

# Collaborative Information Technology(CIT) Applications in Post-Disaster Public-Private Partnerships

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The last several years of the Atlantic Hurricane Season have been some of the busiest and most destructive in history. Although piling in human terms in comparison to the Asian Tsunami with its sobering loss of life, a series of Atlantic Hurricanes from 2004 - 2008 have generated some of the largest response and recovery efforts in U.S. history with damage estimates exceeding \$100 billion.

This paper will discuss two unique public-private partnerships, which operating as computer supported virtual organizations helped redefine state and federal response relating to post disaster construction and temporary housing issues in a disaster. In doing so, the paper will expand collaborative information technology (CIT). The term CIT is used to denote asynchronous technology that provides support for coordination and collaboration through computer supported communication. Although CIT, closely related Computer Mediated Communication (CMC), and Computer Supported Cooperative Work (CSCW) are usually associated with constructing or managing interorganizational communication, this paper will explore how web based technology bridged the information gap between government, the private sector, and victims left homeless by a series of catastrophic hurricanes.

**Key Words:** virtual organizations, atlantic hurricanes, temporary disaster housing, post disaster construction, computer-supported cooperative work, and computer-mediated communication

## I . Introduction

The last several years of the Atlantic Hurricane Season have been some of the busiest and most destructive in history. Although piling in human terms in comparison to the Asian Tsunami with its sobering loss of life, the Atlantic Hurricanes over the last several years have generated some of the largest response and recovery efforts in U.S. history with damage estimates in excess of \$100 billion.

This paper will discuss two unique public-private partnerships, which operating as computer supported virtual organizations helped redefine state and federal response relating to post disaster construction and temporary housing issues in a disaster. Although the technology was also used in the aftermath of Hurricane Katrina, emphasis will be placed on the 2004 hurricane season in Florida, a busy season for the state and the federal government with damage estimates around \$42 billion. In doing so, the paper will expand collaborative information technology (CIT). The term

CIT is used to denote asynchronous technology that provides support for coordination and collaboration through computer supported communication. Although CIT, closely related Computer Mediated Communication (CMC) and Computer Supported Cooperative Work (CSCW) are usually associated with constructing or managing interorganizational communication, this paper will explore how web based technology bridged the information gap between government, the private sector, and victims left homeless by this series of catastrophic hurricanes.

## II. The Need for Information in a Disaster

Access to information is critical in a disaster situation. Governmental and non-governmental response agencies use it for guiding decision making and response actions; the private sector and the public use it to acquire aid and resources. Citizens' information needs are a public good and service central to virtually all of government's response and recovery efforts.

During the recent Atlantic Hurricane Seasons, two unique public-private partnerships, the Disaster Contractors Network and Disaster Housing Resources Online, fulfilled the definitions of CMC and CSCW by conveying information to disaster victims and those who sought to help them. In each instance, these public-private virtual organizations, using web-based computer served systems, linked government, the private sector, and disaster victims with information to help speed the recovery process.

Communication and coordination, the "two c's", are repeatedly cited as the two areas needing the most improvement in disaster response and recovery operations. Often at the core of each of these is the transmittal or translation of information. Information here can be defined as the communication or reception of knowledge and intelligence during the disaster and post disaster event and the process by which

knowledge is impressed upon others. Increasingly this communication and coordination of information is accomplished with the assistance of computer technology in an Emergency Operations Center, Command Post, or via the World Wide Web.

## III. Describing Communication Technology

Using technology to fill information needs is not a new concept. The first computer-supported social network (CSSN) was in the 1960's when the U.S. Defense Department's Advanced Research Projects Agency developed ARPANET to link large university computers and some of their users. The concept of computer supported cooperative work (CSCW) has been used to describe the design, introduction, and use of groupware systems to bridge the dynamics and diversity of different organizations and groups within organizations (Rittenbruch, Kahler, & Cremers, 1998). More descriptive and to the point for this paper is the concept of Computer Mediated Communication (CMC). CMC is the name given to a large set of functions in which computers are used to support human communication (Santoro, 1995). Computer Mediated Communication (CMC) is distinguished by the nature of the human-computer interaction and by the role taken by the computer in mediating the human communication process. The element of CMC explored here is one in which the computer plays an active role as the repository or maintainer of organized information. This information and knowledge originates or is coordinated by a governmental entity, working with private sector partners, and is utilized by disaster victims and resource providers in a very interactive way. Santoro (1995) refers to this as "informatics". Central to our discussion is the use of computer systems and networks for the building, transfer, storage and retrieval of information between government agencies, private sector resources, and disaster victims. In our examples, the

computer/network system becomes a mediator rather than a processor of the multi-directional information (Santoro, 1995).

#### IV. Using Virtual Organizations to Transmit Information with Low Transaction Costs

DeSanctis, Gerardine, & Peter Monge, (1999) define virtual organizations (VO) as: “a collection of geographically distributed, functionally and/or culturally diverse entities that are linked by electronic forms of communication and rely on lateral, dynamic relationships for coordination” (DeSanctis, et al, p.693). These organizations, though bounded by shared goals and a defined identity, may be constantly morphing or reconfiguring the structure and processes of the organization. Virtual Organizations can also be thought of as a “a form of cooperation of legally independent companies or people contributing their core competencies to a vertical or horizontal integration and appearing as one organization to the customer” (Rittenbruch, Markus, Kahler Helge, & Armin B. Cremers, 1998, p. 30).

The success of virtual organizations hinge on shared, interdependent processes that are designed to achieve shared objectives (Grabowski, et al., 1999). The communication benefits include reaching a larger geographical area, larger participation rates, and being more efficient, i.e., a faster response time and task specialization (DeSantis, et al, p. 694). A downside of VO communication is the organization’s struggle to maintain a coherent identity, and the possibility of alienation and information overload for the participants.

Computer networks sufficiently reduce the costs of coordination, allowing virtual organization partner organizations in our examples to achieve active information dissemination and resource coordination without high transaction costs (Dilling, Blanchard, Connolly, and Heffron, 2005). Transaction cost theory

is an interdisciplinary approach that is derived from three different, but related literatures: economics, organization theory, and contract law (Williamson, 1981 p.573). Williamson defines a transaction as an event whereby “a good or service is transferred across a technologically separable interface” (1981, p.552). The good or service here is information on steps to take after the disaster and a series of databases containing service, material or temporary housing providers. The more complete information available to the participant, the lower the costs, risk, and uncertainty levels in the transaction process (Maser, 1998). Here information technology is being used to provide a time and cost efficient way of disseminating and obtaining information regarding a resource transaction, in addition to decreasing the spatial distribution of the exchange. Information technology operating within virtual organizations, then, lower transaction costs and encourage interaction (Dilling, Blanchard, Connolly, and Heffron, 2005). With both DCN and DHROnline this translates into using collaborative information technology to exchange information and disaster intelligence between resource providers and victims. After the occurrence of a significant natural disaster such as the series of hurricanes in 2004, these efficient exchanges help stimulate the activity that will result in recovery efforts to the benefit of the affected communities. Therefore, the use of computers and the World Wide Web to coordinate and disseminate information can be thought of in terms of transaction cost theory.

#### V. Computer Information Technology and E-government

E-government refers to the delivery of governmental information and services through the Internet or other digital means, freeing citizens to access information at their own convenience (West, 2004). The development of e-government solutions in

the United States has dramatically risen over the last ten years. Nevertheless, three recent nationwide surveys of local e-government applications found e-government to be mainly informational in nature, with very few interactive or transactional functions taking place (Coursey and Norris, 2008). So, although government web sites are common-place, they are used primarily for one-way or static mechanisms to display information.

West (2004), distinguished among four general stages of e-government development: 1) the billboard stage; 2) the partial-service delivery stage; 3) the portal stage, with fully executable and integrated service delivery; and 4) interactive democracy with public outreach and accountability enhancing features (p. 17). The two virtual organizations represented in the case descriptions we will discuss later, would be categorized as at stages 3 and 4 within West's typology. West (2004, p. 17) characterized the third stage as a one-stop portal with fully executable and integrated services, where all participating or related agencies can be accessed, improving citizen ability to find information. The fourth stage moves a web site beyond a service delivery model to having such features as web site personalization, push technology, two-way communications, feedback options to "boost democratic responsiveness and leadership accountability" (West, 2004, p. 17).

One challenge to e-government is the clear need to educate the public on the availability of the web site or web portal and the services it offers. One of the strengths of establishing a virtual organization of public and private partners with a common mission is that it magnifies the ability of all stakeholders to reach their desired audience. The public sector, for example has new avenues, e.g., other government agencies, private professional associations, and private sector membership of those associations, to reach out to the public they serve. In the example of the Disasters

Contractors Network, described later, network communication channels for multi-directional information and knowledge sharing more than doubled utilizing the virtual organization concept.

## VI. Knowledge Sharing through Virtual Organizations

Public sector agencies have long been willing to share information across organizations, but were not as adept at sharing it within their own organizations. Private sector organizations have been much better at sharing knowledge within the organization but because of proprietary restrictions have been reluctant to share knowledge external to the organization. Therefore, it is an important challenge for both public and private organizations to establish an organizational culture that promotes knowledge sharing (Kim and Lee, 2006). Technology innovations have enabled this culture to expand. Knowledge sharing is most often accomplished by means of the internet, web-based portals, databases, and teleconferencing (Kim and Lee, 2006).

Within the virtual organizations covered in this paper, knowledge sharing using all of these means have enabled and built strategic alliances between public sector and private sector partners to benefit the disaster victim. This has expanded the concept of knowledge sharing beyond organizational boundaries within the context of a virtual organization. It has also created an atmosphere of cooperation, ownership, and commitment (Bartol and Srivastava, 2002) among the participating organizations for the virtual organization's mission. Because strategic alliances are "interfirm cooperative arrangements aimed at achieving the shared strategic objectives of the partners" (Das and Teng, 1998, p. 491), cooperation and knowledge sharing is vital to a virtual organization's success. By forming a virtual organization, public and private organizational partners gain access to the

embedded knowledge and communication networks of the other partners.

## VII. The Disaster Contractors Network and Disaster Housing Resources Online

### 1. The Disaster Contractors Network

The construction industry is a valuable resource to government and its citizens in a disaster. The Disaster Contractor Network (DCN) is a vehicle for helping contractors maximize their impact on the governmental and private sector response. DCN does this, first, prior to a disaster, in encouraging businesses and homeowners to employ mitigation measures, and secondly, post-disaster, when they can both help prevent secondary damage with more rapid re-building and assist their customers in building back better using mitigation techniques. The Disaster Contractor Network (DCN) is an unprecedented partnership between the Associated Builders and Contractors of Florida (ABC), the Florida Roofing, Sheet Metal and Air Conditioning Contractors Association (FRSA); the Association of General Contractors (AGC); the Florida Home Builders Association (FHBA); the Center for Disaster Risk Policy (CDRP) at Florida State University; the Federal Emergency Management Agency (FEMA), Region IV; the State of Florida Department of Community Affairs and the State of Florida Department of Business and Professional Regulation. Underwritten largely by the Department of Community Affairs and FEMA, the DCN is the first attempt anywhere in the United States to coordinate contractor association through their existing state and local networks.

In the case of the DCN, 25 private sector construction industry related professional associations partners become an information conduit to a huge industry - the private sector construction industry, linking them to key state and federal agencies. This includes not only major commercial and homebuilder

associations, but also related associations such as architect and engineer associations. Combined, they serve tens of thousands of private sector small and large businesses that are in some way related to the success of a post-disaster recovery. The network provides access to disaster construction related information and trains local associations of the major contractor organizations in the State of Florida in disaster management issues. During actual disaster activation, the DCN consolidates disaster intelligence from all its partner organizations and disseminates it over a website, [www.dcnonline.org](http://www.dcnonline.org) in the form of situation reports and hot issue postings. The member associations also directly disseminate the information to their members. Therefore the virtual organization structure is used to coordinate multiple public and private sector agencies and organizations. It also uses a DCN virtual operations center to match critical building or labor needs with available construction and construction material resources to help speed the re-building effort. Updated information on licensing and permitting issues, constantly changing after a major disaster, are also posted by county.

