

**THE COMPUTER BASED INFORMATION/COMMUNICATION REVOLUTION:
A DOZEN PROBLEMATIC ISSUES AND QUESTIONS THEY RAISE
FOR DISASTER PLANNING AND MANAGING***

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We are now in terms of world history in a time period of very rapid change. The social landscape and features of the 21st Century will be noticeably different from that in which we have lived much of this Century. The most important structures and activities of human life are drastically changing (Smelser 1991). Massive social changes are happening in the political, economic, familial, cultural, educational and scientific areas. For example, there are basic alterations occurring in the role and status of women along with the emergence of new family and household patterns, the growing diffusion and expanding use of applied social science to many areas of life, the globalization of popular culture, and the spread of at least nominal democratic patterns of government. These and the other changes will markedly affect the number and kinds of future disasters and also the planning and managing of them (Quarantelli 1996).

However, in this paper we discuss only one of these major changes, namely the information/communication revolution brought about by developments and innovations in computers and related technologies. Or as predicted even 25 years ago, our focus is on the shift "from mechanization to cybernation" (Meadows 1971: 12). This can be seen in the increasing presence in everyday activities of cellular phones, fiber optic cables, satellite dishes, mini-camcorders, CD-ROM discs, scanners, fax machines, automated data bases, layered graphics, on line photographs, video tapes and multi media pieces of equipment and other audiovisual devices. The underlying base is the computer either as a common element or the linking mechanism between various other technologies.

Nevertheless, the crucial aspect is the *revolution*, not the technological base upon which it rests. The mentioned devices allow a variety of technologically based processes. These include communicating by voice mail, the electronic uses of geographic information systems, obtaining national/world wide access by paging systems, the downloading of **WWW** homes pages, distribution of automated situation reports, audio and visual teleconferencing and discussion groups, the production of digitized maps, dialing up of bulletin board systems, the transferring of files, virtual reality simulations, the producing of electronic newsletters and indexes, and other activities possible through the **Internet**.

This revolution will have many kinds of *positive* effects and outcomes for all aspects of social life, including the disaster area. We do not challenge the idea that disaster planning and managing could be considerably improved by the adoption of computer related technologies. In the United States alone, case studies of Hurricane Andrew and the Loma Prieta and Northridge earthquakes have shown, for example, that geographic information systems (GIS) were extensively used with worthwhile results in those disasters (K. Tierney 1994; Dash 1997). The general adoption of new technologies usable for disasters is accelerating everywhere (see Stephenson and Anderson 1997). In fact, increasingly they are spreading around the world as indicated by the current effort to initiate a Global Disaster Information Network (GDIN) which is an attempt to link multi national systems into a collective international one (Disaster Information Task Force 1997; Quarantelli 1997a, 1998a), as well as the advocacy of Global Emergency and Risk Management Systems

(GERMS) which calls for the use of advanced technologies to manage disasters (Hays and Eguchi 1998). Whether it will be GDIN, GERMS or something similar, they will improve disaster mitigation, preparedness, response and recovery everywhere. We agree that:

The convergence of computers and communications, and the accelerating growth of global information networking is beginning to have a profound impact on the organisation of disaster mitigation, planning and response and on the underlying matrix of research and knowledge transfer (Stephenson and Anderson 1997: 305).

However, sociologically speaking, all significant social phenomena have some *negative* effects for someone, somewhere. Therefore, in this paper we raise problematical aspects of the currently accelerating cyberspace revolution, that is, the possible and probable consequences of an unwanted nature or which should at a minimum raise questions for any interested party. This kind of analysis does not deny all the desired and positive results. It simply assumes that we must take a balanced view, and not ignore potential negative effects. So for discussion purposes, our position is that of a devil's advocate, not a Luddite one. Our basic interest is in explicating such negative social implications as there may be of the ever developing computer based systems available for monitoring, collecting, indexing, processing, analyzing, writing, publishing, disseminating and retrieving data and information usable by disaster planners, managers and researchers.

We derived our observations from an intensive perusal of *five* bodies of literature, practically every item of which has been published since the year 1990. *First*, there was a set of mostly non-scientific writings about the social effects of the growth of computer use, ranging from forecasts by pioneers in the area (Gates 1996) and their enthusiastic followers (Harnad 1991; Gelernter 1998; Moravec 1998; Tapscott 1998) to ever more growing critics of this trend (Burstein and Kline 1995; Sale 1995; Stoll 1995; Rawlins 1997). *Second*, we examined the small body of writings specifically on the topic by disaster-knowledgeable authors (Anderson 1994, 1995; Butler 1994, 1995; Botterel 1995/1996, 1996a, 1996b; Fischer 1998). More important, our essay derives its analytical thrust from looking at the substantial literature on the diffusion of innovations (Valente 1993a, 1993b; Dearing and Meyer 1994; Rogers 1995; Cooke and Mayes 1996; Garson 1997) and another set that present theoretical frameworks for understanding societal change (Bourdieu and Coleman 1991; Haferkamp and Smelser 1992; Luhmann 1992; Sztompka 1994; Beck 1995; Jones 1995; Schaeffer 1997). *Fifth*, for statements of general principles, we used the ever increasing social science literature on disasters and disaster planning (Cutter 1994; Dynes and Tierney 1994; Kreps and Bosworth 1994; Mitchell 1996; Porfiriev and Quarantelli 1996; Sylves and Waugh 1996; Hewitt 1997; Turner and Pidgeon 1997; Quarantelli 1998b).

A DOZEN QUESTIONS AND ISSUES THEY RAISE

We address a dozen questions and the issues they raise. They are not necessarily the only ones that could be addressed. In the end they may turn out to be not even among the

most important that disaster planners and researchers will have to deal with in their involvement in the information/communication revolution. Time will tell. However, our rationale for where we start is indicated in the following:

Close inspection of technological development reveals that technology leads a double life, one which conforms to the intentions of designers and interests of power and another which contradicts them--proceeding behind the backs of their architects to yield unintended consequences and unanticipated possibilities (Noble 1984: 325)

1. The probability that the "rich will become richer" in dealing with disasters.

Proponents of the revolution argue that it will make for radical democratization of social life (Ess 1996), a common theme advanced with the advent of many major technologies. However, studies show that technological developments of any kind usually make "the rich richer, and the poor poorer." Those in the most advantageous economic and/or political positions can best take advantage of technological developments of any kind. The computer-based revolution requires not only initial capital investments and unending costs for maintenance upkeep, but also funding for the training of specialists and the continual upgrading of technical and related knowledge. Therefore, as others have said, the development of the new technology:

far from creating a more egalitarian world, will bring about a world which is more unequal as well as socially fragmented . . . tend to confirm or reinforce existing inequalities, or to create new inequalities (Thomas 1995: 91).

This may also occur in the disaster area. At the national level, disasters occur most frequently (up to 80-90%) in developing societies that by definition already lag in most dimensions of modern life (e.g., in 1995 only 12 of Africa's 54 countries were linked to the **Internet**, French 1995). There are many reasons to think that such countries will lag even more in the future, although this does not preclude a slower eventual adoption of some technologies. But even then there can be complications, as Peters notes:

'W've heard all sorts of airy-fairly kinds of things about how we'll all be connected by technology and be able to call up anywhere in the world and find out about epidemics. But we still have to actually go there with gloves and masks, get samples and get them out to a lab, even in a country where there isn't one. During the Ebola outbreak in Zaire, we sent a satellite phone with our people so they could tell us what they needed most urgently. In Kikwit, a city of 250,000 people, there was no E-mail, fax or regular electricity. There was no radio station to deliver health messages. They had to be delivered, instead, by bicyclists with megaphones (1997:46).

However, the problem must not be seen just in terms of differences between developed and developing societies. Even within any country, there are resource rich and resource poor regions and communities, with many of those less well favored often existing in the most disaster vulnerable areas. Rural districts in developing countries are often good examples of this. In developed societies, even within the same metropolitan areas there

can be huge differences in the interest, knowledge, competency and access regarding computers and related technologies (Poole 1996) that different neighborhoods will have. Even today but 40 percent of American households have computers (J. Tierney 1997: 48) and many are only used by children or seldom turned on. This has led to the view that:

. . . there is a growing information apartheid already in the United States . . . The problem is not limited to America, and becomes much clearer when one considers the rest of the world, particularly the developing countries (Tapscott 1998: 102)

If the poorer in any sense, as research indicates, are most vulnerable to hazards and suffer disproportionately, their lesser access to computers and related technologies, will handicap the improvement of their disaster planning and managing. At least relatively, they will continue to be worse off than the better off. Improvements in technology, because they are differentially adopted, cannot change that.

2. The possibility that technology will be so overemphasized that what is a "means" will be turned into an "end" in itself.

Too strong an emphasis on technology per se can have several unfortunate consequences. For one, what should be "means" are at times turned into "ends" with the accumulation of more and more technology particularly at the operational level. This is not a new problem. In the 1960-1980s, Disaster Research Center (**DRC**) studies found that many emergency oriented community agencies after disasters thought that what was needed was more communication "means" such as radios and walkie-talkies and pushed for their acquisitions. However, the research showed that the real problem was knowing what questions to ask and having an information flow that was not inaccurate, incomplete or misdirected. These kinds of difficulties not solvable by more communication equipment. Dash illustrates a similar problem from a very recent professional experience. She reports:

When Hurricane Felix was approaching the East Coast of the United States...I was called by the Emergency Operations Center (EOC) . . . in one of the affected states . . . They asked me if I would like to come in and observe . . . When I got to the EOC, I was led to a computer and was asked to tell them what data they had available. I ended up spending the next two days in the EOC working with their GIS data. In fact, there was very little I could offer . . . because their system consisted of GIS software and Army Corps of Engineers/FEMA data. They had no plan of implementation. They had no idea what they even had available. As I sat in the EOC, I realized that, while they thought they had a GIS, they actually did not. Somehow this system, all on its own, was supposed to answer questions no one knew to ask (1997:142).

Technological developments also often lead to the notion that there can be a "technological fix" for all problems. This notion can be additionally pushed, not only by the enthusiasm of pioneers, but also by commercial interests (and in some societies by cultural values that sees technology as the ultimate solution to problems). We can currently see these factors operative in the spread of geographic information systems (**GIS**), even granting the usefulness of the technology. More important, difficulties or

problems that are of a "social or human" nature such as knowing what questions to ask requires "social or human" solutions, not technological ones.

In this context, an emphasis on technology will also reinforce an already existing tendency in disaster planning/management which is to apply technology to those problems that are most easily addressed by the technology, and to ignore or downplay those that can not be so easily handled. Similarly, in disaster research, there may be a movement away from more basic and important problems to mostly doing studies that easily lend themselves to the use of computer based technologies or the end products such as data banks or whatever is available on the **Internet**. This tendency calls to mind an admonition that Ph.D. advisors frequently give their graduate students, namely that the methods to be used in a dissertation should be dictated by the research question being addressed, and not to let the methods determine the question. Use of computer technology in the disaster area should similarly be determined by the problems that need solutions, and not vice versa.

An interesting negative byproduct of an overfocus on technology as almost an end in itself, is a failure to develop non-technological back up systems. There can be such an overdependence on technology that little thought is given to planning for its failure. An example is a case studied by **DRC**. An explosion in a Louisiana chemical plant severely disrupted a state-of-the-art hazard monitoring system in the complex. The initial explosion was a minor incident, but occurred very close to huge quantities of phosgene and chlorine gas. However, the plant operators had no idea, with the collapse of their monitoring system if there was a new major threat from the poison gases and how perilous the situation might be. They had absolutely no non-technological back up system of any kind to assess the danger. It took hours before plant officials could clearly establish the actual threat. Meanwhile, there was major social disruption of community life as thousands of people were evacuated in the middle of a rainy night (Quarantelli, Phillips and Hutchinson 1983). This absence of a backup system is not that rare.

Yet the fact is that various electronic systems will often not work during major disasters because much communication equipment in impacted areas will be disabled or limited, especially those dependent on electric power or telephones. As Lechat notes:

New technologies should be used whenever and wherever they may provide relevant information. That information should be meaningful and cost acceptable. It should also be integrated with commonplace and more prosaic methods. For example, while remote sensing systems are of growing importance in planning for disasters, they should be complementary to ground surveys, which can provide data not obtainable from satellites. newspaper clips, rumors, snake behavior and tam-tams are also part of information. There should be no technological dogmatism in that matter (n.d.: 2).

It is not good when technologies which should always be used as "means" are turned into "ends" in themselves.

3. The inevitable information overload problem.

We are hardly the first to recognize that information overload can be a major problem at times of crises. There are many examples of this in the military intelligence area, with often very serious consequences. The computer based revolution, at one level, seems certain in many situations to produce more information than can be handled during crises. As Michael has said:

Information cuts both ways and herein lie the dilemmas or paradoxes arising from ever more information created, processed, and disseminated by proliferating information technologies. More information can result in more control but it also creates circumstances that reduce or defy control. It clarifies some issues but it obscures and complexifies others . . . unprecedented amounts of information can be brought to bear on issues of policy and action but the persons who must use the information to make the decisions become overloaded and everything gets muddled. In some cases one feels more information really gives an understanding of a situation. In more cases more information deepens a feeling of uncertainty (1985: 34).

In addition, any information or data at some point has to be assessed and interpreted (e.g., despite its massive technological input, the US National Weather Service has this problem in issuing hurricane warnings). This problem of *interpretation* and *meaning* cannot be solved by the addition of more technology. The use of "artificial intelligence" might help, but cannot provide ultimate answers. As was said in an early symposium on the use of computer technology in emergency management:

The essential point that humans provide in an operational center . . . is to act as a corporate memory. They have to know who the people are, who knows what, at what point in time . . . no amount of technology can make up for the inadequacies of training, quality, motivation, and energized leadership (Vincent Heymen quoted in Chartrand 1985: 22).

In that same symposium it was argued that:

While the presence or absence of a computer in an EOC or a networking arrangement with some external resource may affect to a degree the effectiveness of such a facility, it is generally agreed that the key ingredient is the human being. It is this component, usually represented by a team of persons who have trained together, that must cope with situation at hand. And all too often, when crises arise unexpectedly, the ensuing situation is much like that characterized by William Allen White as: "that indefinite, shifting intangible series of hunches, guesses and hypothetical phantasms." In emergencies . . . the responses required are often akin to those demanded in political imbroglios. Diverse and conflicting human impressions which comprise the data that must be acted upon, sometimes along with at least tangentially useful background information, may be all that exist for the emergency manager besieged by intense advocates of opposite claims and decisions (Chartrand 1985: 20)

The simple point is that it always takes human beings to assess information, no matter how it has been gathered or obtained. The greater the volume of such data, the more difficult any assessment will be.

4. For a variety of technologically related reasons there is likely to be a reduction of learning from errors.

Human beings and social groups can learn from mistakes and errors. To a considerable extent this is what disaster research focuses on. It appears however, that the computer revolution along some lines may reduce the possibility of learning from prior errors. Rochlin has particularly discussed this possibility. He notes that highly automated rapid-response systems that depend on real-time interactions between sophisticated computers and expert human operators may have an inherently high probability of error in situations not explicitly accounted for in their design (and disasters with their fluidity are very difficult to design for). In discussing him, Hunter agrees in that "by removing the opportunity for people to make modest mistakes and learn from them, automation may be undermining the basis of the human expertise that it was originally designed to supplement" (1997: 23). As Rochlin states it: "taking away the easy part of an operator's tasks will make the hard ones more difficult" (1997: 100).

Oddly enough, the computer revolution will also result in an accelerated loss of past disaster relevant information. In prerevolutionary time, there is often a "paper" trail of organizational activities, and of mass media reports. While such archival data do not always consist accurate records, they nonetheless provide material for self evaluation and research purposes (historical and otherwise), in looking at disaster planning and disaster behavior. Such permanent "*hard*" records are less likely to exist in the coming revolution, a general fact already commented upon by librarians and archivists, and decried by historians who have noticed the disappearance of "*soft*" data especially in the change of governmental administrations. The point is that the loss of a paper trail makes it much more difficult to learn from history which documents allowed us to do in the past.

Actually when the information does not disappear, that can also create problems. Thus, it has also been observed that, outdated and perhaps misleading information can remain "cobwebbed" at **WWW** sites. Even now we are aware of past electronic discussions among those involved in disaster where incomplete if not misleading statements of a major nature were made (judged against the full body of the most recent social science disaster research). In fact, in a recent Electronic Conference on "Solutions for Cities at Risk" in which we participated we saw advocacy of the **Incident Command System (ICS)** with its use of a "command and control" mode that many researchers consider an invalid approach or at least open to question. Such texts now are in different systems and are accessible to anyone who wants to bring them up for perusal, but who will be misled by what they find. Far from learning from errors, the opposite may happen.

To be sure the same can correctly be said about incorrect statements in published or written sources. However, there seems to be less caution or skepticism about electronic sources. One expert in the area recently wrote:

Irrelevance may also proceed from the illusion that computers can generate meaningful information from unstructured and sloppy data (Lechat n.d.: 3).

Perhaps this has to do with the general ease of finding the "information," possibly creating a greater passivity in the user. Perhaps in one sense as others have noted the sheer quantity of information electronically available leads to a more ready acceptance of what surfaces. At any rate, our general and overall point is that in the computer world we are moving into, we may be less likely to learn from our errors and mistakes in planning for and managing disasters.

5. The greater likelihood of the diffusion of inappropriate disaster relevant information.

For our purposes here, we do not discuss the likely deliberate sabotage of the information flow in one category of crises, since following one major theoretical research viewpoint we distinguish between *consensus* (i.e., disasters) and *conflict* (e.g., riots and civil disturbances) occasions. Our interest is less in bogus messages (likely in conflict but not in consensus crises), than in the diffusion of inaccurate or misleading information that for many reasons will be facilitated by the availability of new computer technology. More access means more likelihood of greater and quicker diffusion of incorrect information, which is even now a problem (and usually thought of as the spread of "rumors"), although relatively minor compared to what could occur in the future. A recent discussion of the possible use of the **Internet** for disaster planning in developing countries noted:

The negative side of the Internet comes from its very strength: its unregulated, often chaotic nature. Free, unbridled exchange of information can result in a confusion of choices, and a profusion of the pseudo-scientific, politically motivated, disguised commercial, or clearly unethical material . . . The Internet's power as a communication tool has not been grossly misused in the disaster field . . . yet. The time will come when unsubstantiated earthquake "predictions" or unfounded rumors (so common after disasters) will immediately find a global audience (Editorial 1996).

Stephenson and Anderson note that:

. . . data quality has proved to be a significant problem with all resource databases designed for emergencies. A disconcertingly large proportion of data were found to be unreliable in some operations. Reportedly, in one commercial database used extensively in the Northridge recovery operations, there was a 40 percent error rate in locating and identifying hospitals alone (Stephenson and Anderson 1997: 313).

Also, problems can be compounded by the availability of real time information that discourages delaying responses. However, research has shown that a timely response in a crisis is one thing, a quick response is another. (a **DRC** field study found that an

unauthorized radio network request that all ambulances come to the scene of the Beverly Hills night club fire, led to a massive convergence of so many vehicles that soon all entry by motor vehicle into and out of the disaster site on the one usable road was completely blocked). An implication of this is that perhaps the use of the new technology might be more useful and helpful in disaster planning outside of the response phase.

Even in disaster research, the quick diffusion of findings could be unfortunate. Even now cases occur where the results of poor studies are directly, widely and publicly disseminated via electronic means instead of being screened out by peer review and other mechanism devised to insure the quality of scientific work. The coming revolution is clearly undermining the traditional quality control framework, and it is difficult to see what new winnowing devices might be instituted.

6. The implications of even further diminution of nonverbal communication.

It is very probable that computers have allowed most users to increase the quantity of their communicative interaction with others. At a personal level, we can attest to this; where letters would not have been exchanged, Email messages are. However, quantity is one thing, quality is another. More of something is not necessarily better than less of something. This is not always understood by those who, for example, note that today "instead of corresponding with 6 or 7 people, we have 150 E-mail partners" (J. Tierney 1997: 47). Moreover, meaningful human communication is *dependent* in many ways on gestures, inflections, body language and affective tones, etc., over and beyond the cognitive symbols involved. As even a computer enthusiast notes:

Spoken words carry a vast amount of information beyond the words themselves. While talking, one can convey passion, sarcasm, exasperation, equivocation, subservience and exhaustion--all with the exact same words. In speech recognition by computers, these nuances have been ignored or, worse, treated as bugs rather than features. They are, however, the very qualities that make speaking a richer medium than typing (Negroponte 1996: 139).

These subtleties even now are very seldom addressed in contemporary disaster planning and have been all but ignored in disaster research. However, because something is neglected does not mean that it is unimportant. We have in the literature studies of airplane cockpit behavior at times of emergencies that suggest nonverbal interaction is important in crisis decision making. Concerning plane disasters, it has been observed:

"The plane is flown for the most part by the flight management computer . . . and the pilot is essentially a systems manager who mainly has to monitor that its doing what it's supposed to" . . . This is a widely shared view. But many safety specialists are quick to add the caveat that, with the progress of automation, pilots--as well as controllers, mechanics, and operations people--can be lulled into complacency, which can readily lead to accidents (Witkin 1996:8)

Related to this, although not of a crisis nature, is that some businesses who have tried using a "virtual office" have been pulling back from it because in the words of an article in the financial pages of the NY Times, "the virtual office bumps into some very real limits" (Kirk 1996: 10F). In using voice mail and E-mail the employees of one such company were resorting to "deliberate communication" because "they were not getting any real feedback, because they were not talking to real human beings". Missing was face-to-face and unplanned encounters around water coolers, hallways and elevators where it is much more possible to "size up" the person(s) with whom you are interacting. Or in the felicitous words of a historian about the failure of the videophone in work places, it did not capture "the richness of sociability of the office" (Flichy 1995: 173) There is also evidence, although not in the disaster area, that visual communication through mechanical means can lead to a desensitization to whatever information content is pictorially presented.

At any rate, there would seem to be the likelihood of even more of a diminution in the nonverbal dimension because of the computer based revolution (see articles in the Journal of Human-Computer Interaction). There will be an even greater going away from the full import of face-to-face interaction when communication is filtered through mechanical intermediaries (which is presently recognized in the use of photos and films). Of course those who believe cyberspace sex is equivalent to interpersonal sex may not believe this, but they will have difficulty convincing the nonbelievers.

7. Intra and interlevel group communication in disasters may be made even more difficult.

Whether at the societal, community or organizational levels, the vertical and hierarchical flows of information, are normally very complicated and difficult. Because of the heterogeneity of the diverse content, and the various social interests and cultural values they reflect, this often undermines the intra and intergroup coordination needed at crisis times. This is the current not-too-good situation. Yet such coordination is at the very heart of effective and efficient disaster management.

However, the coming revolution in several ways likely will aggravate this ever present problem in disasters. Part of this is related to the information overload and the quickness of the message flow noted earlier. The existence of better communication facilities does not necessarily lead in itself to a better exchange of knowledge and intelligence, and/or a greater understanding of what is occurring.

But additionally there will be more problems because the revolution will encourage the undermining of "authority" and experts and lead to a "democratization" process which will argue that anyone's views must be taken into account (for a view of the positive and equalitarian consequences of the new computer technology and a spreading of anti establishment notions in popular culture, see Rushkoff 1994). While challenges to traditional power and knowledge elites can be desirable and valuable at disaster as well

as at other times, only someone who totally accepts the postmodernistic thesis that any view is equally as valid as any other, will see this as a completely positive outcome for disaster planning and disaster research.

In addition, sometime there is a confusion of the physical with the social. We note what one enthusiast writes:

One of the strange and wonderful things about networking is the way it turns "ORs" into "ANDs." For example, the ancient dilemma of "centralization-for-efficiency OR decentralization-for-responsiveness" vanishes in a networked environment, where physically-separated decision-making can coordinate through "virtual meetings" and "groupware" systems. A shared, networked "knowledge-base" can erase, or at least substantially blur, the very line . . . It becomes possible to have centralization AND decentralization simultaneously (to the extent that those words retain any meaning at all.) (Botterell 1995/1996: 43)

Apart from the unwarranted technological determinism implied in the position taken, it overlooks that such notions as "decentralization" and "centralization" fundamentally have to do with social roles and positions, authority and power, etc. and a welter of other social aspects. These features are determined by the operative cultural norms and values and social structural arrangements and divisions of labor, which have almost nothing to do with the physical setting in which they exist. There are problems enough regarding the use of the new technology in the disaster area without creating unnecessary ones from inappropriate generalizations.

Also, traditional organizations are not necessarily always the prime players at the height of disasters. The emergency or crisis period of disasters is characterized by the emergence of new informal groups, with the greater the disaster the more likely that there will be more such ad hoc groupings. In the immediate aftermath of the cyclone that hit Darwin, Australia, 24 new disaster-related committees emerged. Research studies have consistently shown that not only will such groups appear but more important that they are crucial to dealing with crisis time needs ranging from search and rescue to coordination of the overall response. However, since these kinds of groups are new to the situation and have no predisaster existence, it is reasonable to assume their use of computer related equipment will be problematical at best. (However, electronic networks did spring up after the Kobe earthquake which provided advice for contacting friends and relatives). It is the traditional organizations and agencies that are far more likely to have such equipment available posing problems for crisis planning and for disaster management.

8. The negative consequences of the probable acceleration of fads and fashions associated with computer use.

The communication/information revolution will almost undoubtedly increase *fads* and *fashions* in the disaster area. These labels are technical terms drawn from the sociological collective behavior literature and refer to the extrinsic reasons for quick adoption of certain

social innovations. Moreover, it is important to note that the intrinsic merit or lack of merit of any innovation is independent of its characterization (unlike in everyday discourse where such labels denote a negative evaluation).

Current examples of fads and fashions in the disaster area would be the increasing use of certain kinds of crisis intervention psychological techniques based on the notion that disasters generate many post traumatic stress disorders (**PTSD**), or as already mentioned, that the Incident Command System (**ICS**) is the best management model for crises occasions. These spreading ideas may eventually turn out to have some validity, although at present the empirical research does not seem to provide much systematic evidence in support of such ideas (for **PTSD** see Bowman 1997; Tedeschi, Park and Calhoun 1998).

More important would be possible dysfunctional consequences of fads and fashions for disaster planning and the study of their increasing acceptance. These range from premature closure on competing ideas to the advancement of agendas driven primarily by vested interests to a failure to consider what could be used as criteria to evaluate success or failure. If something is "obvious," such as giving the highest priority to mitigation, then questions or challenges are unlikely. The quantity of information and the speed of communication almost inherent in computer use, should not blind us to the need to consider that if there is an acceleration of fads and fashions in disaster planning and research, the outcome may be more negative than positive.

Related to this is that individuals and organizations with particular agendas and superior access to the **Internet**, can "flood" the market with their views. In fact, not only can they, but they do. But put another way, the "best" does not always win out in such a marketing situation.

9. