USING A GROUP SUPPORT SYSTEM TO RE-ENGINEER THE DISASTER DAMAGE ASSESSMENT PROCESS

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ABSTRACT

The American Red Cross establishes a temporary relief organization that may consist of thousands of people and may spend hundreds of millions of dollars to provide disaster relief services following a major disaster. The effective and efficient mobilization of resources and delivery of services requires that the Red Cross has the capability to determine what services are required and where they are needed. This paper describes a recent workshop of Red Cross disaster experts and the use of a Group Support System (GSS) to facilitate the re-examination of the organization's disaster related information needs and the re-engineering its damage assessment process. The twenty workshop participants identified data object classes and data attributes, provided a preliminary data architecture, and prioritized information needs. The successful use of the GSS demonstrates that technology is useful for more than collecting, processing, and distributing information. The GSS provides valuable tools for determining what information is critical to disaster managers, why it is required, and when and where it is needed.

INTRODUCTION

The American Red Cross and other response organizations must, in order to mobilize appropriate resources and deliver effective services, quickly obtain a useful understanding of the problems and demands created by a disaster. We deliberately selected utility as the criteria for evaluating the information picture that must be created for these responders. Terms more descriptive of data quality obscure the fact that utility is the only true test for information during a crisis. Crisis response is obviously time constrained and trade offs must be made between the four criteria of data quality: accuracy (is the data correct?), completeness (are critical data missing?), consistency (are conflicting values reported?) and timeliness (does the data reflect current conditions?). The American Red Cross, recognizing that their ability to obtain useful disaster information is a key to improving their response capability, has initiated a major re-design of its damage assessment process.

Improved use of information technology will obviously be a key part of the Red Cross damage assessment initiative. When information technology is proposed as a means for improving the process of assessing damage after a disaster, the focus is usually on the HOW of damage assessment. How we obtain, process, and transmit information is certainly critical and is obviously amenable to improvement through the appropriate application of information technology. This paper, however, describes an innovative use of group support technology to determine WHAT information is required, and WHY disaster response managers require it. Only when we have clear answers to these questions can we set the priorities that will enable us to select the best technologies for collecting, processing, and transmitting information. Too often, crisis decision making is based on information that is available or is trusted rather than on information that is required. In order to improve the quality of information, we must first ensure that the design of the damage assessment process is driven by response needs, not by the availability of data.

A recent workshop of 20 American Red Cross disaster managers was convened by the national Red Cross to begin the process of re-engineering that organization's damage assessment process and procedures. The authors facilitated the workshop in the George Washington University Management Decision Center, an electronic meeting room environment. Group decision and process support tools were provided by the Group Support System (GSS) software GROUPSYSTEMS V, developed by Ventana Corporation. The results of the meeting provide a critical first step in the improvement of the Red Cross damage assessment function.

BACKGROUND

The objective of Red Cross disaster services is to provide prompt, effective services that meet disaster caused basic human needs and to assist disaster victims to begin and complete their disaster recovery efforts (ARC, 1991). These services include both emergency mass care services and assistance to individuals. The role of the American Red Cross in disaster response was established by Congressional Charter and was re-affirmed in 1988 by the Stafford Disaster Relief and Emergency Assistance Act (PL 93-288 as amended). The American Red Cross is the only non federal agency included as a lead agency in the U.S. Federal Response Plan and has been assigned lead responsibility for Emergency Support Function (ESF) Six, Mass Care (FEMA, 1992). When a disaster occurs, the American Red Cross establishes a disaster relief operation organized along functional lines. There are four direct service functions:

- *Mass Care:* The provision of emergency shelter and feeding to disaster victims
- *Family Service:* The provision of financial assistance to individuals and families
- *Disaster Health:* The provision of health services to victims and disaster workers
- *Disaster Welfare Inquiry*: The provision of information regarding the location and status of disaster victims

These direct service functions are supported by eight internal support service functions, seven external support services, and the overall administration and management of the operation. For a major disaster operation, this organization is staffed by and reports to ARC Disaster Services management in Washington, D.C. It coordinates its activities with the Federal Disaster Field Office through its ESF 6 staff and other liaison mechanisms.

THE DAMAGE ASSESSMENT WORKSHOP

Planning for rare events such as disasters is a difficult task for organizations and managers. Organizational knowledge is fragmented; managers must elicit, reconcile, and integrate the partial knowledge of experts who have experienced different events under different circumstances. Belardo and Harrald (1992) first conceptualized the application of Group Support System tools to this problem domain. They emphasized the need for the support of divergent thinking as described recently by Gallup and Cooper (1993) and Dennis and Valacich (1993), as well as the need to facilitate group convergence and the integration of ideas. Alharthi (1993) tested these concepts with a controlled experiment involving Red Cross planners and found that the facilitated GSS meetings did, in fact, produce outcomes superior to the normal Red Cross planning process.

Based on this experience, the George Washington University proposed, and the Red Cross accepted, the use of a Group Support System environment to initiate the re-engineering of the disaster damage assessment process. The Red Cross assembled 20 of their most experienced disaster relief functional managers at the GWU Management Decision Center on November 7, 1994. The objective of the meeting was to identify the performance requirements and conditions of satisfaction for the information and reports generated by the Red Cross Damage Assessment function; the participants were experts from other Red Cross functions, the primary users of this information. The workshop was conducted as a facilitated, scenario driven, set of exercises. The initial scenario described a major disaster and the exercises were driven by questions posed by the facilitator. The exercises were designed to move the group through a process that (1) identified the demands that the disaster would place on the Red Cross, (2) identified the information required to support functional managers efforts to meet these demands, (3) structured these information requirements, and (4) prioritized these requirements.

EXERCISE RESULTS

The first exercise was intended to identify the key tasks for which must be supported by information generated by the damage assessment process. The GSS Topic Commentator tool was used to provide each participant with a set of electronic folders representing the Red Cross 4 direct service (*mass care, family service, health services*, and *disaster welfare inquiry*) and 9 support functions. They were then asked to identify the most important tasks that must be done for each function during the first week of the disaster response. The participants generated 265 task statements, evenly allocated between the direct service functions (101) and support functions (100). They identified 21 tasks for the relief operation director and administrators and 100 tasks for the relief operation support functions. The four

headquarters elements accounted for another 30 tasks and 13 tasks were identified for external organizations. The results from this exercise provided the basis for the determination of information requirements. The task statements generated were a valuable product in and of themselves for Red Cross managers; the task statements provide the raw material for the creation of an enterprise model of the Red Cross disaster relief operation.

Exercise two, the identification and structuring of information needs, was executed in three iterations. In the first iteration, proposed data object classes or categories were generated using the Idea Organizer GSS tool. Participants responded to the question: What information do you need to know to perform the functions and tasks identified in exercise one. Next, the experts were asked to generate amplifying descriptive comments under each proposed category. Finally, the categories were restructured in public session with the aid of the facilitator by combining similar categories and eliminating redundancies. The first iteration produced 74 potential data object classes and 257 amplifying comments or object descriptions. In open session these were collapsed into 15 data object classes. These classes and the number of attribute descriptions provided are shown in table 1. Four interesting observations may be inferred from this table:

1. Much of the information required by the ARC can be gathered before the disaster strikes: demographic information, housing stock description, information about government jurisdictions.
2. The ARC has little use for the initial media reports that stress the death and injury toll. The ARC needs a complete description of the incident, the affected geographic area, and the damage to structures to estimate demand, and infrastructure damage to enable managers to mobilize the relief operation.
3. Knowledge concerning what other response organizations (Federal, State, local, and volunteer) are doing is critical to the ARC, although it is not usually considered disaster assessment information.
4. Two of the critical information areas are derived data; the analysis of secondary hazards and the service delivery analysis must be produced by analysts in the Red Cross or other organizations based on initial damage reports.

The third and final exercise was an evaluation of the priority of information needs. During the prioritization exercise participants were requested to evaluate the importance of each data object class for each function or organizations listed using the rating capabilities of the GSS tool Group Matrix. They were directed to use a scale of 1 to 5 where the rating represented the relative criticality of the data object class for the successful completion of the function's or organization's tasks:

5 = very critical
4 = critical for
3 = important for
2 = useful for
1 = interesting, but not really required

The prioritization exercise yielded three important results:

1. The sum of all the evaluations across all functions and organizations (Group Matrix row totals) gives a ranking of the relative importance of the data object classes.
2. The sum of all the evaluations across all data classes (Group Matrix column totals) gives the relative ranking of the relative importance of information for each function and organization.
3. Comparison of cell entries in the matrix furnish valuable insight into differences in information requirements between functions and organizations.

The prioritization exercise clearly differentiated between the most important and the least important data. Four data object classes were evaluated as critical overall:

INCIDENT DESCRIPTION	4.13
DESCRIPTION OF DAMAGED STRUCTURES	4.08
SERVICE DELIVERY/SUPPORT ANALYSIS	3.98
GEOGRAPHIC AREAS AFFECTED	3.96

This result re-affirms the traditional Red Cross damage assessment process that focuses on obtaining information about damaged structures. Incident description and affected area information, however, are unlikely to come from internal Red Cross sources. The importance of these data identifies a need for the Red Cross to ensure that it has established reliable means of obtaining information from federal, state, and local governments. Service

delivery and support analysis are derived data and the importance given to these data indicates that a rapid information processing and analysis capability is very important to the Red Cross operational response.

Only one data object, MEDIA CONTACTS AND ACTIVITIES was rated as less than important (<3.0). Two other data object classes were, however, almost fell below the 3.0 importance score:

MEDIA CONTACTS AND ACTIVITIES	2.79
HOUSING STOCK	3.03
DEATHS AND INJURIES	3.13

Media interest ensures that DEATHS AND INJURIES are the most available data following a disaster. The results of this exercise shows, however, that this data is of limited interest to the Red Cross responders.

The evaluation exercise also showed that Red Cross functions varied widely in their dependence upon information for the successful completion of their assigned tasks. The most information dependent functions were, as shown below, the local and headquarters management of the relief operation and the two primary service delivery functions, *mass care* and *family service*, and *media relations:*

Disaster Relief Operation Administration	4.39
Headquarters Operations	4.27
Family Service	4.16
Media Relations	3.95
Mass Care	3.95

At the other end of the spectrum, damage information was evaluated as less than important to the success of six functions. These functions are all administrative or support in nature; they do not involve providing direct services to victims.

Records and Report	2.11
Disaster Relief Operation staffing	2.68
Building and Repair	2.79
Headquarters staffing	2.83
Supply and Logistics	2.85
Communications	2.94

Examination of the individual cells in the Group Matrix output provides a comparison by function and by information type. This comparison shows that different functions require a different mix of information and that each function has critical information needs. For example, the INFRASTRUCTURE data object class was evaluated as critically important (4.00) to *Supply and Logistics*, even though the function ranked relatively low in its overall dependence on information. Similarly, the DESCRIPTION OF DAMAGED STRUCTURES object class was evaluated as critically important (4.22) to the building and repair function. The DEATHS AND INJURIES object class, although rated as not critical to the operation as a whole, was rated as critical to the *Disaster Health* function (4.71), the *Disaster Welfare Inquiry* function (4.61) and the *Relief Operation Administration* function (4.28). Detailed examination of the prioritization matrix will yield additional insights for Red Cross managers.

The final exercise evaluated the requirement for timeliness of each data object class for each function or organization. Participants were asked to assign an number that represented their assessment of when the data type is required by each function or organization using the following convention:

1 = within one day of the disaster
2 = within two days
3 = within three days
4 = within four days
5 = within five days

It is informative to examine the data classes evaluated as required within the first two days. Three data classes were evaluated as required within 36 hours (mean of <1.5): INCIDENT DESCRIPTION, GEOGRAPHIC AREA, and INFRASTRUCTURE DAMAGE. These represent the information that is most time critical and should be obtained first. Four other data classes were evaluated as required within 48 hours (mean of <2.0): DEMOGRAPHIC INFORMATION, DESCRIPTION OF DAMAGED STRUCTURES, SERVICE DELIVERY ANALYSIS, and LOCAL GOVERNMENT/CHAPTER ACTIVITIES. These represent the information that should be obtained next.

Seven functions were identified that need information within 48 hours: *Administration, Mass Care, Disaster Health Services, Public Affairs, Media Relations, Government Liaison,* and *Family Service*. These represent the functions that should have priority in the ARC information distribution process.

CONCLUSIONS

Three important results were obtained from this one day workshop. The first was a preliminary structure of the Red Cross disaster damage assessment information needs. The second was an evaluation of the relative need for this information measured both in terms of criticality and timeliness, for each Red Cross function. Finally, the utility of GSS as a disaster planning tool was demonstrated.

Figure 1 is a data structure diagram constructed from the results of exercise 2. For clarity in presentation, the data attributes identified during the workshop are not shown. Figure 1 leads to several interesting inferences:

- There are three general clusters of Red Cross information requirements: information about the disaster itself, information about other organization's response to the event, and derived data that is used as the basis for organizational decisions.
- Several critical data classes in the disaster event group are best obtained from information sources outside of the disaster operation. Demographic information and housing stock information can, for example, be maintained for high risk areas prior to an event. Most of the incident description data are obtained from federal government sources, e.g. the National Hurricane Center for Hurricanes, the U.S. Geological Survey for earthquakes.
- The most critical data object classes are all closely linked to knowledge of the area affected. The central nature of this data class is clearly shown in the data structure diagram.
- Information about the activities of other response organizations is required by most Red Cross functions. Obtaining the information is not a formal element of the Red Cross disaster information gathering process.

The results of the prioritization exercises provides important guidance to Red Cross information planners. There is a wide variation in the value of information by data object class across the Red Cross functions. The data object and attribute descriptions produced during the exercises should be refined and a complete data model produced. The function/object matrix analysis should be extended to produce traditional data source--data use matrices. The Red Cross can use this type of analysis to ensure that their revised system gets the right information to the right function at the right time.

An important result of this project was the demonstration of Groups Support System (GSS) technology as an effective and efficient aid to disaster planning. The GSS brainstorming provides a mechanism for extracting the partial expertise of experts. The organizing and prioritizing tools enable a group to organize and integrate its output. This project shows that GSS technology can play a critical role in the design of disaster plans and systems.

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Table 1
DATA OBJECT CLASSES IDENTIFIED

DATA OBJECT CLASS		NUMBER OF ATTRIBUTES DESCRIBED
1.	INCIDENT DESCRIPTION	27
2.	GEOGRAPHIC AREA AFFECTED	12
3.	GOVERNMENT JURISDICTIONS AFFECTED	6
4.	DEMOGRAPHICS OF AFFECTED POPULATION	40
5.	HOUSING/BUILDING STOCK AFFECTED	12
6.	DEATHS AND INJURIES	2
7.	DAMAGED STRUCTURES	11
8.	INFRASTRUCTURE DAMAGE	30
9.	ANALYSIS OF SECONDARY HAZARDS	14
10	FEDERAL AND STATE ACTIONS	10
11	LOCAL GOVERNMENT/CHAPTER INITIAL ACTIONS	25
12.	LOCAL VOLUNTEER ORGANIZATION ACTIONS	8
13.	MEDIA CONTACTS AND ACTIVITIES	2
14.	SERVICE DELIVERY AND SUPPORT ANALYSIS	51
15.	PRE-DISASTER RESPONSE PLANS	7

FIGURE 1

DATA STRUCTURE DIAGRAM OF RED CROSS INFORMATION NEEDS