower Manhattan in response to the 9/11 attacks to the fact that boat operators had established both formal and informal relationships which enhanced their familiarity with one another.

Previous studies on technology acceptance have focused heavily on private sector uses of technology as it often serves to provide a competitive edge to a private sector organization. In contrast, disaster response necessitates the use of technology that can support collaboration. Specifically, the acceptance and use of emergency management DSS technology promoted as providing for a common operating platform for multiple agencies responding to disasters and facilitating improved disaster response decision making merits further investigation. For example, WebEOC Professional contends that it "is the first-ever virtual collaborative incident management system" (WebEOC, 2013) while Eteam claims "when incidents require cross-jurisdictional collaboration, E Team is the only incident management system that supports true data sharing" (Eteam, 2012).

Independent IT Department

The presence of an information technology (IT) department within an organization has been studied by several scholars as a facilitating factor in technology adoption. The primary contention is that IT departments support technology adoption as a means to increase their prominence in an organization by making other departments dependent upon their support and consequently gaining additional resources (Jun & Weare, 2011). Moon and Norris (2005) found that the presence of a separate IT department facilitated e-government implementation in U.S. cities. In another study on the adoption of e-governance, Jun and Weare (2011) found that cities with an independent IT department are earlier adopters of innovative e-governance programs. This leads to the inclusion of having an independent IT department as another variable in this study.

GIS Specialist

As discussed earlier, one area in which technology is playing an increasing role in emergency management is through the use of GIS. Jennings and Arlikatti (2011) found that having internal GIS support within a county emergency management department increased the likelihood that the department would also have DSS technology.

Form of Government

Scholars from public administration have examined the influence of council-manager and mayor-council forms of government on innovation where innovation is defined as the adoption of new approaches to problem solving (e.g., the use of DSS technology). One theory is that the council-manager form of government is more supportive of innovation due to the cooperative nature of council-manager municipalities (Nelson & Svara, 2012). Some believe that professionalism and efficiency increasingly valued by city managers lead them to support innovation (Moon & Norris, 2005). Moon and deLeon's(2001) empirical study on reform toward efficient and innovative government backed the idea that the council-manager form of government supported innovation. In the context of increased efficiency and innovation, others found the council-manager form of government positively influenced the adoption of e-governance technology (Holden, Norris & Fletcher, 2003; Moon, 2002). However, Brudney and Seldon (1995) found that form of government did not influence the adoption of computer use in smaller Georgia cities. Contrary to Moon's 2002 study, Moon and Norris (2005) could not find significant support for the influence of the council-manager form of government on adopting e-governance which they attributed to mediation with other variables such as manager innovation orientation. Hence, form of government is an important indicator for inclusion in this study.

Dedicated EOC

The EOC serves as a place, structure and function. It is the place where officials gather and organize themselves to manage the disaster response (Perry, 1995). Quarantelli (1997) has noted the importance of a well-functioning EOC as vital to effective disaster management. Functions performed by the EOC include information gathering, operations management and overall coordination in order to manage the disaster response. EOCs come in a variety of formats including dedicated, multi-purpose and temporary EOCs. Krueger et al. (2009) suggest that EOCs can be an indicator of emergency management proactivism in areas such as training, resource acquisition and technology usage. Hence the presence of a dedicated EOC will facilitate the use of DSS technology and therefore is included in this study.

Demographic Variables

Age

Subjective norms, attitude toward technology and perceived behavioral control significantly influenced older workers while only attitude was significant in younger adults (Morris & Venkatesh, 2000). Overall, it has been found that younger workers are more likely to use new technologies. Morris, Venkatesh, and Ackerman (2005) examined the simultaneous effect of gender and age in technology adoption and found that as age increased, women were more influenced by perceived behavioral control than men while as men age, they were more influenced by attitude toward use than women.

Gender

A number of IS studies have examined the role of gender in technology. Igbaria and Chakrabarti (1990) argued that women experienced higher levels of computer anxiety than men while Venkatesh and Morris (2000) showed that women have lower levels of computer self-efficacy or “one’s judgment about one’s ability to use a computer for a specific task” (119) than men. They indicated perceived usefulness on intent to utilize technology to be more important for men than women. Terzis and Economides (2011) and Vasileios and Economides (2011) found that studies on the effect of gender on technology have mixed results. Venkatesh et al. (2003) found perceived usefulness as a stronger predictor for men than women while ease of use and social influence was more important for women than men. Similarly, Ong and Lai (2006) found ease of use a stronger predictor for women than men. However, Cheung, Lee, and Chen (2002) found perceived usefulness is stronger for women than men while Yuen and

Ma (2002) see no difference. Considering these mixed findings, it is worthwhile to include age and gender in the present study.

Ethnicity

Several studies have examined the effect of ethnicity on technology adoption. Hoffman and Novak (1998) argue that minorities lag non-minorities in technology adoption. More recently, the National Telecommunications and Information Administration (NTIA) (2010) found that internet adoption runs lower in black and Hispanic households than white or Asian households. However, La Rose et al. (2012) contend that the disparity in technological adoption by minority groups is due to income differences rather than ethnic differences.

Education

Numerous studies on technology acceptance have also examined the effect of education on an individual's willingness to use technology (Burton-Jones & Hubona, 2006; Davis & Davis, 1990; Igbaria & Parsuraman, 1989; Mathieson, Peacock, & Chin, 2001). Igbaria and Parsuraman (1989) found that the higher the level of education, the greater the perceived ease of using technology and therefore the higher likelihood of accepting technology. Davis and Davis (1990) argued that level of education influenced the ability to learn new technologies and therefore higher levels of education led to greater use of new technologies. Mathieson et al.'s (2001) research supported these findings by showing that higher levels of education increased the use of technology. In contrast, Burton-Jones and Hubona (2006) examination of federal employee use of technology showed that the level of education did not have an influence on the use of technology.

Professionalism

Several studies have examined the relationship between professionalism and the adoption of technology. Brudney (1988) and Brudney and Seldon (1995) found that professionalism within an organization leads to both the adoption of technology and the extent of that adoption. Teo (2011) examines the adoption of technology noting that some professions, such as teaching, lead to a professional sense of duty to adopt and use technology.

Experience and Voluntariness

Venkatesh et al (2003) included experience and voluntariness as moderating variables in their study. Experience referred to experience an individual had with a particular technology which can have a moderating effect on the primary independent variables. In that the DSS technology of interest in this study is relatively new, it is assumed that experience levels with the technology would be minimal and was not obtained in the survey. Voluntariness was included in their study for comparison purposes in examining technologies that are mandatory in the workplace to technology that was not mandated. Emergency management agencies are not required to use the DSS technology of interest in this study.

Type of Study

Previous studies on technology acceptance have focused on the private sector (Davis et al., 1989; Thompson et al., 1991; Venkatesh et al., 2003) with limited studies examining technology acceptance in the public sector (Lee & Rao, 2007; Thomas, 2009). While Venkatesh et al. (2003) included public administration accounting in their survey utilized in the development of the UTAUT model, public administration accounted for only 38 out of 215 surveys utilized, or approximately 18% of the sample size. 107 MBA students from the University of Michigan business school were surveyed in the development of the Davis (1989) technology acceptance model while Thompson et al. (1991) surveyed 212 employees of a multi-national firm. Dadayan and Ferro (2005) surveyed public education and public health employees in their research on technology acceptance, while Brown and Brudney (2003) surveyed 314 police officers within a single metropolitan police department on their use of laptops for problem solving. A broader view of city employee acceptance of technology is captured by Thomas (2009) in her survey utilizing the responses of 333 employees of one city on their use of a variety of software applications for their job.

Several studies on the adoption of technology have used case study approaches. One case study focused on factors leading to GIS diffusion across four agencies within a single county government (Nevodic-Budic & Godschalk, 1996) while another study utilized a comparative case study of county government GIS technology adoption (Robey & Sahay, 1996).

Study findings on technology adoption within the private sector cannot be generalized to public sector organizations. Moreover, studies on public sector technology acceptance generally limited to a single government entity call for more research across multiple jurisdictions especially in disaster management contexts. In addition, the case studies noted above have been limited to county governments. This study differs from most studies on technology acceptance in that it focuses on the public sector. To the best of my knowledge, it will be the first study on technology acceptance in the public sector that studies both city and county government emergency management officials in the same sample. Furthermore, it is the first study conducted on the acceptance of DSS technology used by local emergency management agencies. This is especially relevant as it expands upon the UTAUT model and examines how variables unique to emergency management and disaster response conditions influence technology acceptance.

Research Hypotheses for Intent to Use DSS Technology

Previous research on factors influencing the intent to use technology and the UTAUT model adapted for disaster response technology led to development of the Emergency Management DSS Technology Adoption Conceptual Model as shown in Figure 2 and the following hypotheses. A summary of the hypotheses are presented in Table 1.

Performance Expectancy

H1: Respondent’s perception of increased performance expectancy will be positively correlated with the intent to use of DSS technology.

Venkatesh et al. (2003, 447) define performance expectancy as “the degree to which an individual believes that using the system will help him or her to attain gains in job performance” Others have viewed performance expectancy as the perceived usefulness of a system or job-fit of the application.

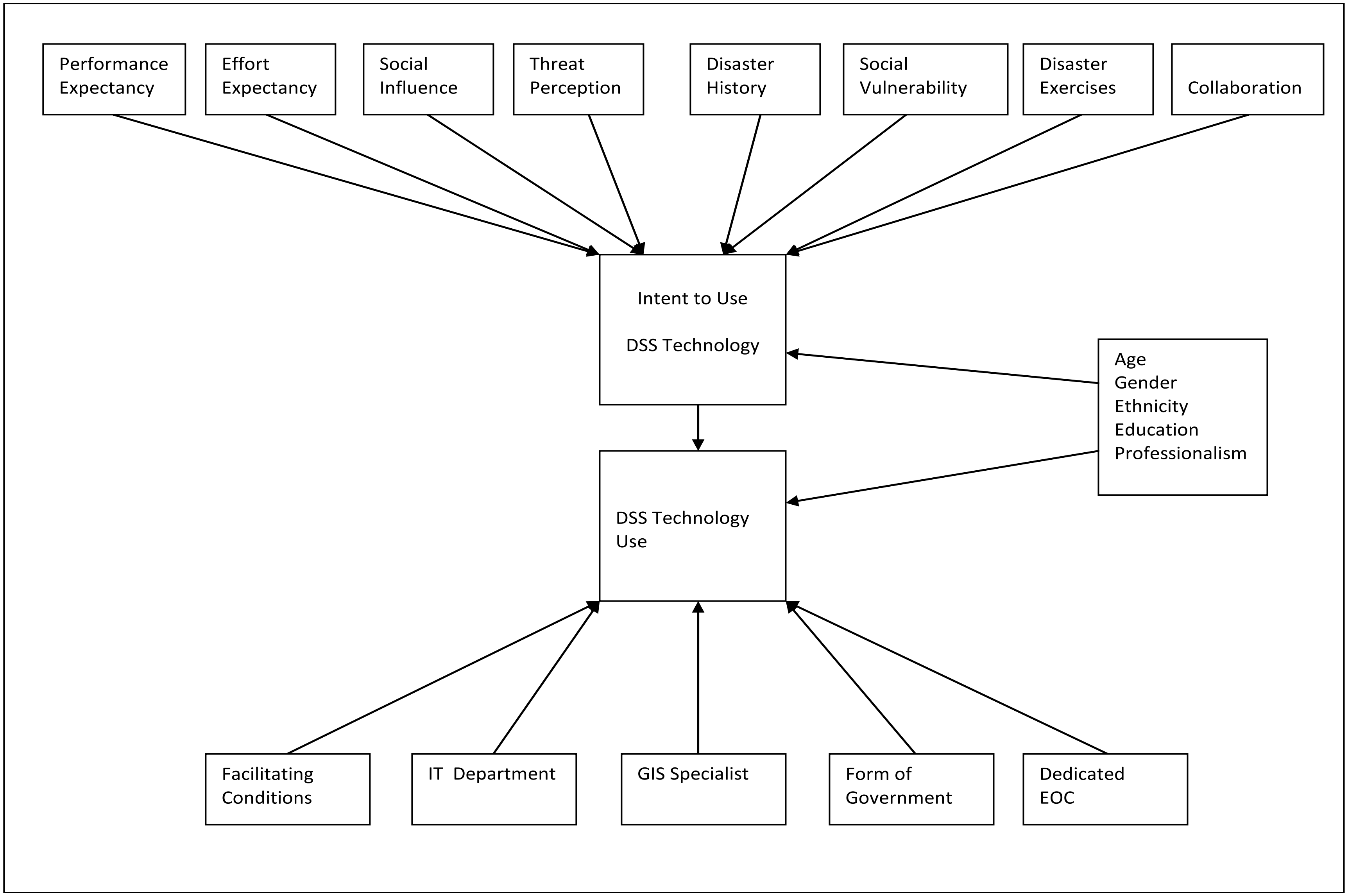

Figure 2. Emergency management DSS technology adoption conceptual model.

Table 1

Hypotheses for Intent to Use DSS Technology

	Independent variable	Anticipated relationship
H1	Performance expectancy	+
H2	Effort expectancy	+
H3	Social influence	+
H4	Threat perception	+
H5	Disaster history	+
H6	Social vulnerability	+
H7	Exercises	+
H8	Collaboration	+
H9a	Age	-
H9b	Gender	±
H9c	Ethnicity	±
H9d	Education	+
H9e	Professionalism	+

When examining disaster response decision making technology, this can be viewed as the degree to which an individual believes the technology will improve their ability to manage the disaster response. The approach taken by Venkatesh et al. (2003) evaluates the overall performance expectancy of a technology. As noted previously, the disaster response environment is complex and multi-faceted in that one needs to obtain and maintain situational awareness in order to more effectively utilize resources and delegate tasks to ensure the functions necessary for the response are accomplished.

Effort Expectancy

H2: Respondent's perception of effort expectancy will be positively correlated with their intent to use DSS technology.

Effort expectancy is defined as “the degree of ease associated with the use of a system” (Venaktesh et al., 2003, 450). Effort expectancy captures the degree to which a person believes a system will be complex and difficult to learn or relatively free of effort. For the purposes of this study, defining effort expectancy does not require modification.

Social Influence

H3: Respondent’s perceptions of social influence will be positively correlated with their intent to use DSS technology.

Social influence has been seen as subjective norms, social factors and image in the IS literature on technology acceptance. Venkatesh et al. (2003) define social influence as “the degree to which an individual perceives that important others believe he or she should use the new system” (451). Since this study specifically focuses on disaster response DSS technology this study views social influence as the degree to which an emergency management official believes that others think he or she should use disaster response DSS technology. Although local jurisdictions have the primary responsibility for disaster response, when the event exceeds their capabilities, they typically reach out to regional and state officials for assistance. Consequently, social influence incorporates the social influence of regional and state emergency management partners as well as others that local emergency managers believe are important.

Threat Perception

H4: Respondent’s perception of increased disaster threat level to their jurisdiction will be positively correlated with their intent to use DSS technology.

Threat perception is the belief that hazards exist which could negatively impact a community. In order for an emergency management official to believe there may be a need to solve problems arising from hazards by using DSS technology, they must first believe that the potential for threats to materialize exists.

Disaster History

H5: Disaster history in the respondent's jurisdiction will be positively correlated with their intent to use DSS technology.

Disaster history is the number of federally declared disasters a community has experienced in the previous 10 years. In that DSS technology promotes itself as being able to facilitate responding to disasters, previous experience from disasters should provide incentive to intend to use DSS technology.

Social Vulnerability

H6: Respondent's community social vulnerability will be positively correlated with intent to use DSS technology.

Social vulnerability is an index created from socioeconomic variables for each county. The higher the SoVI score, the more vulnerable a community is to the hazards that are possible in that community. If a community is more vulnerable to hazards then it is likely that the impact of those hazards will be greater presenting more problems that require decision making to solve. Therefore, the intent to use DSS technology should be greater.

Exercises

H7: Number of disaster exercises in the respondent's jurisdiction will be positively correlated with their intent to use DSS technology.

Exercises are the number of functional and full scale exercises conducted in the previous two years. The realization that one may need to use DSS technology can occur from threat perception, disaster history and social vulnerability. As well, exercises provide a means of addressing the response to hazards that could threaten a community in absence of real events. In that DSS technology provides a means of managing disaster response, practicing dealing with hazard events should influence the intent to use DSS technology.

Collaboration

H8: Respondent's level of collaboration will be positively correlated with their intent to use DSS technology.

One primary difference related to social influence from a disaster response perspective incorporates the aspect of collaboration. In that it is widely recognized that collaboration enhances effective disaster response, the degree of collaboration should influence their intent to use DSS technology.

Demographic Characteristics

H9a: Respondent's age will be negatively correlated with intent to use DSS technology.

H9b: Respondent's gender will be correlated with intent to use DSS technology.

H9c: Respondent's ethnicity will be correlated with intent to use DSS technology.

H9d: Respondent's level of education will be positively correlated with intent to use DSS technology.

H9e: Respondent's professionalism will be positively correlated with intent to use DSS technology.

Research Hypotheses for DSS Technology Use

Within the IS literature, scholars not only focus on the intent to use technology but the actual use. Several studies utilize both aspects of technology acceptance (Davis et al., 1989; Venkatesh et al., 2003). The following related hypotheses are derived from research on technology usage, the UTAUT model and disaster response with a summary of the hypotheses provided in Table 2.

Table 2

Hypotheses for DSS Technology Use

	Independent variable	Anticipated relationship
H10	Intent to use DSS technology	+
H11	Facilitating conditions	+
H12	IT department	+
H13	GIS specialist	+
H14	Manager form of government	+
H15	Dedicated EOC	+
H16a	Age	-
H16b	Gender	±
H16c	Ethnicity	±
H16d	Education	+
H16e	Professionalism	+

Intent to Use Technology

H10: Respondent's intent to use DSS technology will be positively correlated with DSS technology use.

Venkatesh et al. (2003) find that behavioral intent to use technology is the strongest predictor of actual use of technology. They note that this is consistent with the theory for all technology use models they evaluated.

Facilitating Conditions

H11: Respondent's perception of facilitating conditions will be positively correlated with DSS technology use.

Venkatesh et al. (2003) define facilitating conditions as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (453). Other studies on technology acceptance have constructed facilitating conditions as perceived behavioral control, facilitating conditions and compatibility.

IT Department

H12: The presence of an independent IT department will be positively correlated with DSS technology use.

Previous studies have found that independent IT departments (Jun & Weare, 2010; Moon & Norris, 2005) lead to greater technological adoption.

GIS Specialist

H13: The presence of a GIS specialist within an emergency management department will be positively correlated with DSS technology use.

In that DSS technology used for disaster response provides for the utilization of GIS technology to be combined with the software, having internal GIS support would influence the adoption of DSS technology as Jennings and Arlikatti (2011) found in their study of county emergency management agencies.

Form of Government

H14: A manager form of government will be positively correlated with DSS technology use.

Studies on form of government and technological adoption suggest that the manager form of government leads to greater technological adoption (Holden et al., 2003; Moon, 2002).

Dedicated EOC

H15: The presence of a dedicated EOC within a jurisdiction will be positively correlated with DSS technology use.

Finally, having a dedicated EOC indicates an emergency management agency is more proactive in their use of technology (Krueger et al., 2009). These can be viewed as organizational support for the use of technology.

Demographic Variables

H16a: Respondent's age will be negatively correlated with DSS technology use.

H16b: Respondent's gender will be correlated with DSS technology use.

H16c: Respondent's ethnicity will be correlated with DSS technology use.

H16d: Respondent's level of education will be positively correlated with DSS technology use.

H16e: Respondent's professionalism will be positively correlated with DSS technology use.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter provides an overview of the research methodology utilized to explain factors that determine acceptance of emergency management decision support software (DSS) technology by emergency management officials. It describes the unit of analysis, development of the survey instrument, obtaining institutional review board (IRB) approval and administration of the survey. The operationalization of variables and the statistical methods adopted are detailed.

Respondents

The unit of analysis in this study was the emergency management official. Specifically, the lead emergency management official for cities and counties in the federal emergency management agency (FEMA) region VI were targeted as the sample population. FEMA region VI includes the states of Arkansas, Louisiana, Oklahoma, New Mexico and Texas. It is appropriate to utilize FEMA region VI as the geographic area to draw the sample population as it represents a diverse region facing a variety of hazards. Texas leads the nation in federally declared disasters having received a total of 86 declarations thru the end of 2011. Oklahoma ranks third among states at 70 declarations. Louisiana ranks sixth with 58 declarations while Arkansas is ninth at 53 declarations. New Mexico is ranked 38th with 24 declarations (FEMA, 2012a). The hazards for which disaster declarations have been issued in FEMA region VI include flooding, hurricanes, landslides, severe storms, tornadoes, wildfires and winter storms (FEMA, 2012a).

The objective of this study was to gauge the perceptions of these emergency management officials towards DSS technology and understand what influenced their decisions regarding their intent to use a particular DSS technology for disaster management. The perceptions of lead emergency management officials regarding the adoption of DSS technology at the local level are important as they are responsible for overseeing the emergency management programs at the local level in the United States.

It is equally interesting to examine technological acceptance by emergency management officials at the city level and county level for several reasons. First, while both city and county governments are tasked with developing emergency management programs and responding to disasters, in many instances the first source of outside assistance for a city goes through the county. Second, disaster declarations issued by the federal government are issued at the county level and not at the city level (Sylves, 2008). For example, if a disaster were to occur that impacted the city of Sanger, Texas and no other municipalities in Denton County, the federal disaster declaration would still be for the entire county.

Within FEMA region VI, the sample population was broken down by state as follows. Within Texas and Oklahoma, all cities and counties were included in the sample population. There are 254 counties and 1,208 cities, towns or villages in Texas while Oklahoma has 77 counties and 391 cities and towns. In New Mexico and Arkansas, all counties were included as well as all cities with a population over 25,000. Cities with a population of at least 25,000 correspond to data from the 2005 National Fire Protection Association Needs Assessment Survey. They found the following breakdown on career versus volunteer fire departments based on city size. In cities with a population greater than 25,000, 67 percent of the fire departments are all or mostly career fire departments (NFPA, 2006). While it is possible that a city would have a volunteer fire department and a separate emergency management official, it is unlikely. The greater probability is that a city with a career fire department would be more likely to have a designated emergency management official. In New Mexico, there are 33 counties and 11 cities with a population over 25,000. Arkansas has 75 counties and 19 cities with a population over 25,000. In Louisiana, emergency management is conducted at the parish level (county equivalent in Louisiana) so all 64 parishes were included. The resulting potential sample population size consisted of 503 counties and 1,629 cities, towns and villages for a total of 2,132.

The rosters for lead emergency management officials were obtained by making requests through each state's emergency management website. The Arkansas Division of Emergency Management's Disaster Management Division provided a current list of county emergency managers with contact information that included email addresses noting that they did not maintain a list of city emergency managers. The contact information for the city emergency management officials in Arkansas was obtained by going to the websites of the 19 cities with a population over 25,000. The contact information for the emergency manager was either obtained directly from the city's website or a request was made for that information through their website.

The Louisiana Governor's Office of Homeland Security and Emergency Preparedness maintained a list of contact information for parish emergency managers on their website and this list was used. A current list of county and city emergency management officials was received from the New Mexico Department of Homeland Security and Emergency

Management's public information officer and the Oklahoma Department of Emergency Management. A Texas Division of Emergency Management District Coordinator provided a contact list for county and city emergency management coordinators, city mayors and county judges. In Texas, the chief elected official is the emergency management director by law. Therefore, if a city did not list an emergency manager the mayor was used as a substitute, while if a county did not list an emergency manager, the county judge was included. The lists were then checked for redundancy. This occurred for several cases in Texas where one individual served as both the county emergency manager and the emergency manager for some cities within the county. There were two cases in Texas where one individual served several counties.

Some email addresses were missing from the list received from each state's emergency management agency. For these cities and counties a thorough web search was conducted to find the appropriate contact for the survey. Ultimately an email list of 1458 emergency management officials was developed and an e-survey was sent out in September, 2012.

Survey Instrument

The Information Technology in Emergency Management Survey created for this study, borrowed content from several surveys. Questions related to professionalism, education, collaboration and types of technology available for use within the organization were taken from the questionnaire used to survey county emergency management agencies, by the National Center for the Study of Counties (NSCS) located in the Carl Vinson Institute of Government at the University of Georgia in 2006 (Clarke, 2006). This survey instrument was designed with input from the National Association of Counties and emergency management scholars from the University of Georgia, Indiana University and the University of North Texas.

Next, the survey incorporated components from the instrument created by Venkatesh et al. (2003), germane to examining performance expectancy, effort expectancy, social influence and facilitating conditions. As the Venkatesh instrument is a general survey and the NSCS survey was of county agencies, modifications were made to specific questions to facilitate understanding of DSS technology acceptance by emergency management officials at both the city and county level. Additional questions as deemed necessary to examine disaster response specific constructs were also added.

The survey was administered online in September, 2012. Obtaining survey data online is gaining favor in the research community, for various reasons. Hoonakker and Carayon (2009) point out several advantages to online surveys including ease of access to large sample populations, providing less expensive means of sampling, increased flexibility easily customizable for target audiences, generally faster generation of results, ease of administering and tabulating results with fewer coding errors and finally, online surveys allow for quick access to determine who has completed the survey and who has not allowing for more targeted follow up to increase response rate. Crawford, Couper, and Lamias (2000) point out a specific advantage of interactive internet surveys concerning non-response. In a traditional mail survey, a non-response results when the recipient fails to return a survey. The researcher doesn’t know if the respondent chose not to begin the survey or began and then chose not to complete or mail the survey back. When interactive online surveying is utilized, researchers have access to data from the questions that are completed even if the respondent does not finish the survey which is an added advantage.

Online surveys do have their weaknesses. Crawford et al. (2000) analyzed research on web based surveys and concluded that web based surveys tend to have response rates 10 to 20 percent lower than traditional mail surveys. However, Guterbock, Meekins, Weaver and Fries (2000) found that web based surveys of populations which are expected to use computers don’t have large coverage errors and therefore response rates are approximately the same as those of traditional mail surveys. Hoonakker and Carayon (2009) point out that several of the concerns with internet surveys are also applicable to mail surveys. These include issues of coverage, sampling, measurement, and non-response errors which impact mail surveys as well. They also contend that lack of anonymity, illiteracy and non-deliverability are issues germane to mail surveys as well. One disadvantage specific to web based surveys is concerns over computer security. They suggest that concerns over computer viruses can cause survey recipients to be wary of emails from persons they do not know. Dommeyer and Moriarty (2000) argue that web based surveys eliminate that segment of the population that don’t utilize computers extensively. They further argue that internet users are biased toward those with higher levels of education. However, in this survey’s sample population, it is assumed that emergency management officials at the city and county level have access to and use computers regularly and most likely will have a high school degree at a minimum.

While debate exists over the advantages of web based surveys versus traditional mail surveys, Crawford et al. (2000) identify several factors that can enhance web based survey response rates. These include an informative email invitation that allows the recipient to make an informed decision on agreeing to participate or not. They note that the invitation email plays an important role in soliciting a response to the survey. Actions to lower the perception of burden to the respondent can elicit greater response rates as well. Particular to web based surveys are the use of an embedded password in the email which facilitates a lowered burden perception as the recipient can simply click on the link rather than having to manually enter a password. Qualtrics® research survey software, purchased by the University of North Texas and available at no cost, was used to conduct this research.

The use of Qualtrics enables the survey instrument to incorporate skip logic. Skip logic automatically takes the respondent to follow-up questions based on specific answers to a survey question. For example, if a respondent indicated they had either Eteam™ or WebEOC® they were directed to follow-up questions specific to their perceptions regarding those DSS programs as well as specific questions regarding their use of these softwares. If the respondent indicated they did not have either Eteam or WebEOC, they were directed to questions asking why they did not have either. This saved time and effort for the respondent. In the case that a respondent indicated they had both software programs, they were directed to follow-up questions for each software. If a respondent indicated they had one but not the other, they were directed to follow-up questions on their perception and use of the one they have and follow-up questions regarding the one they did not have. Questions most relevant to this study are follow-up questions regarding perceptions towards and use of Eteam and WebEOC. As such, these questions were presented early on in the survey to counter respondent fatigue. The survey instrument was designed so that all respondents continued to additional questions after answering the appropriate follow-up questions.

The e-survey design was created in such a way that each recipient had to click on a unique link took them to the survey instrument. Restrictions were placed so that the recipient could not forward the link to someone else to complete the survey ensuring that the perceptions being recorded were those of the lead emergency management official to whom the survey was sent.

Administration of Survey Instrument.

Since human subjects are utilized in this study, it was necessary to obtain approval from the University of North Texas IRB. The IRB application flowchart was utilized to determine that the minimal review application could be utilized rather than expedited or full board review application. Final approval from the IRB was obtained on September 10, 2012 prior to administering the survey.

Administration of the survey instrument utilized Dillman's (2000) methodology for internet surveys. On September 13th an introductory email was sent to 1458 emergency management officials introducing the researcher and identifying the email recipient as the lead emergency management official for their community. The introduction explained the purpose of the research, that the study had been approved by the IRB and was self-funded by the researcher, that their confidentiality would be maintained and informed them that they would be receiving an email inviting them to participate in a survey for the study a week later. The email also asked them to reply with the name and email of the lead emergency management official if they were not the correct person. This led to 22 corrections to the final survey list. Two respondents indicated their city officially fell under their county's emergency management program. Four jurisdictions indicated that their emergency manager position was vacant. A final sample list of 1452 emergency management officials resulted.

On September 21st survey invitation emails were sent to the 1452 individuals previously identified as the lead emergency management official for their city or county inviting them to participate in the survey. A link was provided in the email for respondents to take the Information Technology in Emergency Management Survey. One week later, on September 28th, a reminder email was sent to respondents that had not completed the survey. The reminder explained that the lead researcher understood they were busy and that their opinions were important to this study. Another reminder was sent on October 8th explaining that we wanted to provide another opportunity to participate in the survey, the value of their opinion was important and thanking them for participating. On October 15th, a final invitation reminder was sent informing them that the survey would be coming to a close in one week and that we hoped they would participate as their opinions were important to this study. The final reminder was customized to each state to emphasize the value of the opinions of officials in that particular state regardless of the type of technology they did or didn't use. The survey was officially closed on November 25thwhich allowed for up to one month for anyone who had begun the survey to complete it. Although the survey was begun by 507 respondents only 356 individuals completed the survey. The completion rate was 25 percent. Baruch (1999) contends that response rates for paper based surveys average approximately 56 percent while Kerlinger (1986) and Singleton and Straits (2005) believe that response rates less than 50 percent are common. Furthermore, electronic surveys tend to produce response rates 10 to 20 percent lower than postal surveys (Singleton & Straits, 2005). The response rate was lower than desired but approximate electronic response rates.

Operationalization of Variables.

Two dependent variables of concern are used in this study. The first dependent variable of concern is the intention to use DSS technology. While disaster response decision making support software can consist of numerous programs that assist emergency management officials in making decisions during disaster response this study considers the use of Eteam and/or WebEOC to be the DSS technology of interest. These appear to be the predominant decision support programs used by local emergency management agencies. Jennings and Arlikatti (2011) analyzed the 2006 Emergency Management Survey of County Governments finding WebEOC is utilized by 18% of counties while Eteam is utilized by 11% of counties. In this survey, 255 respondents indicated their emergency management agency had WebEOC, 14 respondents indicated they had Eteam and 6 respondents answered that they had both WebEOC and Eteam for a total of 275 respondents using the DSS technology of interest in this study. However, after including all independent variables utilized to test the hypotheses in this study, it was found that only 196 respondents answered all of the questions. Green (1991) provides a formula n = 104 + m, where n is sample size and m is the number of variables. Consequently, for this study an n of 124 is considered sufficient (n = 104 + 20). The sample size was also verified against Bartlett, Kotrlik, and Higgins (2001) who suggest for a population of 1500, the minimum sample size would be 183. The resultant sample size in this study also meets their criteria.

Intent to Use DSS Technology Dependent Variable

To obtain their intent to use DSS, a question asked them to indicate if their emergency management department currently uses either Eteam or WebEOC. If the respondent selected either or both, they were then asked three questions regarding their intent to use that particular DSS technology. These questions provided a statement regarding their intent to utilize the DSS technology and asked them to rate the response that best expressed their view on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) coded as 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree and 5 = strongly agree. The three follow-up up questions were their “intent to utilize the DSS technology in the next 12 months”, their “prediction to use the DSS technology in the next 12 months” and their “plan to utilize the DSS technology in the next 12 months”.

Due to the skip logic process of Qualtrics, different variables were created for Eteam users and WebEOC users. Each follow-up up question created one variable for Eteam users with a separate variable being created for WebEOC users. Consequently, the Eteam user variables were combined with the WebEOC user variables to create a single variable from each follow-up up question. Three variables were created from the follow-up up cases. The first variable intent was coded as 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree* and 5 = *strongly agree* with the statement “I intend to use Eteam (or WebEOC as appropriate) in the next 12 months.” The variable predict was coded as 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree* and 5 = *strongly agree* with the statement “I predict that I will use Eteam (or WebEOC as appropriate) in the next 12 months.” The variable plan was coded as 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4

= *agree* and 5 = *strongly agree* with the statement "I plan to use Eteam (or WebEOC as appropriate) in the next 12 months."

There were five cases which answered the follow-up up questions for both WebEOC and Eteam. In these cases, the average of their responses for both softwares were used for the values for intent, predict and plan variables. In order to create an index, the intent, predict and plan variables were then recoded into intent1, predict1 and plan1 and coded as 0 = *strongly disagree*, 1 = *disagree*, 2 = *neither agree nor disagree*, 3 = *agree* and 4 = *strongly agree*. An "intent to use" index ranging from 0 to 1 was then created by summing intent1, predict1 and plan1 and then dividing by 12. A reliability test conducted on these three items produced an acceptable value of Cronbach's alpha of .954 suggesting that that these items are internally consistent and acceptable for use in creating an "intent to use" index variable.

DSS Technology Use Dependent Variable

The second dependent variable of concern was DSS technology use. If a respondent indicated they had either Eteam or WebEOC, skip logic followed up with a categorical question concerning how often they utilized that DSS technology. The choices were less than once a month, once a month, a few times a month, a few times a week, once a day or several times a day. From these responses a bivariate variable, "monthly use" was created which was coded 1 if the DSS technology was used at least once a month, 0 otherwise.

Intent to Use DSS Technology Independent Variables

Drawing upon the unified theory of acceptance and use of technology (UTAUT) model, three independent variables are theorized to have a direct influence on intent to use disaster response decision making support technology. These include performance expectancy, effort expectancy, and social influence. Survey questions related to these constructs utilized a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). If the respondent indicated their emergency management agency had the DSS technology, then follow-up up questions regarding performance expectancy, effort expectancy, and social influence were asked.

Performance Expectancy

Performance expectancy was measured by asking questions related to the DSS technology's ability to help a respondent obtain situational awareness, manage resources and tasking. Responses were ranked on a 5-point Likert scale coded as 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree* and 5 = *strongly agree* for statements that captured aspects of performance expectancy. In order to create a performance expectancy index, these statements were recoded into the variables useful1, enable1, increase1, enhance1, manage1 and tasks1 with 0 = *strongly disagree*, 1 = *disagree*, 2 = *neither agree nor disagree*, 3 = *agree* and 4 = *strongly agree*. A "performance expectancy" index ranging from 0 to 1 was then created by summing useful1, enable1, increase1, enhance1, manage1 and tasks1and then dividing by 24. The reliability test on these six items yielded a Cronbach's alpha of .941 suggesting the items are internally consistent and can be used for creating a "performance expectancy" index variable.

Effort Expectancy

Effort expectancy was measured by asking how easy it was to learn and become skillful with the DSS technology. Responses were ranked on a 5-point Likert scale coded as 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree* and 5 = *strongly agree* with statements that were specific to effort expectancy. To develop an effort expectancy index these statements were recoded to create the variables skill easy1, ability1, easy to use1 and easy to learn1 with 0 = *strongly disagree*, 1 = *disagree*, 2 = *neither agree nor disagree*, 3 = *agree* and 4 = *strongly agree*. An effort expectancy index was then created by summing skill easy1, ability1, easy to use1 and easy to learn1 and then dividing by 16. This created the "effort expectancy" index ranging from 0 to 1. The Cronbach's alpha of .926 for these four items indicates internal consistency and validates their use in creating the "effort expectancy" index variable.

Social Influence

Social influence was measured as the degree to which others that mattered thought they should use the DSS technology. Responses were ranked on a 5-point Likert scale coded as 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree* and 5 = *strongly agree* with statements regarding social influence. One statement specifically addressed the influence of their state emergency management agency while another specifically addressed the influence of regional partners. To facilitate creating a social influence index, these statements were recoded into 0 = *strongly disagree*, 1 = *disagree*, 2 = *neither agree nor disagree*, 3 = *agree* and 4 = *strongly agree* with specific statements to create the variables influential1, influence1, state influence1 and regional influence1. These variables were then summed and divided by 16 to create the "social influence" index ranging from 0 to 1. The reliability analysis on these four items results in a Cronbach's alpha of .809 which indicates they are acceptable to use in creating the "social influence" index variable.

Five additional variables are hypothesized to influence intent to utilize DSS technology. These include threat perception, disaster history, social vulnerability, disaster exercises, and level of emergency management collaboration.

Threat Perception

Threat perception was measured by asking the respondent to rank their concern using a 5-point Likert scale ranging from 1 (*not at all concerned*) to 5 (*extremely concerned*) for 20 different hazards. The list of hazards consisted of 13 natural hazards and 7 man-made hazards. The 13 natural hazards included all 7 hazards (flooding, hurricanes, landslides, severe storms, severe winter storms, tornados, and wildfires) that have been responsible for federal disaster declarations in FEMA region VI between 2002 and 2011. In order to create a threat perception index, the response for each hazard was recoded with 0 = *not at all concerned*, 1 = *concern between not at all and neutral*, 2 = *neutral*, 3 = *concern between neutral and extremely concerned* and 4 = *extremely concerned*. A total "threat perception" index was created by summing the threat concern for each hazard and dividing by 80 to create an index ranging from 0 to 1. The reliability analysis on these 20 items shows internal consistency with a Cronbach's alpha value of .786. Consequently, it is acceptable to use these 20 items in creating the total "threat perception" index variable.

Disaster History

The disaster history variable was created by summing the number of presidential disaster declarations over a 10 year period from 2002 – 2011 for each county as reported on FEMA's disaster declarations website. Since presidential disaster declarations are issued at the county level, the number of declarations for a city will be the number of declarations issued for the county in which the city is located. The "disaster history" categorical variable was created by coding the number of disasters as 1 = *none to 2 disasters*, 2 = *3 or 4 disasters*, 3 = *5 or 6 disasters* and 4 = *7 or more disasters*. Another way of viewing these categories of disaster history can be that a community has experienced few disasters if they only had up to 2 disasters, some disasters if they have received 3 or 4 declarations, more than average if they have experienced 5 or 6 disasters with the mean number of disaster declarations being 4.59, and many disasters if they have had 7 or more disasters during the previously identified 10-year span.

Social Vulnerability

Social vulnerability was operationalized as the SoVI® 2006 – 2010 score. The SoVI score is created from 30 socioeconomic variables for each county. The SoVI score ranges from minus 10..693 to plus 12.841 with a lower score representing less social vulnerability. The SoVI score from each jurisdiction's county was utilized as its "social vulnerability" variable.

Disaster Exercises

The survey asked respondents the number of table top, functional and full scale exercises their jurisdiction had participated in over the last two years. The variable disaster "exercises" was operationalized as the sum of functional and full scale exercises they reported having participated in over the previous two years. As table top exercises are simply a facilitated discussion of a hazard scenario, while functional and full scale exercises are conducted in real time to simulate or perform activities, responses that listed table top exercises were not included in the disaster exercise variable.

Collaboration

Collaboration was measured by asking the respondent if they had worked with a variety of agencies in planning and response activities within the last two years. The agencies with which they might have worked with included their state emergency management agency, council of government, regional alliance, other counties, cities within their county and cities outside their county. The activities included formal mutual aid agreements, memorandums of understanding, informal cooperation and joint planning. If they indicated they had worked with one of these agencies at some level that represented some degree of collaboration. To measure overall "collaboration" the sum of the total number of agencies a city or county had worked with and the sum of the types of activities they had engaged in was utilized. If a local emergency management agency had not worked with any other agency in any capacity, their overall collaboration was computed as zero. If a local emergency management agency had worked with all six other types of agencies in all four types of activities, their overall collaboration was24.

DSS Technology Use Independent Variables

Utilizing the UTAUT model, two independent variables are hypothesized to have a direct influence on DSS technology use. The first is intent to use DSS technology which was also used as a dependent variable in the research on intent of use DSS technology previously discussed. The "intent to use" index was created from three survey questions with a Cronbach's alpha of .954 indicting the index is acceptable to use. Details on the creation of the intent to use index was provided earlier in this chapter.

Facilitating Conditions

The second is facilitating conditions. Facilitating conditions were measured as the support received from their organization and senior management as well as the provision of resources to facilitate the use of DSS. If the respondent indicated their emergency management agency had the DSS technology, follow-up up questions regarding facilitating conditions were asked. Responses were ranked on a 5-point Likert scale coded as 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree* and 5 = *strongly agree* with statements regarding facilitating conditions. To develop the facilitating conditions index these responses were recoded to create the variables srmgmt1, org1, resources1, knowledge1 and assistance1 coded as 0 = *strongly disagree*, 1 = *disagree*, 2 = *neither agree nor disagree*, 3 = *agree* and 4 = *strongly agree*. The facilitating condition variables were then summed and divided by 20 to create the "facilitating conditions" index. The reliability analysis produced a Cronbach's alpha of .816. Therefore, internal consistency is indicated allowing for the use of these five items to create the "facilitating conditions" index variable.

Additional Variables

Four additional variables are hypothesized to influence DSS technology use. These are having an independent information technology (IT) department, having a geographic information systems (GIS) specialist in the emergency management department, form of government and having a dedicated emergency operations center (EOC).

Respondents were asked if their jurisdiction has an independent IT department and responses coded as 1 if yes and 2 if no. The dichotomous variable “IT department” was recoded as 1 = yes, 0 = no. Respondents were asked if their emergency management department has an internal GIS specialist coded as 1 if yes and 2 if no. A dichotomous variable representing “GIS specialist” was recoded 1 = yes, 0 = no. To best describe the form of government their jurisdiction operates under, respondent’s choices were council/manager coded as 1, mayor/council coded as 2, commission/administrator coded as 3, and commissioner’s court coded as 4. Thirty-five respondents did not answer this question regarding their form of government. The form of government for their jurisdiction was obtained by going to the jurisdiction’s website and then manually entering the correct code for these respondents. A form of government variable was created and coded as 1 if operating under a ”manager form of government” and coded 0 if operating under an “elected official” form of government. Respondents were given several choices to best describe their jurisdiction’s primary EOC. The choices included dedicated EOC coded as 1, multipurpose EOC coded as 2, EOC converted from other use when necessary coded as 3, mobile EOC coded as 4 and other coded as 5. A new dichotomous variable “dedicated EOC” was created and coded 1 = dedicated EOC, 0 = otherwise.

Demographic Variables

Demographic variables are hypothesized to influence both intent to use DSS technology and DSS technology use. These include age, gender, ethnicity, education, and professionalism. Respondent's "age" is represented as an interval variable. "Gender" is coded as a dichotomous variable, where 1 if male, 0 if female. Ethnicity choices were white coded as 1, black coded as 2, Hispanic coded as 3, Asian coded as 4 or other coded as 5. A dichotomous "ethnicity" dummy variable was created and coded 1 if white, 0 otherwise.

The fourth demographic variable of concern is the education level of the lead emergency management official. The respondents were asked to report the highest level of education they have obtained. The options available were less than high school coded as 1, high school diploma coded as 2, associate's degree coded as 3, associate's degree in emergency management related field coded as 4, bachelor's degree coded as 5, bachelor's degree in emergency management related field coded as 6, postgraduate degree coded as 7 and postgraduate degree in emergency management related field coded as 8. These were collapsed into a categorical "education" variable coded as 0 = high school degree, 1 = associate's degree, 2 = bachelor's degree and 3 = post grad degree.

The respondents were asked about the training and certifications they had obtained. One of the choices included having completed the FEMA Professional Development Series (PDS). The FEMA PDS consists of seven courses providing a "well-rounded set of fundamentals for those in the emergency management profession" (FEMA, 2013). These include courses on disaster exercises, emergency management fundamentals, planning, leadership and influence, decision making and problem solving, effective communication, and volunteer management.

The “professionalism” variable was created and coded as 1 if they indicated they had completed the FEMA PDS series and 0 if not.

Statistical Methods

Regression analysis was chosen to analyze the data. Regression analysis is suitable for several reasons. Regression analysis is the most commonly used statistical technique in the social sciences (Allison, 1999). Regression analysis also provides a means of making causal inferences by separating the effects of independent variables on the dependent variable and by holding the effects of the other variables constant (Allison, 1999).

Two different types of regression are utilized to analyze the effect of independent variables on the two different dependent variables. The first dependent variable of interest is the intent to use DSS technology variable. Since this variable is an index, linear multiple regression is used to examine the factors which lead to intent to use DSS technology. The second dependent variable of interest is DSS technology use. This variable is a dichotomous variable to indicate DSS technology use on a monthly basis. Since the dependent variable is dichotomous, binary regression analysis is utilized to determine the effect of independent variables on DSS technology use.

Reliability tests are utilized to ensure the survey questions measure the constructs of intent to use DSS technology performance expectancy, effort expectancy, and social influence with internal consistency. The data was analyzed for multicollinearity by checking tolerance values and variance inflation factors. Reliability tests are conducted to ensure the survey questions measure the constructs of intent to use DSS technology and facilitating conditions internal consistency. The data were analyzed for multicollinearity by checking tolerance values and variance inflation factors.

CHAPTER 4

ANALYSIS AND RESULTS

Introduction

Hypotheses were developed in Chapter 2 to determine factors that influence the intent of local emergency management officials to use decision support software (DSS) technology as well as factors that influence actual usage. In chapter 3 the survey instrument and administration was explained along with the operationalizational of the variables used in the hypotheses. In this chapter, the statistics are compiled to provide a quantitative description of the characteristics of local emergency managers and the organizations and the factors that influence their intent to use and actual usage of DSS technology. Bivariate intercorrelations are presented to examine the hypotheses developed from the theoretical framework explained in chapter 2. Lastly, regression results with elaboration on the factors that influence the intent to use and actual use of DSS technology by local emergency management officials are provided.

The overall results provide support for the modified unified theory of acceptance and use of technology (UTAUT) model (Venkatesh et al., 2003) by showing that performance expectancy, effort expectancy, and social influence explain the intent to use DSS technology by local emergency management officials and intent to use technology explains actual use of said technology. It also provides limited support for the Emergency Management DSS Technology Adoption Conceptual Model in that level of collaboration influences the intent to use DSS technology by lead local emergency management officials and the presence of a geographic information systems (GIS) specialist influences DSS technology use. While most studies on technology acceptance in the private sector reveal that performance expectancy is the strongest predictor of intent to use technology, this study on emergency management in the public sector shows social influence to be the strongest predictor for intent to use DSS technology. When examining factors that influence DSS technology use, the intent to use that technology and the presence of a GIS specialist in the emergency management department influence DSS technology use.

Descriptive Statistics

Of the 1,452 surveys sent out, local emergency management officials completed 356 of the surveys. Of these, 275 respondents indicated they had the DSS technology serving as the dependent variable in this study. Thirty-nine respondents failed to answer all of the questions necessary to create the indexes specific to their perception of the DSS technology used in this study. Another 15 respondents did not answer all of the questions used to develop the threat perception index. Several respondents failed to answer questions concerning the number of exercises conducted and several of the questions concerning individual demographic characteristics. Only 196 cases sufficiently answered all of the independent variables of concern in the survey. Two cases were filtered out of the final analysis sample as outliers with Mahalanobis distance scores of 45.963 and 45.554. The Mahalanobis distance method was utilized to determine potential outliers with a filter value of 43.829 (alpha = .001, *df* = 19). The descriptive statistics for these 194 cases are discussed below and presented in Table 3.

Table 3

Descriptive Statistics for DSS Technology Adoption

Variables	Mean	Standard Deviation	Min.	Max.
Dependent variables				
Intent to use DSS technology	.753	.181	0	1
DSS technology use	.454	.499	0	1
Intent to use DSS technology independent variables				
Performance expectancy	.658	.180	0	1
Effort expectancy	.596	.210	.06	1
Social influence	.664	.154	.25	1
Threat perception	.578	.107	.15	.85
Disaster history	2.505	.871	1	4
Social vulnerability	-.924	2.708	-6.69	5.86
Exercises	2.918	2.160	0	12
Collaboration	7.680	4.666	0	24
DSS technology use independent variables				
Facilitating conditions	.629	.171	.10	1
IT department	.640	.481	0	1
GIS specialist	.200	.398	0	1
Form of government	.479	.501	0	1
Dedicated EOC	.304	.461	0	1
Demographic variables				
Age	52.080	10.196	24	73
Gender	.880	.330	0	1
Ethnicity	.943	.232	0	1
Education	1.418	1.104	0	3
Professionalism	.550	.499	0	1

n = 194

Dependent Variables

Two dependent variables are utilized in this study. The first dependent variable is intent to use DSS technology. Intent to use was obtained from three survey questions asking respondents to score their agreement with statements concerning their intent to use DSS technology ranging from *strongly disagree* to *strongly agree* on a 5-point Likert scale. From these, an intent to use DSS technology index was created ranging from 0 to 1 (Cronbach alpha = .954). The mean value for intent to use is .753 with a minimum of 0 and maximum of 1. One respondent from a rural community in north Texas scored 0 on the intent to use DSS technology index indicating they strongly believed they would not use the DSS technology in the next 12 months. Forty-five respondents scored 1 on the intent to use DSS technology index indicating they strongly believed they would use the DSS technology in the next 12 months. Of the 45 that scored highest on the intent to use index, 22 are counties. Of the 23 cities scoring highest on the intent to use DSS technology index, 16 are in major metropolitan areas.

The second dependent variable of concern is DSS technology use. This variable was obtained by asking respondents to categorically indicate how often they use the DSS technology. A dichotomous variable was created indicating that they use the DSS technology at least once a month as opposed to less than once a month. Forty-five percent of local emergency management officials use the DSS technology at least once a month. The other fifty-five percent use it even less as they do not use the technology at least once a month.

Intent to Use DSS Technology Independent Variables

Performance Expectancy

Performance expectancy is an independent variable measuring the respondent's belief that the DSS technology would help them do their job better. Performance expectancy was obtained from six survey questions in which respondents scored their agreement with statements designed to capture aspects of performance expectancy on a 5-point Likert scale ranging from strongly disagree to strongly agree. These questions were utilized to create a performance expectancy index ranging from 0 to 1 (Cronbach alpha = .941). The mean value of the index is .658 with one respondent scoring zero on the index indicating they strongly believed that the DSS technology would not improve their job performance. Twelve respondents scored one on the index indicating they strongly believed that using DSS technology would improve their job performance.

Effort Expectancy

Effort expectancy is an independent variable measuring the respondent's belief that it is easy to use the DSS technology. Four survey questions were designed to capture the respondent's perception of effort expectancy. These questions asked respondents to score statements on effort expectancy on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree*. An effort expectancy index ranging from 0 to 1 (Cronbach alpha = .926) was created from these four questions. The mean value for effort expectancy is .596 with a minimum of .06 and a maximum of 1. Two respondents scored .06 on the index indicating they strongly believed the DSS technology would not be easy to use while ten respondents scored 1 on the index indicating they strongly believed the DSS technology would be easy to use.

Social Influence

A third independent variable, social influence measures the respondent's belief that others that matter to them think they should use the DSS technology. Four survey questions were used to capture the respondent's perception of social influence by having them score statements regarding social influence on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree*. These statements were used to create the social influence index ranging from 0 to 1 (Cronbach alpha = .809). The mean value for the social influence index is .664 with a minimum of 0.25 and maximum of 1. One respondent scored 0.5 on the index demonstrating that they strongly believed important others did not believe they should use DSS technology while nine respondents scored 1 on the index revealing that they strongly believed important others think they should use DSS technology.

Threat Perception

Threat perception is an independent variable designed to obtain the respondent's concern for 20 different hazards. The survey asked respondents to score their concern for these hazards on a 5-point Likert scale ranging from *not at all concerned* to *extremely concerned.* These 20 items were used to create a threat perception index ranging from 0 to 1 (Cronbach alpha = .786). The mean value for the threat perception index was .578 with a minimum index score of .15 and a maximum index score of .85 with one respondent scoring at the minimum and one at the maximum.

Disaster History

Disaster history is an independent variable created by summing the total number of federal disasters in the respondent's jurisdiction between 2002 and 2011. A categorical variable was created for disaster history with categories of a few disaster declarations (2 or fewer), some disaster declarations (3 or 4), more than average disaster declarations(5 or 6) and many disaster declarations (7 or more). The mean value for disaster history was 2.505 with the mean value for the actual number of disasters being 4.59. Nearly 12% of respondents were in a jurisdiction that had experienced few disaster declarations while 39 % had some disaster declarations. Above average disaster declarations had been declared in 36% of the respondent's jurisdiction while 13% had experienced many disasters.

Social Vulnerability

The social vulnerability index (SoVI®) was utilized as an independent variable. The mean SoVI score was minus .924 with a minimum of negative 6.69 and maximum of 5.86. One county scored at the low end of the SoVI (-6.69) as the least vulnerable county of those surveyed while one county scored at the high end of the SoVI (5.86) as the most vulnerable county.

Exercises

Respondents were asked how many functional and full-scale exercises they had conducted in the past two years to create the independent variable, exercises. The mean number of exercises conducted was 2.918 with a minimum of zero exercises and a maximum of twelve exercises. Thirteen percent of the respondent's emergency management agencies had not done any functional or full-scale exercises in the last two years while two jurisdictions had done twelve functional or full-scale exercises during that time period.

Collaboration

Collaboration is an independent variable utilized to determine a respondent's level of collaboration with other agencies by asking if they had worked with six different types of agencies through formal mutual aid agreements, memorandums of understanding, informal cooperation and joint planning. The collaboration variable is a sum of the types of collaboration and the number of agencies they had worked with. The mean level of collaboration is 7.68 indicating that on average, each respondent had participated in nearly eight different collaborative activities. Four respondents indicated that they had not undertaken any collaborative activity while two respondents had engaged in the maximum of twenty-four collaborative activities.