Often the cost of obtaining information, from government sources in particular, can be so costly in time and effort as to prohibit citizens from seeking additional information regarding the steps they should take, i.e., a transaction (Maser, 1998). Because Internet-based virtual organizations have a relatively low cost-benefit ratio (cost of obtaining additional information to the benefit of reduced uncertainty) the availability of virtual organizations such as DCN and DHROnline encourage the disaster victims to obtain information, thus making it more likely that the information transaction will actually occur (Dilling, Blanchard, Connery, and Heffron, 2005). Furthermore, there are few costs associated with using information technology to seek out and monitor a transaction partner for citizens in a technologically advanced

society such as the United States – for most, the Internet search process is relatively easy and time efficient.

In the summer and fall of 2004, the potential of the DCN was recently fully realized by taking the partnership from the level of a web based training and information portal to successfully integrating the contractor community and the emergency management community into the recovery and mitigation process of four Atlantic hurricanes. This was accomplished through contractor’s direct involvement in state and local disaster operation centers and field offices, intelligence gathering regarding post storm conditions, and the coordination of eight construction fairs in heavily impacted areas to help the re-building effort.

Prior to the 2004 activation the objectives of the Disaster Contractor Network had been to:

- Develop a “disaster smart” contractor (one that

has planned for their own business continuity and that can operate safely in a post disaster environment)

- Establish a training and information medium for contractors regarding mitigation and disaster operations.
- Achieve incorporation of “DCN” into everyday vernacular among contractors and their associations.
- Create a model public/private partnership between government and the contractor community.
- Provide a medium of direct dialogue between contractors and government during disaster response and recovery.
- Provide identification and support of critical needs and resources to the contractor community during disaster events.
- Serve as a conduit between Federal, State, local, regulatory agency, building associations, and the contractor community.

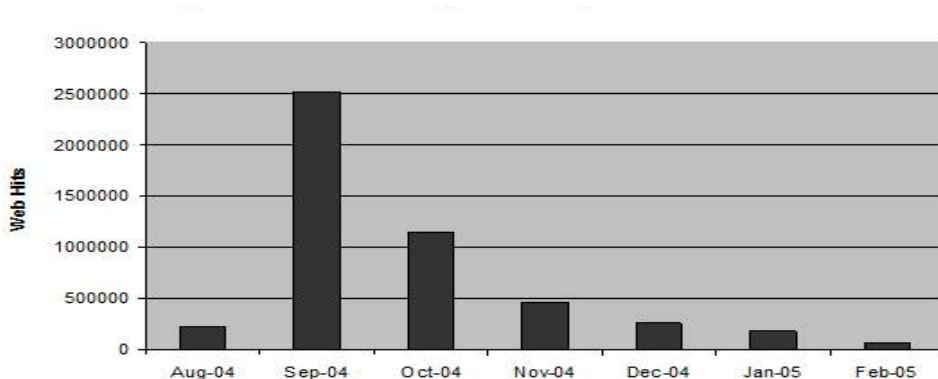


Figure 1. DCN Web Usage Summary for 8/12/04 to 2/13/05

During the 2004 activations however, it was soon recognized that providing direct information to the impacted homeowner in a post disaster environment became paramount after disaster victims discovered the DCN website. Between August 13, 2004 and February 13, 2005 the DCN website experienced over 4,866,873 hits to its website from both contractors and home owners. See Figure 1.

Average hits per day totaled 26,307 for this period with the highest concentration of hits occurring in September, 2004, with over two million hits for that month. Homeowners found the site through a series of outreach activities at thirty-one Disaster Recovery Centers and at DCN special events at local home building supply providers. Traffic to the website peaked on September 21, 2004 with 188,000 hits in one

day. Over 9,643 available resources to aid in the re-building effort were posted by contractors during that period. This is even more remarkable in that the 2004 season represented the first time the DCN was activated for a disaster event. Using a distributed network of databases and construction related knowledge, DCN provided the capacity to search for and retrieve information on resources that would help both contractors working in the field and homeowners requiring repair or re-building services. It also linked mitigation to recovery activities both on the web site and through a series of outreach publications

distributed in the field. In addition to homeowners, the information exchange benefited local government licensing and permitting organizations. Seeing very quickly that no mechanism was in place to coordinate the myriad of temporary changes in permitting and licensing requirements at the local level, the DCN modified its Virtual Operations Center to provide avenue for local citizens and contractors to access those changes. The DCN was adaptive in scaling knowledge for action at multiple levels.



