AC 2008-904: THE ROLE OF IT-RELATED DISASTER RECOVERY IN EXPEDITING THE RECOVERY FROM HURRICANES IN TOURIST-BASED COASTAL COMMUNITIES

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The Role of IT-Related Disaster Recovery in Expediting the Recovery from Hurricanes in Tourist-Based Coastal Communities

Abstract

While proximity to the ocean affords visitors and residents of coastal communities a unique lifestyle, the threat of coastal storms constantly looms, threatening the economic viability of these tourist-based economies. The executive director of community development for a county in a coastal region posed the question: What data needs to be backed up by the community?

In order to answer this question, this study initiates a focus group discussion among construction industry experts from a hurricane embattled region. The transcribed discussions were analyzed using the content analysis technique. The results indicate that protecting data sources that traditionally are the focus of IT-related disaster recovery, while important, are dependent on the physical restoration of the community infrastructure. The physical infrastructure is likewise dependent on a wide range of data and information that, when readily available, drastically reduces the time, cost, and effort of post-disaster reconstruction. Infrastructure data and information, therefore, need to be protected in the same manner as traditional data sources.

These findings indicated the need for a policy or ordinance mandated by the city or state that would require critical infrastructure data to be stored and backed up on a regular basis as new buildings, roads, and other infrastructure are built in the region. Also, such communities should have a disaster recovery policy to ensure the rapid restoration of data after a disaster.

This policy recommendation strives for an ideal solution, and one that is not necessarily possible given the resource restraints of small, municipal governments. The hurdles of this policy are being addressed by integrating this problem within a joint business-engineering course and deploying student teams on-site. Students are tasked with identifying and gathering data as well as devising specifications for an information system that is protected against disaster and provides timely access to critical infrastructure data.

Students are currently developing a pilot methodology and system recommendations to be presented during a city council. Both the students and the municipality attain favorable benefits: the former gaining incomparable real-world insight and experience, the latter gaining necessary technical requirements at minimal costs. This paper advocates the use of the focus group/content analysis method as a means to identify areas that create this type of mutual benefits.

Introduction

As of 1998, over half the global population (3.2 billion people) resided within 120 miles of a coastline, and trends indicate an ongoing dramatic increase of population density in these regions[1]. Coastal regions of the United States are no different, and are increasing in popularity among both tourists and residents. By 2025, an estimated 75% of the U.S. population is expected to reside in coastal counties, an increase from 53% in 1999[2]. Communities on the Alabama coastline receive approximately 4 million visitors every year, 70% of whom are from out of state, who spend approximately $2 billion on travel-related expenses and support about 43,000 tourism-related jobs. Lodging expenditures in Baldwin county, one of the state's two coastal counties, were $241 million in 2006, 28% of the entire expenditures incurred in the entire state[3].

The tourism industry is therefore of vital importance to the economies of both Baldwin county and to the state as a whole. Tourist spending tends to peak during the summer months and the local population has grown steadily in recent years to accommodate the demands of the area's tourism-based services. High-rise condominiums now dominate long stretches of the coastline, with more being built at a blistering pace. Returning visitors and residents recognize that a once quaint beach community populated with rental houses and beach shacks on stilts has been replaced with modern condominiums that in turn fuel the economy of the region. However, while proximity to the ocean affords visitors and residents a uniquely desirable lifestyle, coastal storms pose a constant threat to residents and visitors alike. For the community stakeholders (residents, businesspeople, and government officials) in coastal communities, a major concern is how to sustain the economic viability and stability of this region, especially in the aftermath of devastating Atlantic hurricanes. Although Alabama's coastline is only 53 miles in length, a mere 1.8% of the 2,925 miles of coastline of the continental U.S, this problem is common to many other coastal communities in the U.S.[4]

In 2004, Hurricane Ivan made landfall directly in the Baldwin County city of Gulf Shores, causing extensive and lasting damage. Much of the real estate rental property in this and nearby communities that cater to tourists took six to twelve months to rebuild and reopen for business. From the community's perspective, this time equates to lost revenues and potential business failure as beach-seeking tourists spent their vacation dollars in nearby communities that either sustained less damage or that recovered more quickly. The executive director of community development for this county therefore contacted a large southeastern university seeking answers to the following question: given the availability of a wide variety of disaster recovery methods, what data needs to be backed up by the community?