DSS Technology Use Independent Variables

Facilitating Conditions

Facilitating conditions is an independent variable designed to obtain the respondent's perception that they have organizational support for using DSS technology. Five questions were utilized to capture the respondent's perception of facilitating conditions. Respondents were asked to score statements regarding facilitating conditions on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree*. The facilitating conditions index ranging from 0 to 1 (Cronbach alpha = .816) was created from these statements. The mean value for the facilitating conditions index is .629 with a minimum of .1 and a maximum of 1. One respondent scored .10 on the index indicating they strongly disagreed that they had organizational support for using DSS technology while five respondents scored 1 on the index indicating that they strongly agreed that their organization supported the use of DSS technology.

IT Department and GIS Specialist

Two independent variables were utilized to gather information related to organizational technology support available to the respondent. The first is a dichotomous variable indicating that a respondent's jurisdiction either has an independent information technology (IT) department or not. Sixty-four percent responded their jurisdiction did have an independent IT department with 36% indicating their jurisdiction does not have an independent IT department. The second independent variable concerns the presence of a GIS specialist within the respondent's emergency management department. Twenty percent of respondents indicated they did have an internal GIS specialist while 80% of respondents indicated they did not have an internal GIS specialist.

Form of Government

Form of government is an independent variable which measures whether a respondent's jurisdiction is managed by an appointed manager or elected official. Fifty-two percent of the respondent's jurisdictions are managed by an appointed manager while 48% are managed by an elected official.

Dedicated EOC

Another independent variable measures whether the jurisdiction utilizes a dedicated emergency operations center (EOC) or not. Thirty percent of the respondent's jurisdictions have a dedicated EOC while 70% utilize some other arrangement for their EOC.

Demographic Variables

Several demographic variables are utilized. The mean age of respondents is 52.08 with the youngest being 24 and the oldest being 73. Eighty-eight percent of respondents are male with twelve percent being female. Ninety-four percent of respondents are white with 6% being non-white. A categorical variable for educational level is used with categories of high school diploma, associate's degree, bachelor's degree and post-graduate degree. The mean level of education is 1.418. Twenty-eight percent of the respondents maximum level of education is a high school diploma, 23% have an associate's degree, 28% have a bachelor's degree and 21% have a post-graduate degree. Fifty-five percent of respondents have completed the federal emergency management agency (FEMA) professional development series (PDS) with 45% reporting they have not completed the FEMA PDS.

Intent to Use DSS Technology Correlations

In order to analyze bivariate relationships between the independent variables and the dependent variable intent to use DSS technology, a bivariate correlation analysis was performed. The correlation table for intent to use DSS technology is shown in Table 4 with the Pearson's *r* value. The correlation analysis shows support for a relationship between the independent variable and dependent variable in H1, H2, H3, H4, H6, H7, H8, H9b, and H9e presented in Chapter 2.

Table 4

Intent to Use DSS Technology Correlations

	Age	Gen	Eth	Ed	Prof	Coll	Ex	SoVI	DH	Thr	SI	EE	PE	Int
Age	1													
Gen	.245**	1												
Eth	.201**	-.079*	1											
Ed	-.046	-.057	-.028	1										
Prof	-.058	-.059	-.044	.101	1									
Coll	-.208**	-.150*	-.089	-.036	.224**	1								
Ex	-.033	.000	-.009	-.001	.258**	.128	1							
SoVI	.123	-.038	-.014	-.230**	-.034	.081	.062	1						
DH	.165*	.056	.091	-.172*	.053	.020	.039	.126	1					
Thr	-.057	-.037	-.122	-.062	.104	.180*	.149*	.036	.009	1				
SI	.087	-.038	-.101	-.090	.108	.073	-.051	-.051	.182*	.146*	1			
EE	-.224**	-.217**	-.148*	.123	.176*	.230**	.093	-.128	.009	.215**	.267**	1		
PE	.128	.015	-.089	.080	.054	.139	.062	-.056	.073	.130	.465**	.380**	1	
Int	-.090	-.174*	-.027	.070	.275**	.297**	.159*	-.175*	.064	.188**	.453**	.463**	.398**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Notes: Gen is gender; Eth is ethnicity; Ed is education; Prof is professionalism; Coll is collaboration; Ex is exercises; SoVI is social vulnerability; DH is disaster history; Thr is threat perception; SI is social influence; EE is effort expectancy; PE is performance expectancy; Int is intent to use DSS technology

However, the correlation analysis fails to provide evidence of a relationship between the independent variable and dependent variable for H5, H9a, H9c, and H9d provided in Chapter 2. It should be noted that correlation analysis only provides indication of a relationship. It does not provide support for causation. Bivariate correlation analysis between the independent variable performance expectancy and the dependent variable intent to use DSS technology produces a statistically significant positive relationship with r equal to .398 at $p < .01$ supporting H1. This indicates that when performance expectancy is higher, the intent to use DSS technology is higher.Bivariate correlation analysis between the independent variable effort expectancy and the dependent variable intent to use DSS technology shows a statistically significant positive relationship between the two. An r value of .463 at $p < .01$ indicates that when perceived effort expectancy is easier, the intent to use DSS technology is greater. This analysis provides support for H2. Support for H3 was obtained through correlation analysis between social influence and intent to use technology. The analysis shows a statistically significant positive relationship between these variables ($r = .453$, $p < .01$). This can be interpreted as the stronger the belief that others that are important think they use the DSS technology, the greater the intent to use that technology.

Six additional independent variables were analyzed against the dependent variable, intent to use DSS technology. Bivariate correlation analysis between threat perception and intent to use DSS technology produced a statistically significant positive association with $r = .188$ at $p < .01$ supporting H4. This can be interpreted as the greater the perceived threat, the greater the intent to use DSS technology. Bivariate correlation analysis between social vulnerability and intent to use DSS technology produced a statistically significant negative relationship (*r* = -.175, p < .05). This signifies that the lower the SoVI score (less social vulnerability), the greater the intent to use DSS technology. This fails to provide support for Hypothesis 6. A statistically significant positive relationship was found between the number of exercises conducted and the intent to use DSS technology (*r* = .159, p <.05). This indicates the more exercises conducted, the stronger the intent to use DSS technology. This lends support to Hypothesis 7. Bivariate correlation analysis of the relationship between collaboration and intent to use DSS technology is also statistically significant in the positive direction (*r* = .297, p <.01). Thus, support for H8 is obtained. This signifies that when a greater level of collaboration is reported, a greater intent to use DSS technology also exists. However, support was not obtained through bivariate correlation analysis for H5. The bivariate correlation analysis between disaster history and the intent to use DSS technology failed to produce a statistically significant positive relationship (*r*=.064).

Several demographic variables were analyzed for correlation with the dependent variable, intent to use DSS technology. Of these, only gender and professionalism were statistically significant. A statistically significant negative relationship between gender and intent to use DSS technology was revealed through correlation analysis(*r* = -.174, p < .05) providing support for H9b. This indicates that women have a greater intent to use DSS technology than men. Support for H9e was obtained through bivariate correlation analysis. A statistically significant positive relationship exists between professionalism and intent to use DSS technology (*r* = .275, p < .01). This indicates that when the emergency management official has completed the FEMA PDS courses a greater intent to use DSS technology also exists. Bivariate correlation analysis failed to provide support for H9a, H9c, or H9d referring to age, ethnicity and education. Further examination of the correlation analysis indicates that multicollinearity between independent variables is not a problem. The highest correlation coefficient existed between social influence and performance expectancy. Their correlation coefficient is 0.465 which is well below the limit of 0.70 that would indicate multicollinearity between variables (Voght, 2005).

Multivariate Regression Results Explaining the Intent to Use DSS Technology

In order to determine the association between the dependent variable, intent to use DSS technology and independent variables, ordinary least squares (OLS) regression was utilized. Four models are utilized to determine factors which lead to a greater intent to utilize DSS technology. The first model regressed intent to use DSS technology on performance expectancy, effort expectancy and social influence. The second model adds threat perception, disaster history, social vulnerability and number of exercises as independent variables. The third model adds collaboration as an independent variable while the fourth model adds demographic independent variables age, gender, ethnicity, education, and professionalism. The regression equation for the full model is

$$Y(\text{Intent to use DSS technology}) = \alpha + B_1(\text{Performance expectancy}) + B_2(\text{Effort expectancy}) + B_3(\text{Social Influence}) + B_4(\text{Threat perception}) + B_5(\text{Disaster history}) + B_6(\text{Social vulnerability}) + B_7(\text{Exercises}) + B_8(\text{Collaboration}) + B_9(\text{Age}) + B_{10}(\text{Gender}) + B_{11}(\text{Ethnicity}) + B_{12}(\text{Education}) + B_{13}(\text{Professionalism}) + e$$

While conducting the multivariate regression analysis, collinearity diagnostics were conducted as an additional check for multicollinearity. Tolerance values ranged from .664 to .912. Collinearity diagnostics also checked variance inflation factors (VIFs) with the highest VIF being 1.507. Both of these values indicate that multicollinearity is not a concern even with conservative criteria for collinearity. Chen et al. (2003) suggest that variables should be investigated when their tolerance values fall below .10 or their VIF is greater than 10. Allison (1999) takes a much more conservative view on multicollinearity suggesting that a tolerance value less than .40 or VIF greater than 4 should be a concern. As noted, the tolerance values and VIFs for the variables used to determine the intent to use DSS technology meet the conservative criteria.

The results of the four models are provided in Table 5. The first model in Table 5 indicates that the three independent variables performance expectancy, effort expectancy and social influence all have a statistically significant effect in the positive direction on the intent to use DSS technology. These three factors explain 33% of the variance in the intent to use DSS technology with an adjusted R^2 value of .333. The second model in Table 5 adds threat perception, disaster history, social vulnerability, and number of exercises conducted as independent variables. Model 2's results indicate that performance expectancy, effort expectancy and social influence continue to be statistically significant predictors of the intent to use DSS technology. Of the three independent variables added to this model, only social vulnerability and the number of exercises are statistically significant indicators of intent to use DSS technology. While Model 2 has added two significant variables and two non-significant variables, the model's ability to explain the variance in intent to use DSS technology has improved slightly. Model 2 explains approximately 36% of the variance in intent to use DSS technology (adjusted R^2 = .355).

Table 5

Multiple Regression Analysis Explaining the Intent to Use DSS Technology

	Model 1					Model 2					Model 3					Model 4			
	Unstd Coeff	SE	Std Coeff	Sig.		Unstd Coeff	SE	Std Coeff	Sig. Sig.		Unstd Coeff	SE	Std Coeff	Sig.		Unstd Coeff	SE	Std Coeff	Sig.
Performance expectancy	.131	.070	.130	.062	*	.119	.069	.118	.086	*	.108	.067	.107	.111		.133	.069	.132	.055
Effort expectancy	.287	.055	.333	.000	****	.255	.056	.296	.000	****	.224	.055	.260	.000	****	.194	.058	.225	.001
Social influence	.356	.079	.303	.000	****	.366	.079	.312	.000	****	.369	.077	.314	.000	****	.362	.078	.308	.000
Threat perception						.080	.102	.047	.436		.042	.100	.025	.676		.059	.100	.035	.555
Disaster history						.001	.012	.006	.923		.001	.012	.006	.919		.001	.012	.003	.962
Social vulnerability						-.008	.004	-.126	.035	**	-.010	.004	-.144	.014	**	-.009	.004	-.135	.024
Exercises						.012	.005	.141	.019	**	.010	.005	.125	.032	**	.008	.005	.097	.101
Collaboration											.007	.002	.190	.002	***	.006	.002	.160	.009
Age																.000	.001	-.015	.797
Gender																-.055	.033	-.100	.093
Ethnicity																.073	.046	.094	.110
Education																.003	.010	.021	.724
Professionalism																.044	.022	.121	.046
(Constant)	.259	.053		.000	****	.189	.075		.012	**	.181	.073		.014	**	.160	.102		.120
n	194					194					194					194			
R Square	.343					.379					.412					.441			
Adjusted R Square	.333					.355					.386					.400			
F-value	33.135	****				16.204	****				16.179	****				10.907	****		

****	p≤.001
***	p≤.01
**	p≤.05
*	p≤.1

In Model 3 in Table 5, the independent variable collaboration is added. All statistically significant indicators from Model 2 continue to be statistically significant with the exception of performance expectancy. The new independent variable, collaboration is statistically significant. The introduction of collaboration has improved the models ability to explain the intent to use DSS technology to nearly 39% (adjusted R^2 = .386).

The final model to explain the intent to use DSS technology adds the following demographic variables, age, gender, ethnicity, education, and professionalism. The results of the full model are shown as Model 4 in Table 5. The full model's unstandardized regression equation is

> *Intent to use DSS technology = .160 + .133(Performance expectancy) + .194(Effort expectancy) + .362(Social Influence) + .059(Threat perception) + .001(Disaster history) - .009(Social vulnerability) + .008(Exercises) + .006(Collaboration) + .000(Age) - .055(Gender) + .073(Ethnicity) + .003(Education) + .044(Professionalism)*

In this full model performance expectancy (B = .133, $p \leq .1$), effort expectancy (B = .194, $p \leq .01$), social influence (B = .362, $p \leq .001$), social vulnerability (B = -.009, $p \leq .05$), level of collaboration (B = .006, $p \leq .01$), gender (B = -.055, $p \leq .1$), and professionalism (B = .044, $p \leq .05$)are all statistically significant. Gender and social vulnerability are significant in the negative direction while the other significant variables are in the positive direction. The full model's determination of coefficient (adjusted R2) is .400 indicating that performance expectancy, effort expectancy, social influence, social vulnerability, level of collaboration, gender, and professionalism explain 40 percent of the variance in intent to use DSS technology. Discussion of each of the independent variables is presented below. The statistically significant predictors are discussed first followed by the insignificant predictors.

Performance Expectancy

Performance expectancy is statistically significant in the positive direction (B = .133, $p \leq .1$). This can be interpreted as, on average, a one unit increase in the belief that DSS technology helps one do a better job, increases intent to use DSS technology by .133, while holding all other factors constant. Performance expectancy is statistically significant in three of the four models indicating that it is a fairly robust predictor of intent to use DSS technology which predicted that as performance expectancy increases, the intent to use DSS technology increases as well. The full model regression provides support for Hypothesis 1. Furthermore, this finding is consistent with Venkatesh et al.'s (2003) UTAUT model that as performance expectancy increases, so does intent to use technology in the private sector.

Effort Expectancy

Effort expectancy is statistically significant in the positive direction (B = .194, $p \leq .01$). The interpretation for effort expectancy is that on average, a one unit increase in one's belief that the technology is easy to use increases intent to use DSS technology by .194, all else being equal. Effort expectancy is statistically significant in all four models indicating that it is a robust predictor of the intent to use DSS technology and that as effort expectancy increases, the intent to use DSS technology increases. Therefore, support for Hypothesis 2 is found. The UTAUT model (Venkatesh et al., 2003) predicts that as effort expectancy increases, intent to use technology increases. This finding lends further support to the modified UTAUT model.

Social Influence

Social influence is statistically significant in the positive direction (B = .362, *p* ≤ .001). This finding indicates that on average, as the perception that others that are important think that one should use DSS technology increases by one unit, intent to use DSS technology increases by .362, when other predictors are held constant. Social influence is also statistically significant in all four models indicating that it is a robust indicator of the intent to use DSS technology. Hypothesis 3 which stated that as social influence increases, the intent to use DSS technology would also increase is supported.

Social influence is the strongest predictor of intent to use DSS technology with a standardized coefficient of .362 (*p* ≤ .001). Venkatesh et al.'s (2003) UTAUT model predicts that as social influence increases, the intent to use technology increases. The findings from this study are consistent with those results. However, the results show that social influence is the strongest predictor of intent to use the technology. Thus it appears the strength of this predictor surpasses performance expectancy (standardized coefficient = .132, p ≤ .1) and effort expectancy (standardized coefficient = .225, *p* ≤ .01) found in studies on the private sector by Venkatesh et al. (2003).

Social Vulnerability

Social vulnerability is statistically significant in the negative direction (B = -.009, *p* ≤ .05). The interpretation for social vulnerability is that on average, when the social vulnerability of the community decreases by one unit, the lead emergency management official of that community scores .009 higher on intent to use DSS technology when all other factors remain constant.

Hypothesis 6 from Chapter 2 posited that as a community's social vulnerability increased, the intent to use DSS technology would increase. The findings indicate the opposite occurs, as social vulnerability decreases the intent to use DSS technology increases. Therefore, Hypothesis 6 is rejected.

Collaboration

The level of collaboration that an emergency management agency participates in is statistically significant in the positive direction (B = .006, $p \leq .01$). The interpretation for level of collaboration is that on average, when controlling for the effects of the other independent variables an increase in the level of collaboration by one collaborative activity increases intent to use DSS technology by .006. Collaboration was not added until running the third model but is statistically significant in both Model 3 and 4 indicating it is a robust predictor of intent to use DSS technology. The regression result for collaboration in Model 4 provides support for Hypothesis8 which predicted that as collaboration increases, the intent to use DSS technology would also increase. This finding lends further support to the abundant literature on the collaborative nature of emergency management (Andrew, 2009; Drabek, 2007; Feiock, 2004; Kendra & Wachtendorf, 2002; Lindell& Perry, 2007; McEntire, 2007; McEntire, 2007a; Patton, 2007).

Professionalism

Professionalism is statistically significant in the positive direction (B = .044, $p \leq .05$). All else being equal, emergency management officials that complete the FEMA PDS courses on average score .044 higher on intent to use DSS technology than officials that do not complete the FEMA PDS courses. Hypothesis 9e that predicted professionalism would lead to a greater intent to use DSS technology found support. This lends credence to the argument that professionalism leads to the adoption of technology offered by numerous scholars (Brudney, 1988 ;Brudney&Seldon, 1995).

Gender

Gender is statistically significant in the negative direction (B = -.055, $p \leq .1$). On average, the intent of men to use DSS technology is .055 lower on the intent to use DSS technology index than women when other predictors are held constant. Hypothesis 9b predicted that gender would influence intent to use DSS technology. Consequently, Hypothesis 9b is supported in the positive direction. Although the literature on gender effects tends toward suggesting that men are more likely to adopt technology (Morris & Venkatesh, 2000; Venkatesh & Morris, 2000), sufficient research exists contending the opposite effect occurs (Cheung et al., 2002, Thomas, 2009). Furthermore, Venkatesh et al. (2003) find that women value social influence and effort expectancy more than men in technology acceptance. This study lends support to the latter premise. This result seems logical in that social influence and effort expectancy are stronger predictors of intent to use DSS technology than performance expectancy.

Non-Significant Variables

Threat perception, disaster history, number of exercises, age, ethnicity, and education are not statistically significant. The linear regression output from Model 4 in Table 5 does not provide support for their associated hypothesis (4, 5, 7, 9a, 9c, and 9d developed in Chapter 2. While none of these variables are significant in the full model, the number of exercises was statistically significant in the positive direction in Model 2 (B = .012, $p \leq .05$) and Model 3 (B = .010, $p \leq .05$). A summary of hypotheses testing is provided in Table 6.

Table 6

Summary of Hypotheses for Intent to Use DSS Technology

	Hypothesis summary	Direction	Result
H1	Respondent's perception of increased performance expectancy will be positively correlated with the intent to use of DSS technology.	+	Supported
H2	Respondent's perceptions of effort expectancy will be positively correlated with their intent to use DSS technology.	+	Supported
H3	Respondent's perceptions of social influence will be positively correlated with their intent to use DSS technology.	+	Supported
H4	Respondent's perception of increased disaster threat level to their city/ county will be positively correlated with their intent to use DSS technology.	+	No evidence for support
H5	Disaster history in the respondent's jurisdiction will be positively correlated with their intent to use DSS technology.	+	No evidence for support
H6	Respondent's community social vulnerability will be positively correlated with intent to use DSS technology.	-	Rejected
H7	Disaster exercises in the respondent's jurisdiction will be positively correlated with their intent to use DSS technology.	+	No evidence for support
H8	Respondent's level of collaboration will be positively correlated with their intent to use DSS technology.	+	Supported
H9a	Respondent's age will be negatively correlated with intent to use DSS technology.	-	No evidence for support
H9b	Respondent's gender will be correlated with intent to use DSS technology.	±	Supported in positive direction
H9c	Respondent's ethnicity will be correlated with intent to use DSS technology.	±	No evidence for support
H9d	Respondent's level of education will be positively correlated with intent to use DSS technology.	+	No evidence for support
H9e	Respondent's professionalism will be positively correlated with intent to use DSS technology.	+	Supported

Standardized Coefficients

The relative strength of the predictors reveals interesting results. By comparing standardized coefficients, the relative strength of variables can be compared. In the final model, the strongest predictor of intent to use DSS technology is social influence with a standardized coefficient of .308 ($p \leq .001$). The next strongest predictor is effort expectancy ($\beta = .225$, $p \leq .001$) followed by collaboration ($\beta = .160$, $p \leq .01$), social vulnerability ($\beta = -.135$, $p \leq .05$) and performance expectancy ($\beta = .132$, $p \leq .1$). The statistically significant demographic variables strengths are professionalism ($\beta = .121$, $p \leq .05$) and gender ($\beta = -.100$, $p \leq .1$).

DSS Technology Use Correlations

Correlation analysis was conducted in order to analyze bivariate relationships between the independent variables and the dependent variable DSS technology use. The correlations for the dependent variable DSS technology use and independent variables with Pearson's *r* values are provided in Table 7. The bivariate correlations support Hypotheses 10, 11, 13, 16b, and 16e provided in Chapter 2. The correlation analysis fails to support Hypotheses 12, 14, 15, 16a, 16c, and 16d.

Bivariate correlations analysis between the independent variable intent to use DSS technology and DSS technology use, reveal a statistically significant positive relationship ($r = .376$, $p < .01$) supporting Hypothesis10. This indicates that when intent to use is greater, actual use is more likely. Hypothesis 11 is supported by correlation analysis between the independent variable facilitating conditions and DSS technology use.

Table 7

DSS Technology Use Correlations

	Age	Gen	Eth	Ed	Prof	IT	GIS	Form	EOC	FC	Intent	Use
Age	1 **											
Gen	.245 **	1										
Eth	.201	.179 *	1									
Ed	-.046	-.057	-.028	1								
Prof	-.058	-.059	-.044	.101	1							
IT	-.242 **	-.022	-.091	.148 *	.070	1						
GIS	.068	-.091	-.104	.037	-.020	.154 *	1					
Form	-.006	.016	-.032	.114	-.038	.141	-.136	1				
EOC	-.159	-.058	.017	.024	.152 *	.123	.069	-.074	1			
FC	-.125	-.055	-.056	-.006	.250 **	.110	.255 **	-.158 *	.229 **	1		
Intent	-.090	-.174 *	-.027	.070	.275 **	.247 **	.063	-.053	.188 **	.463 **	1	
Use	-.116	-.161 *	.000	.002	.144 *	.038	.176 *	-.025	.095	.221 **	.376 **	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Notes: FC is facilitating conditions; EOC is dedicated EOC; Form is form of government; GIS is GIS specialist; IT is IT department; Prof is professionalism; Ed is education level; Eth is ethnicity; Gen is gender

The analysis indicates a statistically significant positive relationship between facilitating conditions and DSS technology use (r =.221, $p < .01$). Consequently, when facilitating conditions are perceived to be greater, DSS technology use is more likely. Correlation analysis signifies a statistically significant positive association between having a GIS specialist and DSS technology use (r = .176, $p < .05$). This means that when an emergency management agency has a GIS specialist in the department, DSS technology use is more likely providing support for Hypothesis 13.

Correlation analysis between the independent variable IT department and DSS technology use was not statistically significant (r = .048) indicating there is no relationship between having an independent IT department and DSS technology use. The correlation analysis between form of government and DSS technology use was insignificant (r = -.025). Consequently, there is no relationship between a manager form of government and DSS technology use. As well, there is not a relationship between having a dedicated EOC and DSS technology use (r = .095).

Correlation analysis on demographic variables provides support for Hypothesis 16 b and 16e but fails to support Hypotheses 16a, 16c, and 16d. The relationship between professionalism and DSS technology use is statistically significant in the positive direction (r = .144, p < .05). This reveals that when the lead emergency management official has completed the FEMA PDS courses, DSS technology use is more likely. Gender is statistically significant to DSS technology use, (r = -.161, $p < .05$). Therefore the correlation analysis supports Hypothesis 16b. The correlation analysis indicates the lack of a relationship between age, ethnicity, or education and DSS technology use.

Correlation analysis was also used to check for multicollinearity between independent variables. Multicollinearity between independent variables is not a problem. The highest correlation coefficient existed between facilitating conditions and intent to use DSS technology with a correlation coefficient of .463. This is well below the limit of .70 that would have indicated multicollinearity between variables exists (Voght, 2005).

Binary Regression Results Explaining DSS Technology Use

In order to determine the relationship between the dichotomous dependent variable, DSS technology use and independent variables binary regression analysis was utilized. Three probit models are utilized to determine factors which lead to a greater probability that that the lead emergency management official uses DSS technology at least monthly as opposed to not using the technology at least monthly. The first model regressed DSS technology use on intent to use DSS technology and facilitating conditions. The second model adds the presence of a centralized IT department, the presence of a GIS specialist in the emergency management department, the form of government and whether or not the jurisdiction has a dedicated EOC. The third model adds demographic independent variables age, gender, ethnicity, education, professionalism, and community social vulnerability. The binary regression equation for the full model is

$$(\textit{DSS technology use}) = \alpha + B_1(\textit{Intent to use DSS technology}) + B_2(\textit{Facilitating conditions}) + B_3(\textit{IT department}) + B_4(\textit{GIS specialist}) + B_5(\textit{Form of government}) + B_6(\textit{Dedicated EOC}) + B_7(\textit{Age}) + B_8(\textit{Gender}) + B_9(\textit{Ethnicity}) + B_{10}(\textit{Education}) + B_{11}(\textit{Professionalism})$$

In order to ensure multicollinearity was not a problem in determining factors that predict DSS technology use, collinearity diagnostics were performed on the independent variables. The lowest tolerance value was .682. The highest VIF was 1.465. Both of these indicators of mulitcollinearity were well below Allison's (1999) conservative criterion for collinearity diagnostics. This indicates that the variables predicting DSS technology use do not have a multicollinearity problem.

The results of the three binary regression models are presented in Table 8. The first model in Table 8 shows that that intent to use DSS technology has a statistically significant effect on the likelihood of the lead emergency management official using DSS technology at least once a month while facilitating conditions does not have a statistically significant effect. The second model in Table 8 adds, having an independent IT department, the presence of a GIS specialist within the emergency management department, having a manager form of government and a dedicated EOC as predictors of DSS technology use. The binary regression results for Model 2 reveal that not only is intent to use DSS technology statistically significant, but having a GIS specialist is statistically significant. The full model adds the demographic variables age, gender, ethnicity, education, and professionalism. The results of the full model are shown as Model 3 in Table 8. The full model's binary regression equation is

> *DSS technology use at least monthly = -4.164 + 3.564(Intent to use DSS technology) + 1.242(Facilitating conditions) - .591(IT department) + 3.079(GIS specialist) + 1.264(Form of government) + .992(Dedicated EOC) - .970(Age) - .639(Gender) + 1.983(Ethnicity) - .922(Education) + 1.271(Professionalism).*

Table 8

Binary Regression Estimates to Predict DSS Technology Use

	Model 1				Model 2				Model 3			
Predictor	b	Odds ratio	Sig		b	Odds ratio	Sig		b	Odds ratio	Sig	
Intent to use	1.213	3.364	.000	****	1.325	3.764	.000	****	1.271	3.564	.000	****
Facilitating conditions	.778	2.177	.459		.141	1.151	.901		.217	1.242	.852	
IT department					-.437	.646	.217		-.527	.591	.159	
GIS specialist					.974	2.650	.026	**	1.125	3.079	.014	**
Form of government					.160	1.173	.630		.234	1.264	.490	
Dedicated EOC					.094	1.098	.794		.008	.992	.983	
Age									-.030	.970	.091	*
Gender									-.448	.639	.415	
Ethnicity									.684	1.983	.350	
Education									-.081	.922	.590	
Professionalism									.240	1.271	.485	
Constant	-5.593	.004	.000	****	-5.659	.003	.000	****	-4.164	.016	.010	***
-2 log likelihood	235.957				230.069				224.778			
Model χ2	31.312				37.199				42.491			
Percentage correct	66.0				68.0				69.1			
N	194											

**** p≤.001

***p≤.01

**p≤.05

*p≤.1

In the full model intent to use DSS technology (b = 1.271, Exp(B) = 3.564, *p* ≤ .001), having a GIS specialist (b = 1.125, Exp(B) = 3.079, p ≤ .05) and age (b = -.030, Exp(B) = .970, *p* ≤ .1) have a statistically significant effect on DSS technology use. Discussion of each of the statistically significant variables is discussed below followed by a discussion of the non-significant variables.

Intent to Use DSS Technology

Intent to use is statistically significant (b = 1.271, Exp(B) = 3.564, *p* ≤ .001). On average, a one unit increase in intent to use DSS technology increases the predicted odds of using that technology at least once a month by a factor of 3.564 compared to less than once a month, all else being equal. Hypothesis 10 that predicted the intent to use DSS technology would be positively correlated with DSS technology use found support.

Presence of a GIS Specialist

Having an GIS specialist in the emergency management department is statistically significant (b = 1.125, Exp(B) = 3.079, *p* ≤ .05). On average, the predicted odds of an emergency management official of an emergency management department that has a GIS specialist within the department using DSS technology at least once a month are 3.079 times that of an emergency management official of an emergency management department that does not have a GIS specialist within the department when other predictors are held constant. Hypothesis 13 which predicted that the presence of a GIS specialist within an emergency management department would be positively correlated with DSS technology use found support. This finding is in line with Jennings and Arlikatti's (2011) finding that having a GIS specialist within a county emergency management agency increases the likelihood that the county will have DSS technology.

Age

Age is statistically significant (b = -.030, Exp(B) = .970, $p \leq .1$) in the negative direction. On average, a one year decrease in age increases the predicted odds of using DSS technology at least once a month by .970 compared to using the DSS technology less than once a month when other factors are held constant. Hypothesis 16a stated that age would be negatively correlated with DSS technology use is supported.

Non-Significant Variables

Facilitating conditions, having an independent IT department, utilizing the manager form of government and having a dedicated EOC are not statistically significant predictors of DSS technology use. Output from binary regression Model 3 in Table 8 does not provide support for Hypotheses 11, 12, 14, or 15. Furthermore, the demographic variables, gender, ethnicity, education, and professionalism, are not significant indicators of DSS technology use. Consequently, support is not obtained for Hypotheses 16b, 16c, 16d, or 16e. A summary of the hypotheses tests for DSS technology use is provided in Table 9.

Table 9

Summary of Hypotheses for DSS Technology Use

	Hypothesis summary	Direction	Result
H10	Respondent’s intent to use DSS technology will be positively correlated with DSS technology use.	+	Supported
H11	Respondent’s perception of facilitating conditions will be positively correlated with DSS technology use.	+	No evidence for support
H12	The presence of an independent IT department will be positively correlated with DSS technology use.	+	No evidence for support
H13	The presence of a GIS specialist within an emergency management department will be positively correlated with DSS technology use.	+	Supported
H14	A council-manager form of government will be positively correlated with DSS technology use.	+	No evidence for support
H15	The presence of a dedicated EOC within a jurisdiction will be positively correlated with DSS technology use.	+	No evidence for support
H16a	Respondent’s age will be negatively correlated with DSS technology use.	-	Supported
H16b	Respondent’s gender will be correlated with DSS technology use.	±	No evidence for support
H16c	Respondent’s ethnicity will be correlated with DSS technology use.	±	No evidence for support
H16d	Respondent’s level of education will be positively correlated with DSS technology use.	+	No evidence for support
H16e	Respondent’s professionalism will be positively correlated with DSS technology use.	+	No evidence for support

CHAPTER 5

DISCUSSION AND IMPLICATIONS

This study examines factors that influence the intent to use and actual use of decision support software (DSS) technology by the leading emergency management official for local jurisdictions in the federal emergency management agency (FEMA) region VI. In order to examine these factors, an online survey of these officials was conducted to collect data which could be used to test hypotheses related to the intent to use DSS technology and DSS technology use. In addition to the data collected from the survey, data on disaster declarations was obtained from FEMA as well as data on community social vulnerability from the Hazards and Vulnerability Research Institute. The findings on intent to use DSS technology are discussed in this section with the findings on DSS technology use discussed in the next section.

The hypotheses developed in Chapter 2 drew upon literature in the information sciences (IS) field, particularly the unified theory of acceptance and use of technology (UTAUT) model (Venkatesh et al., 2003) developed to explain the intent to use technology. Hypotheses development also drew upon much of the disaster literature to adapt understanding of technological adoption to a specific type of technology used in emergency management, DSS technology such as Eteam™ and WebEOC®.

The results of this research supported six of the thirteen hypotheses developed to explain the intent to use DSS technology. While it failed to provide support for the other seven hypotheses developed, only one of these hypotheses is statistically rejected. The results of this study extend many of the findings of Venkatesh et al. (2003) to the first known study of technological adoption for DSS technology utilized for managing response to disasters. It also extends the extensive disaster literature on collaboration (Andrew, 2009; Drabek, 2007; Feiock, 2004; Kendra & Wachtendorf, 2002; Lindell & Perry, 2007; McEntire, 2007; McEntire, 2007a; Patton, 2007) to show that collaboration influences the intent to use DSS technology in emergency management. This study failed to provide as much support for DSS technology use as it did for intent to use DSS technology. Three of the eleven hypotheses to explain DSS technology use are supported while the other eight cannot be supported by this study.

Intent to Use DSS Technology

Hypothesis 3 predicting that as a local emergency manager's perception of social influence increased their intent to use DSS technology would also increase is supported by this study. One unique aspect of this study is that it is assumed that others that influence a local emergency management official's behavior would be their regional emergency management partners and the state emergency management agency. These categories of others were in addition to others simply categorized as people who are important to the emergency management official. While this research did not specifically explore who those others might be, it would not be unreasonable to assume they could be other first responding agencies from within the local jurisdiction or volunteer organizations that assist the local community in responding to disasters. So, while disaster response is primarily considered to be a local responsibility (FEMA, 2007), the opinion of state and regional partners matter when intending to use DSS technology.

As just noted, intent to use DSS technology is influenced by state and regional emergency management partners. However, this does not explain how pre event processes with those partners might influence a local emergency manager's intent to use DSS technology. Hypothesis 8 found support in that, as the level of collaboration increases, the intent to use DSS technology by that local jurisdiction's lead emergency management official would increase. The assumption made in this study is that collaboration could occur through four primary types of activities. These included formal mutual aid agreements, memorandums of understanding, joint planning and informal cooperation. Furthermore, it is assumed that these activities could occur with multiple partners including the state emergency management agency, a council of government, a regional alliance, cities within the corresponding jurisdiction's county, cities from a different county, or with a different county all together.

This study supports scholarly research that underscores the importance of collaboration. In particular the emphasis on pre disaster collaborative efforts as being critical (Andrew, 2009; Feiock, 2004; Kendra & Wachtendorf, 2002) is supported. The finding in this study suggesting that social influence is the strongest predictor of intent to use DSS technology is not surprising. Given that the majority of research on technology adoption has focused on private sector applications (Thomas, 2009) their findings that performance expectancy and effort expectancy are the best predictors make sense. In private sector applications, performance expectancy can be viewed as gaining a competitive edge which is assumed to be a key aspect of job performance. For consumer adoption of technology, performance helps the individual consumer do something better and more easily. In contrast, disasters are not isolated to impacting a single jurisdiction and require a collaborative effort in response (Buck et al., 2006; McEntire, 2007; Waugh, 1994; Wenger et al., 1990). That collaborative effort extends to influencing the intent to use DSS technology.

Hypothesis 1 is consistent with the UTAUT model in predicting that as performance expectancy increases, the intent to use DSS technology will increase. The assumption made in this study is that the DSS technology of interest provides a means of helping emergency management officials do their job better during disaster response. In particular, this DSS technology facilitates developing or maintaining situational awareness during disasters along with managing resources, delegating tasks and completing those tasks in a timelier manner.

The belief that a technology is easy to use is a significant predictor of the intent to use that technology (Venkatesh et al., 2003). Hypothesis 2found support that, as the perception of local emergency managers that effort expectancy increased, their intent to use DSS technology would increase. Consequently, the easier local emergency management officials believe it is to learn, become skillful with, and use DSS technology, their intent to use that technology increases.

Community social vulnerability was addressed by Hypothesis 6 which predicted that as a community's social vulnerability increases, the intent of that community's lead emergency manager to use DSS technology would increase. Hypothesis 6 was rejected by this study. That this finding occurred is perplexing. In that DSS technology is intended to help emergency managers deal with the difficult and complex decisions that have to be made in responding to disasters, it theoretically and intuitively makes sense that those emergency managers in more vulnerable communities would intend to use DSS technology as greater vulnerability results in a greater impact from hazard events. There are a couple of reasons that this expectation might not have occurred. It could be that emergency managers are unaware of the SoVI® score for their community. Another factor could be that the SoVI scores vulnerability at a county-wide level and therefore does not account for the unique differences in vulnerability between cities within a county (or for that matter differences in vulnerability of neighborhoods within a city).

Gender was predicted to have an effect on intent to use DSS technology. Hypothesis 9b found support in that women have a greater intent to use DSS technology than do men. The research on gender effects on technology acceptance provides mixed results although the literature leans towards men being more inclined to adopt technology. However, studies which specifically focus on gender moderation of variables that explain intent to use technology find that women consider social influence more than men when adopting technology (Venkatesh et al., 2003). When considering that social influence was the strongest predictor of intent to use DSS technology in this study, finding that women are more likely to intend to use DSS technology is not necessarily surprising.

Hypothesis 9e found support that, as the respondent’s level of professionalism increased, their intent to use DSS technology would increase. This study assumed that completing the FEMA professional development series (PDS) courses is a measure of professionalism. The FEMA PDS series provides training for emergency management officials on fundamentals of emergency management including effective communication, and decision making and problem solving. In that the DSS technology of interest in this study is a tool to facilitate communication and decision making in order to solve problems in disaster response, this finding is expected. Research by Brudney (1988) and Brudney and Seldon (1995) indicating that professionalism within an organization increases the adoption of technology is supported by this study.

Hypothesis 4 predicted that as threat perception increases, the intent to use DSS technology would increase and Hypothesis 5 predicted that a greater number of federally declared disasters would lead to greater intent to use DSS technology did not find support. There could be several reasons these hypotheses failed to find support in this study. Perhaps when considering risk or based on previous experience, emergency managers consider DSS technology to be a potential liability. A concern over the failure of a technology when it is being relied upon could overcome the potential positive attributes of using that technology. It is also possible that the effect of disaster history is based upon a shorter timeframe than used in this study. For example, although Texas leads the nation in disaster declarations, the previous three years only resulted in three disaster declarations in the state. Another possibility could simply be that they feel they handled disasters without DSS technology previously.

It was also anticipated that the number of functional and full scale exercises conducted in the jurisdiction in the previous two years would influence intent to use DSS technology. The results obtained in this study did not support this. It was expected that since exercises serve as means of preparing for and practicing dealing with disasters, they expose the problems of interorganizational coordination and should influence the intent to use DSS technology. While this study operationalized exercises as the total number of functional and full scale exercises conducted in the previous two years several factors could explain why this variable lacked statistical support. It is unknown to what extent the emergency management department and/or lead emergency management official was involved in the exercises. For example, it could be that the respondent included exercises that were oriented to a particular department or situation that did not include a major role for emergency management that was directly relevant to using DSS technology. For example, a special weapons and tactics exercise for the police department or an apartment complex fire for the fire department might not have included a significant role for emergency management officials. Nor is it known what role the emergency management official played in the exercises. It could be that the lead emergency management official's primary role in the exercise was designing or facilitating the exercise, rather than an exercise player.

DSS Technology Use

Hypothesis 10 predicted that intent to use technology would be positively correlated with technology use. Support for this hypothesis was found in this study. Support was not found that facilitating conditions would influence actual use of DSS technology as predicted by Hypothesis 11. Therefore it does not appear that the perception of organizational support to facilitate using DSS technology leads to more likely use of that technology. This is in contrast to studies in the private sector on facilitating conditions (Venkatesh et al., 2003). The finding that organizational support does not influence DSS technology use may not be surprising when considering the low salience of emergency management in local governments as noted by numerous scholars (Kreps, 1991; Krueger et al., 2009; McEntire & Dawson, 2007; Perry & Lindell, 2003; Picket & Block, 1991; Waugh, 2000, 2007

This study further examined specific organizational factors such as having an independent information technology (IT) department in the jurisdiction, having a geographic information systems (GIS) specialist within the emergency management agency, having a manager form of government and having a dedicated emergency operations center (EOC) that were hypothesized to influence DSS technology use. Of these four organizational factors, only having an in-house GIS specialist was positively correlated with DSS technology use. In that the DSS technology utilized in this study incorporates GIS, this finding makes sense. This finding provides additional support to Jennings and Arlikatti's (2011) contention that having a GIS specialist leads to greater likelihood of a county emergency management agency having DSS technology.

Hypothesis 12 which proposed that having an independent IT department would positively influence actual use of DSS technology did not find support. Jun and Weare (2010) contend that IT departments support technology adoption in order to increase their prominence in an organization and gain additional resources. This research fails to provide support to their argument. In the case of DSS technology, it may be that IT departments take a different view seeing it as a specialized type of technology for an individual department that would be a drain on their resources rather than contributing resources. It could also be that the IT department does not support a specialized technology that in their mind is not routinely utilized and has minimal frequent use.

Hypothesis 14 which posited that having a manager form of government would influence DSS technology use failed to find support in this study. The literature on the effect of form of government and technology adoption is mixed. It could be that government managers take the same view on DSS technology that IT department might take; that DSS technology is too specialized and doesn't provide enough organization wide utility for them to support. It could also be that they don't influence the inner workings of an emergency management department.

Findings from this study do not provide support for a positive relationship between having a dedicated EOC and DSS technology use. It is possible that those jurisdictions that use multipurpose EOCs, EOCs converted from other use when necessary or mobile EOCs find it just as necessary to use DSS technology as those jurisdictions with dedicated EOCs. It could be that since the DSS technology being utilized in this research is web based technology, the need for a dedicated EOC, in fact the need for a physical EOC is less necessary to use this technology.

Implications

There is a huge push in the 21st century to use technology to improve decision making, create greater transparency, increase accountability and improve productivity. New and improved technologies flood the market touting their benefits for improving the workplace. The use of these technologies presents theoretical and practical challenges for understanding the benefits and improving their implementation. Yet little is known about their popularity and adaptability in disaster response decision making. The findings from this study begin to address these theoretical and practical challenges.

Theoretical Implications

This study helps close the gap in the IS literature on technology acceptance in that it focuses on technology acceptance in the public sector, specifically emergency management. The vast majority of the technology acceptance literature has focused on private sector and consumer acceptance of technology with less research on public sector applications (Lee & Rao, 2007; Thomas, 2009). This research provides a comparison of technology acceptance in the specific public sector discipline of emergency management to private sector technology acceptance in that it is the first to focus on technology acceptance by emergency managers for decision making in disaster response. A summary of the differences are provided in table 10.

Table 10

Comparison of Public and Private Sector Technology Acceptance

Intent to use technology	Public Sector (Emergency Management)	Social influence is the strongest predictor of intent to use technology followed by effort expectancy and collaboration. Social vulnerability also explains intent to use technology Performance expectancy explains intent to use technology but not to the same degree as other predictors
	Private Sector	Performance expectancy is the strongest predictor followed by effort expectancy and social influence
Technology use	Public Sector (Emergency Management)	Intent to use technology explains technology use Facilitating conditions fails to explain technology use The presence of a GIS specialist explains technology use
	Private Sector	Intent to use technology and facilitating conditions explain technology use

Consequently, it is the first research that explains the factors that influence emergency management officials in their intent to use and actual use of DSS technology. This research provides insight into the thought process that emergency management officials undertake when determining whether or not to adopt technologies that serve as decision-making tools in dealing with disaster. It is important to understand that thought process in order to better use DSS technology as a decision-making tool in disaster response. Ultimately, the decision making that occurs during disaster response impacts the communities emergency management officials serve.

This research is supportive of theories predicting that performance expectancy, effort expectancy and social influence lead to intent to use technology (Ajzen, 1975; Davis et al., 1989; Fishbien & Ajzen, 1975; Thompson et al., 1991; Triandis 1980; Venkatesh et al., 2003). However, the vast majority of the research based on those theories contends that performance expectancy and effort expectancy are the predominant factors that explain technology acceptance. One important theoretical contribution of this study is that when examining the public sector and in particular, emergency management, social influence is the strongest predictor of intent to use technology which counters the majority of the technology acceptance literature. Clearly, the type of organization that is using the technology and the purpose for which it is created matter.

Another important theoretical contribution of this study relates to the role of facilitating conditions in predicting technology use. The research on technology use generally contends that use is dependent upon intent to use technology and facilitating conditions (Thompson et al., 1991; Triandis 1980; Venkatesh et al., 2003). As this study indicates, in emergency management organizations DSS technology use is not influenced by general facilitating conditions but rather by specialized organizational support such as having an in-house GIS specialist. Theories on technology use may need to be adjusted dependent upon the type of organization using the technology. As well, these theories may need to be expanded to differentiate on the specific type of technology being utilized. In particular, technologies that may be infrequently used and serve very specific purposes should be incorporated into theories on technology use.

Practical Implications

In addition to theoretical contributions, this research has practical implications. When examining the intent to use technology, social influence and collaboration matter. While collaboration is clearly manifest in dealing with disasters, it is now evident that pre-event collaboration is important in intending to use DSS technology that will enable better decision making in a disaster context. While that collaboration may undertake a variety of forms and partners, that collaboration should be extended to include collaborative efforts related to technologies being utilized during normal times.

This study shows that while intent of the lead emergency management official to use DSS technology influences their actual use of that technology, not much else influences their use. The one additional factor that influences DSS technology use is having a GIS specialist within the emergency management department. While it may not be practical for all emergency management agencies to hire a GIS specialist, those that want to use DSS technology may find that it is worthwhile to obtain GIS training. Emergency management academic programs should take note of this finding as well. Incorporating GIS training into their curriculum will ensure their graduates are more competitive on the job market.

One finding from this study is that quite simply, DSS technology is not used on a frequent basis. Less than half of those surveyed use the technology at least once a month. This could be a cause for concern. If the technology is not used frequently, how well will it be utilized when it is necessary for responding to a real event? Perhaps, emergency management officials need to incorporate the use of DSS technology more often through exercises, special events and routine events.

Finally, this research has practical implications for technology application developers. While performance expectancy and effort expectancy matter, social influence matters even more in the intent to use DSS technology in emergency management. DSS technology developers need to be cognizant of the fact that social influence is key, if they want to expand their reach of end users. Not only should such technology assist emergency managers in performing their jobs better and faster, and be easy to learn, but it should be so developed that social influentials who work with emergency managers also see the value of this DSS technology. The collaborative nature of dealing with disasters should be fine-tuned in DSS technology development so that it fosters and sustains collaboration.

Furthermore, DSS technology developers should be aware that their technology is not used frequently, much less on a daily basis. They should consider product development that can be incorporated into the more routine activities of emergency managers. They should also provide training and certification incentives with continuing education credit options which are meaningful to first responders and emergency management officials.

Limitations

As with any study, this study is not without its limitations. First, the response rate was lower than expected. Although 35 percent started the survey, only 25 percent completed the survey which raises concerns regarding the generalizability of the findings. However, the sample size of 194 is deemed sufficient by numerous scholars (Green, 1991; Bartlett, Kotrlik, & Higgins, 2001).

Second, the survey was limited to local emergency management officials in FEMA region VI. This limits the ability to generalize the findings to other regions of the country that may face different types of hazards or operate under different emergency management structures. Clearly, the findings in this study cannot be extended to explaining factors that influence technology adoption by officials in other levels of government. Future studies could sample officials in other geographic regions and levels of government.

Another limitation of this study is due to the cross-sectional design. It captures the perception of the lead emergency management official at one point in time. It does not account for how perceptions could change over time. This could be perceived as critical to a study on technology acceptance as it is a rapidly changing field. However, I believe that while a particular technology may change, the basis for explaining factors that influence the intent to use technology and actual use of technology remain grounded in theory. Consequently, the findings of this study are relevant to understanding factors influencing the intent to use DSS technology and its actual use by local emergency management officials. It would be interesting to see the changes in factors over several points in time, in future studies.

Future Research

In that this is the first known study on technology acceptance by emergency management officials involving DSS technology used in disaster response, a healthy research agenda can follow to extend the line of research began by this study. Future research should also be conducted to overcome several of the limitations of this research. First, this study should be conducted on a national scale. This would extend the generalizability to all local emergency management officials, as well as allow for comparative analysis of factors that influence DSS technology adoption. Comparisons could be conducted between urban and rural emergency management agencies, city and county emergency management agencies, and emergency management agencies based on geographic regions.

Second, the research could be conducted at the state and tribal government level to see if the factors that influence DSS technology adoption by state and tribal nation emergency management officials differ from that of local emergency management officials. This could be especially important if state emergency management agencies begin pushing the use of DSS technology down to local emergency management agencies.

The research could be extended to determine factors that influence DSS technology adoption by other disaster response officials/ organizations such as the fire, police or emergency medical personnel. While this study provided insight into factors that influence the adoption of DSS technology by the lead emergency manager, it does little to expand our understanding of those actually involved in field response operations or those that staff the EOCs when activated for disasters and actually use the DSS software

The finding on gender in this research is contrary to much of the literature that suggests that males are more likely to adopt technology than females. Additional research could be conducted to find out if this is an anomaly somehow unique to the field of emergency management or to this dataset. Emergency management is a male dominated profession making it worthwhile to investigate whether there are unique leadership characteristics or technology use preferences evidenced in women who join this profession.

It would be meaningful to follow up with these respondents over time. Conducting a longitudinal panel study would provide improved causal inferences. Additionally it would be interesting to see whether a respondent's reported intent to use DSS technology actually translated to actual use at a later date.

Conducting the research after refined operationalization of some variables might provide new information related to factors that influence DSS technology adoption by emergency management officials. In this study, threat perception was designed to obtain the level of concern respondents had to 20 different hazards. However, refining threat perception to address only those threats of greatest concern might reveal differences in DSS technology based upon the predominant threats to a community.

Disaster history was a variable intended to capture their disaster experience. Disaster history was calculated as the number of federally declared disasters for the jurisdiction between 2002 and 2011. Federal disaster declarations are issued at the county level and not the city level. Therefore it is possible for a disaster declaration to be issued for a county but the event impacted cities within the county at varying degrees or not at all. Refining disaster history to incorporate a more detailed assessment of the specific impact to a community could provide additional perspective on technology adoption. Disaster history in this study does not include hazard events that may not result in a federally declared disaster declaration but can certainly impact a community and require decision making by emergency management officials.

Determining the role of these types of events could also shed additional perspective on technology acceptance.

The SoVI is intended to provide a calculated value for social vulnerability and therefore address risk to a community. The SoVI has several limitations itself. The SoVI is reported at the county level rather than at the individual city level. It is certainly possible that cities within a county could have varying levels of social vulnerability. Even if the SoVI was available at the city level, inaccuracies could occur due to disproportionate levels of measures utilized in the SoVI. Research utilizing more defined geographic social vulnerability data could provide additional understanding of factors that influence adoption of technology.

Finally, while this study provides insights into factors that influence the intent to use DSS technology and actual use, it does not explain the reasons why some local emergency management officials do not adopt technology. Despite their belief that performance expectancy will increase, the technology is easy to use, and others think they should use it, there may be some compounding factors that are detrimental to their actually adopting this technology. On the other hand there are those that do not use DSS technology and prefer alternative methods. It would be interesting to understand the perspectives of these two groups and investigate these factors in future studies.

Conclusion

This study examined factors that influence the intent to use and actual use of decision support software (DSS) technology by emergency management officials using a data set obtained by surveying local emergency managers in FEMA region VI. This study adapts the unified theory of acceptance and use of technology for use in an emergency management context.

Analysis of the data through multivariate regression reveals that social influence is the strongest predictor of intent to use DSS technology in contrast to private sector studies on technology adoption that indicate performance expectancy as the strongest predictor. In addition to social influence, effort expectancy, collaboration, social vulnerability, professionalism, performance expectancy, and gender explain 40 percent of the intent to use DSS technology. This research underscores the importance of collaboration in dealing with disasters, demonstrating that collaboration is not only a post-disaster necessity but should be extended to collaborative efforts related to technologies before disaster strikes.

Contrary to prior studies on use of technology in the private sector this study finds that facilitating conditions do not influence technology use. Rather, the binary regression analysis indicates that actual technology use is influenced by the lead emergency manager's intent to use DSS technology, having an in house GIS specialist, and his/ her age.

This dissertation makes a considerable contribution to the literature by showing that the adoption of DSS technology in emergency management is unique in some facets. It is noteworthy that contrary to most studies on intent to use technology, when looking at the intent to use DSS technology in an emergency management context, social influence is a stronger predictor than performance expectancy or effort expectancy and that facilitating conditions is not a significant predictor of actual use of DSS technology. These findings show that the specific type of technology and the context in which it is intended to be use clearly matter.

APPENDIX

TRADEMARKED NAMES USED

Aloha® modeling program, National Oceanic and Atmospheric Administration U.S. Department of Commerce, Washington D.C., http://response.restoration.noaa.gov/aloha.

Cameo® chemical emergency software suite, Environmental Protection Agency, Washington, DC, http://www.epa.gov.

ESi® emergency management and public safety computer hardware, ESi Acquisition, Inc., Augusta, GA, http://esi911.com.

Eteam™ emergency management software, NC4 LLC., El Segundo, CA, www.nc4.us.

HazusMH®software, United States Department of Homeland Security, Washington, DC, http://www.fema.gov/hazus.

Marplot® mapping application, National Oceanic and Atmospheric Administration U.S. Department of Commerce, Washington D.C. 20230, http://response.restoration.noaa.gov.

NC-4 Risk Center™ risk analysis service, NC4 Inc., El Segundo, CA, www.nc4.us.

NC-4™ situational readiness solutions, NC4 Inc., El Segundo, CA, www.nc4.us.

NC4™ Street Smart™ public safety software, NC4 Inc., El Segundo, CA, www.nc4.us.

Qualtrics® research survey software, Qualtrics Labs, Inc. Provo, UT, www.qualtrics.com.

SoVI® vulnerability index, Hazards and Vulnerability Research Institute, University of South Carolina, Columbia, SC, http://webra.cas.sc.edu/hvri/.

WebEOC® emergency management and public safety software, ESi Acquisition, Inc., Augusta, GA, http://esi911.com.

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