Figure 2. The Home Page of the Disaster Contractors Network

The DCN includes on its site a mechanism in which consumers can check the state licensing status of a potential contractor provider. This is accomplished by working closely with one of the partner organizations, the Department of Business and Professional Regulation, which serves as the state licensing agency. This is an example of where collaborative information technology has the potential to significantly reduce the transaction costs in a disaster. This is accomplished when resources are scarce by providing information regarding the value and quality of the product or service as well as information about the seller to the consumer. When more information is known about a

contractor, the consumer is likely to feel a greater trust because the uncertainty of the transaction is minimized. Thus, according to transaction cost theory, when trust is established between the consumer and provider the exchange is more likely to occur (Frant, 1996).

Computer-supported social networks (CSSN) are mostly used to communicate the exchange of information with people posting a question or comment and receiving information in return. With DCN both questions and resource requests were posted. Resources were match to critical needs. It allowed for increased access to experienced, skilled people in

government for questions and access to the private sector for services. An argument may also be made that DCN offered emotional support as well as access to goods and services during a disaster. Seeing that government and private sector professionals are there to help, those participating in DCN may have felt that they were not alone during the stress following the

disaster. Research has shown that, “despite the limited social presence of CMC, people find social support, companionship, and a sense of belonging through the normal course of CSSNs of work and community, even when they are composed of persons they hardly know”(Wellman, et al., 1996, p. 220).



Figure 3. Matching Needs with Resources

## 2. Disaster Housing Resources Online

Another critical problem with the large numbers of homes that were damaged and destroyed by the 2004 hurricanes in Florida was the issue of finding temporary housing for the thousands of victims left without a place to live. After seeing the success of DCN and the ease of which it could be administered in times of disaster by FEMA reservists, FEMA contacted the Center for Disaster Risk Policy to apply the DCN model to this issue. DHRonline was the result. Built on the same premise of creating a virtual organization that could muster information and resources of multiple organizations the DHRonline was molded together in ten days to help fill critical housing needs. In addition to FEMA and the Center for Disaster Risk Policy, the Florida Housing Finance Corporation and the Florida Association of Realtors

were brought on as partners because of their access to housing providers who could list properties on the site.

The DHRonline was developed to help displaced victims find housing quickly and easily. Prior to DHRonline going live, disaster victims would call a FEMA hotline and be provided available property listings from a FEMA inventory by call center operators. In September and October call volumes were in the thousands per day, with FEMA operators spending long amounts of time going over property listings with victims. DHRonline uses a searchable website to allow victims to not only access the thousands of properties FEMA has in their inventory but also others that could be posted with full property descriptions and photos by property managers and realtors. Advanced searches were possible allowing call center operators to provide victims with DHRonline website address, with full confidence that

they would be able to find a property within their budget and with amenities needed by their family.

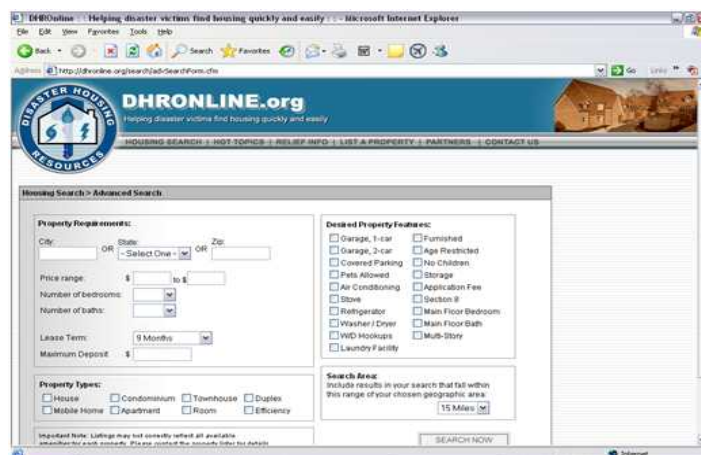


Figure 4. The Advanced Search Function of DHRonline

See Figure 4.

“The structure of the Net encourages specialized relationships because it supports a market approach to finding social resources in virtual communities. With more ease than in almost all real life situations, people can shop for resources from the safety and comfort of their homes or offices, and with reduced search and travel time” (Wellman, et al., p. 221). This reduces time spent on the phones with FEMA and state agencies, thus reducing the transaction cost of the information.

## VIII. The Importance of Virtual Organizations in Information Dissemination

Each of the web portals described above meet West's (2004) typology for stage 3 and 4 transformation. They improve the citizen's ability to find information across multiple state and federal agencies, and private sector partners. They have security features that allow major stakeholders, e.g., partners, contractors, property owners to post and update information that is helpful to disaster victims. They have information in other languages. They allow contractors, suppliers (DCN) and property

owners/managers (DHR) to customize and personalize profiles to manage their own listings with advanced image features. They allow for push technology through automatic news updates and email/ticket features for two way communication. There are mapping functions, and interactive feedback mechanisms to rate contractors/vendors, match critical needs with resources, etc.

Despite these features, however, the overarching feature that made these web portals work, achieve dramatic hit counts, and serve the disaster victim was the virtual organization concept with its participating partner organizations. The magnification of knowledge sharing and cooperation beyond traditional organizational boundaries to meet the needs of the major stakeholders (contractors/property owners) and ultimately the needs of the disaster victims (rebuilding/temporary housing), is what makes the web portals themselves successful.

A case in support of the importance of the partner organizations came out of Hurricane Katrina. After the huge success of both the DCN and DHR in Florida, FEMA was anxious to expand the services to the impacted states of Katrina. In the case of the DCN, they wanted the impacted states to request activation

of the DCN and build their own state specific partnerships to form the state level virtual organization with FEMA representing the federal level partner. In all cases, despite interest from the respective Governor's offices and the major contractor associations the states, through their emergency management offices did not pursue the DCN. And although the site itself was activated for those states, without the partners sharing and disseminating information, web usage was low, with the exception of Florida where all partners continued to promote it.

The Disaster Housing Resources Online was a different story. FEMA and the Department of Homeland Security activated DHROnline for the entire country since Katrina's victims fled to all parts of the United States. And with the help of the Center for Disaster Risk Policy, partner organizations at both the federal and state level were recruited to meet the concept of the virtual organizations with their knowledge sharing and information dissemination. Web hits in the high period of the disaster were in the range of 2 million hits per day as a consequence. The importance of the partner organizations as information conduits and for web portal promotion cannot be underscored.

## IX. Summary

In a 1996 study Barry Wellman and his co-authors cautioned against the overuse of computer mediated communication because they were concerned with "the effects of losing verbal nuances (e.g. voice tone, volume), nonverbal cues (e.g. gaze, body language), physical context (e.g. meeting sites, seating arrangements), and observable information about social characteristics (e.g. age, gender, race)" (Wellman, Barry, Janet Salaff, Dimitrina Dimitrova, Laura Garton, Milena Gulia, & Caroline Haythornthwaite, 1996, p. 218). However, there are benefits to what can be gained using information

technology and virtual organizations this way. For example, it is one thing to tell a person over the phone about an apartment/service that is available to them and another for that person to see the photos of the apartment/service on-line. Although the authors state that "some participants prefer in-person contact to CMC for ambiguous, socially sensitive, and intellectually difficult interactions" (Wellman, et al. p. 218), CIT and CMC has the advantage of maintaining social distance, documenting contentious issues, providing more complete information, and allowing numerous parties various distances apart to communicate together simultaneously.

DCN and DHR are ultimately public goods and services required to meet citizens' demands and preferences for critical disaster information and resources. In each instance victims, service providers, and government agencies are linked in a working virtual organization to solve disaster response and recovery problems. Disparate organizations are able to coordinate with one another in a dynamic but bounded organization to meet the needs of the partner organizations and the constituencies they serve.

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