To address this research question, a comprehensive literature review was performed to identify first the type of essential data that needed to be backed up by the community. A focus group discussion was conducted to elicit information from community stakeholders identified by the executive director of the community development organization. A content analysis of the discussions among the participants in the focus group indicated a substantial difference in what the participants value as critical data and information compared to that reported in the literature. These steps led the authors to develop a policy recommendation to the local community on how to use their IT services effectively when threatened with hurricanes or other disasters in the

future. This paper describes this study and its findings in detail, and concludes with a discussion of the limitations of the research and further questions that need to be researched to enhance and protect the economies of tourist-based communities that may be disrupted by natural disasters.

Background: Critical Community Data Sources

A community has many stakeholders, including residents (individual families, condominium owners, apartment owners), business owners (small, medium, and large), and government agencies (local, state, and federal). Disaster recovery methods that relate to the loss of historic data and the ongoing collection of transactional data in the face of community-wide natural disasters call for a strategy that helps prepare for the emergency in advance and then assists in a quick recovery afterwards.

The consequences of losing critical data and IS can be financial loss, damage to reputation, or legal action[5]. Financial loss arises for many reasons including lost revenues, compensatory payments, future loss of revenue, loss of productivity and customer attrition[6,7,8,9]. Indirect financial impacts may be felt from damage inflicted on a brand or reputation[9,10]. In financial industries, customer trust is of utmost importance and new legislation requires disclosure of customer data loss[11,12]. Businesses losing data invite exposure to litigation, especially for data regulated by governmental mandates such as HIPAA[9,10]. After a disaster, a reported 43% of businesses never reopen[13]. Compounding this problem is the reported 93% business failure rate following a significant data loss[14]. A community-wide natural disaster that affects both the physical and IS aspects of an organization is therefore a threat to the vitality of all the organizations in that community.

Critical data and IS resources depend on a specific organization's industry and business practices. For instance, although both client-centric organizations such as accountants and document-centric firms such as publishing companies are heavily reliant on data in their operations, each defines its critical data sources differently[16]. Examples of critical data resources include inventory records, personnel information, orders, invoices, payroll, customer databases, financial documents, mailing lists, and electronic data interchange forms from vendors and customers, social security numbers, and credit card numbers[6,16,17,18,19]. These critical data and information reported in the literature provide and initial understanding to the question addressed in this research.

Research Methodology: Focus Group

This section discusses the methodology used in this research, namely a focus group discussion, and demonstrates its appropriateness for addressing the research questions. The value of this methodology lies not only in the individual responses of the participants but also in the discussions that arise among the respondents that reflect a shared, social understanding of a particular topic. Additionally the opportunity exists for researchers moderating the focus group to delve deeper into any emergent topics that arise from these semi-structured, dynamic discussions.

The recommended number of participants for a focus group is six to ten. Of these participants, a degree of homogeneity is both expected when recruiting participants who are knowledgeable on a specific topic and desirable to promote interaction among participants[20]. A degree of diversity, however, is also beneficial in preventing conformity, which may suppress the voicing of important issues. The recruitment process includes the need to designate a meeting time and place and the onus is on the researcher to coordinate a meeting time and place that is acceptable to all participants. All of these steps can be facilitated by the use of a key informant, that is, an individual with both knowledge and influence among a group of potential participants.

The executive director of Baldwin County Economic Development Alliance was identified as a key informant who could identify and recruit hurricane-experienced decision makers. The Economic Development Alliance is a coalition of community and business leaders in Alabama's Baldwin County that was formed in 1995 to promote and sustain the economic growth of the region, with recognition of the critical economic role of a narrow stretch of beaches. The Alabama Gulf Coast Convention & Visitors Bureau building was selected as a meeting place that was geographically convenient for the participants and could accommodate the group meeting from 11 am until 2 pm on February 5, 2007. Researchers from the Departments of Mechanical Engineering, Management, and Sociology at the university led the discussion and the faculty member from the Department of Sociology served as the moderator.

Ten hurricane-experienced government officials and private business representatives with insight into the most critical components and adoption issues related to disaster recovery were selected and invited to discuss the components of appropriate disaster recovery methods and the issues that prevent or encourage the adoption of those methods. The construction industry is of utmost importance to coastal communities that survive and thrive economically, not only from real estate rental services but also as the result of quick restoration of rental properties that have sustained damage after a coastal storm. The participants completed a demographic questionnaire that identified the organization they represented and their role in the organization. This questionnaire also disclosed to the participants the intended use of the data collected. A summary of the data obtained from the questionnaire is shown in Table 1.

Table 1: Focus group participant organizations' demographic statistics

	Government (n = 6)		**Commercial (n = 4)**		**Total (N =10)**	
Demographic	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**
Years of Operation	22	[12, 50]	35.3	[16, 55]	34.7	[12, 55]
No. of Employees	70	[5, 200+]	182.8	[51, 300+]	136.6	[5, 300+]
Years of Experience	11.2	[5, 20]	11.5	[5, 16]	11.3	[5, 20]
Annual Revenues in $1,000	10,058	[500, 26000]	5,000	[5000+]	7,392	[500, 26000]
No. of IT Staff	0.83	[0, 5]	12.3	[0, 25]	2.6	[0, 25]

Analysis Procedures

The discussion from the moderated focus group meeting was recorded with audio equipment and supplemented with notes taken by the moderators. The audio recording of the discussion, which was approximately 71 minutes long, was transcribed into text by a professional transcription service and then confirmed by the researchers and augmented to include timestamps of each speaker's contributions and the identities of each speaker.

The content analysis method was used to analyze the data generated from the focus group. Content analysis is a research method that, according to Neuendorf adheres to a rigorous six-part definition, namely: (i) a reliance on the scientific method, (ii) the unit of analysis and/or data collection must be the message, (iii) quantitative treatment of the data, (iv) the message set is summarized by coding messages, (v) an applicability to all contexts, and (vi) all message characteristics are subjected to the content analysis[21]. This study adhered to all parts of this definition.

Results & Discussion

The content analysis of the focus group discussion resulted in the identification of 476 data points, each representing a distinct part of the discussion. Of these data points, infrastructure data sources such as engineering drawings, surveys of property lines, locations of structures, and locations of sub-concrete utility access were identified as being the most critical in the restoration of a community that had sustained hurricane damage and were mentioned 53 times, or, 11.13% of the overall discussion.

During the course of reviewing disaster recovery methods from the literature and prior to the focus group, the researchers compiled a list of data source examples. These examples pointed to traditional data sources such as inventory records, personnel information, orders, invoices, payroll, customer databases, financial documents, mailing lists, and electronic data interchange forms from vendors and customers, social security numbers, and customer credit card numbers. The discussants did specifically address these types of data, referring to data from approximately 14,000 customers, billing software, databases, and e-mail servers. Certainly, these data are critical and, if lost, the effort required to recreate them is potentially fatal to an organization and will detract from community stability. However, although they considered them critical, these data were not the major concern among the focus group discussants. They instead and overwhelmingly identified the entire range of infrastructure data that is generated during construction, modification, and reconstruction of physical facilities as the most important priority for their community's recovery after a major disaster that incurs substantial property and infrastructure damage such as a hurricane.

For the tourist-based economies in the Gulf Shores region, the physical facilities of high-rise condominiums and other rental properties are essential to accommodate travelers who, in turn, generate revenue for the community. The range of infrastructure data therefore includes "as-built" drawings of the original building properties, drawings of structural and property modifications, surveys of property lines, locations of structures such as fences and swimming

pools, locations of sub-concrete utility access (water, sewer, telecommunications, electrical), stress points, and electrical plans. These data and any other information that is generated at any stage of construction or maintenance of real estate rental property are highly customized for each property and are typically stored as rolled drawings or in other physical forms. After the damage that inevitably follows a hurricane, having this data readily available greatly facilitates the restoration of damaged properties. However, despite the importance attached to these data by the focus group discussants, at present they are seldom available during reconstruction. Several times during the focus group, discussants identified cases in which organizations lost their entire infrastructure archive and had to recreate their records from scratch. On reviewing this finding, the Executive Director of Baldwin County commented:

> *The focus group participants focused on the critical path data; if infrastructure data is not available and reconstruction cannot happen quickly, speedy data recovery by businesses in the coastal communities is irrelevant. They have no place to operate and no customers to cater to.*

This comment illustrates that the availability of infrastructure data precedes the need for traditional data. For example, what good are customer records for a tourist-based, location specific business such as a beachfront condo if the condominium is in disrepair after a storm. Reconstruction must first occur, but for this to occur, it is dependent on the availability of infrastructure data and information, which not being traditional IT data sources are likely not to be subject to the necessary disaster recovery protections.

Policy Recommendations for Service-Based Coastal Communities

The findings pointed to the need for a policy or ordinance mandated by the city or state that would require critical infrastructure data to be stored and backed up as new buildings, roads, and utilities are installed in the region and to have a disaster recovery policy and implementation plan so that the data can be restored quickly after a disaster. The discussions highlighted the need for digitization and use of Global Positioning System (GPS) coordinates to locate infrastructure elements after a disaster. As one participant stated:

> *You also have the cost of going in there with jack hammers if necessary, or surveying and testing so that you can locate the utility lines with your sonar or whatever. Non-destructive/destructive testing to locate utilities is one of the most expensive items. The actual engineering and architectural cost of reconstruction is more than double the cost of the original building. You've got to know where the pilings are and none of these things are visible; they all have to be fleshed out to be determined to be where they are. So it could cost if you have a severe loss. In all probability, you're better off just to bulldoze it and start it over brand new, which would probably cost you less money than trying to find the substructures on what you already have. If you have the digital plans it's a different story; you know where to look.*

Enforcement of disaster recovery methods for infrastructure data would alleviate these problems; however, reconstruction of the community infrastructure must take place even before the process

of reconstruction of commercial property can begin. Another member of the focus group explains:

> *You have six or seven feet of sand over your highway and you do more damage to utilities. Sand removers also remove water hydrants, water valves, they tear up telephone pedestals, they tear them out of the ground with front-end loaders trying to get sand out of roads.*

This member further suggested that infrastructure data, in its present form, is insufficient to meet the needs of the recovery process. Geographical information systems (GIS) were identified as being the ideal solution for this problem.

> *If you've gotten GIS located, you've got GIS coordinates in a GIS databank then you go right back there and put flags on them before the bulldozers come through or the front-end loaders come through to take that sand off. And you keep people down there; it's not just a one-day deal. You keep re-flagging, flag gets knocked down you re-flag. Still that's cheaper than having to replace all that stuff.*

The participants stated that GIS data could be supplemented with the aerial photography already produced annually by the county. For example, after Hurricane Ivan many of the property owners in Baldwin County found that the electricity to their buildings was cut off, extensive water damage had occurred, and utility lines and services were completely destroyed. Sand is swept over many places where utility pipes and services existed and pools are totally washed out. In order to restore the buildings to operational condition and get the community back to work, massive amounts of information and data about the area had to be recreated. Roads were completely washed out and had to be remapped and rebuilt.

Efforts to formulate, enact, and enforce an ordinance of this type that affects many network stakeholders is a massive undertaking. City building departments would need to increase their knowledge and resources so that capturing the data would not be a bottleneck in the construction process and drive builders to nearby communities without such requirements. A policy of this scope would require a massive amount of resources to identify, locate, and in many cases re-create critical data and information. The data and information would then need to be integrated, periodically updated, and made to be accessible even directly after a disaster. Although the focus group determined an ordinance to be the best course of action, achieving this goal was not necessarily perceived to be a reality.

Educational Implications

University faculty can address these issues not only directly in discussions with their students but also, in their research and service roles, in their communities. During the Spring of 2008 a student team enrolled in a upper level business-engineering crossover course took on the task of making the policy recommendation become a reality. The students were tasked with identifying and gathering data as well as devising specifications for an information system that is protected against disaster and provides timely access to critical infrastructure data. In this manner, they identify critical data by contacting city officials, gather GPS coordinates of the critical data, and

specifications for an information system to store, protect, and disseminate the data. These efforts will culminate in a presentation of the results during a city council meeting. In this capacity, students can gain hands on experience while updating critical data sources in the community.

This service-oriented student project differs from others in that it is ongoing, designed to continue into subsequent academic terms with new student teams building upon their predecessors work. This project was made possible by employing the focus group and content analysis methodologies. These research methodologies permit a high realism of context and thus enabled the researchers to gain a substantive understanding of the problem area. This led to identifying both the problem of not having critical data and information after a disaster but also the problem of not having the resources to ensure the availability of this data and information. These two problems are simultaneously addressed by student teams.

Limitations & Future Research

This study has several limitations. The focus group methodology achieves a high degree of realism but at the expense of generalizability and precision of measurement. Future research efforts can address this limitation by employing different theoretical perspectives and/or research methods, such as a survey questionnaire. In this manner, a broader population could be reached to possibly identify issues that were overlooked during the focus group. For example, critical customized software related to water treatment and sanitary systems were not identified by this focus group but may be uncovered when employing far-reaching methods.

Another limitation and area for future research is to broaden the stakeholders represented in the sampled population. For instance, an important limitation of adoption of disaster recovery was that data are dispersed across a network of stakeholders. Condominium owners and the insurance industry were identified as part of the stakeholder network but were not represented in the data of this study.

This research addresses what are critical data and information should be backed up by the community but does not address issues regarding how this should be done. Many technical and social issues abound including any ethical implications of developing such a system, that is, even though much of the information is public record, should it be made freely accessible on a web site. Another question is what formats (e.g. portable document format or PDF) will data be stored? Future research can look toward these and other issues related to system implementation.

Conclusion

This research recommends that city officials capture and preserve infrastructure civil engineering data including geographical data, commercial businesses proactively endorse these practices, and university faculty and students serve their community by raising awareness and working directly in the community using service projects. The findings and policy recommendations were developed after analyzing focus group discussion data from representatives of stakeholders in tourist-based coastal communities; however, the implications of this study are likely to also apply to other regions with different physical and economic characteristics. For example, the

American Midwest has recently experienced devastating floods unmatched since 1913 (Moyer, 2007) and even inland communities may be subject to community-wide natural disasters that threaten the community viability and stability. This research provides guidance to those decision makers who are charged with promoting community viability.

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Bibliography

1. UN Atlas of the Oceans (2007). Human settlements on the coast, accessed August 24, 2007, available at http://www.oceansatlas.com/servlet/CDSServlet?status=ND0xODc3LjIxMDkmNj1lbiYzMz1kb2N1bWVudHMmMzc9aW5mbw~~
2. Hinrichsen, D. (1998). *Coastal Waters of the World: Trends, Threats, and Strategies*. Washington D.C.: Island Press.
3. Alabama Gulf Coast & Convention & Visitors Bureau (2007). CVB statistics, accessed August 24, 2007, available at HTUhttp://agccvb.org/stats/UTH
4. Infoplease (2007). Coastline of the United States, accessed August 24, 2007, available at http://www.infoplease.com/ipa/A0001801.html
5. Gibb, F., & Buchanan, S. (2006). A framework for business continuity management. *International Journal of Information Management*, *26*(2), 128-141.
6. Marshall, J., & Heffes, E. M. (2006). Surveys: Data losses spur consumer flight. *Financial Executive*, *22*(1), 10.
7. Lewis, D. (2005). Personal disaster recovery software: An essential part of business disaster recovery plans. *Computer Technology Review*, *25*(6), 10.
8. LaPage, A. & Gaylord, K. (2003). Protect against data loss with W2K's backup utility. *Windows Professional*, *8*(2), 8-12.
9. Freeman, E. Q. (2000). E-merging risks: Operational issues and solutions in a cyberage. *Risk Management*, *47*(7), 12-15.
10. Eckert, B. (2006). Protect computerized data with off-site backups. *Nursing Homes*, *55*(5), 42.
11. Duke, B. (2006). Data security: behind the headlines. *ABA Banking Journal*, *97*(8), 18.
12. Mearian, L. (2005). IT managers criticize federal data-loss bill. *Computerworld*, *29*(30), 10.
13. Wenk, D. (2004). Is 'Good Enough' storage good enough for compliance? *Disaster Recovery Journal*, *17*(11), 1-3.
14. Rike, B. (2003). Prepared or not...That IS the vital question. *Information Management Journal*, *37*(3), 25-33.
15. O'Bannon, I. M. (2006). Beep, beep, beep...back it up. *CPA Technology Advisor*, *16*(2), 20-21.
16. Marlin, S. (2005). Data losses blamed on stores and software. *InformationWeek*, 1037, 30.
17. Ferelli, M. (2001). Disaster recovery tips: Steps you should take today for the future. *Computer Technology Review*, *21*(1), 10.
18. Hawkins, S.M., Yin, D.C., & Chou, D.C. (2000). Disaster recovery planning: A strategy for data security. *Information Management & Computer Security*, *8*(5), 222-229.
19. Janusz, C. (1993). Selecting UPS systems for midrange computers. *Computer Technology Review*, *13*(11), 110-112.
20. Gibbs, A. (1997). Focus groups. *Social Research Update*, 19.
21. Neuendorf, K.A. (2002). *The Content Analysis Guidebook*. Thousand Oaks, CA: Sage Publications, Inc.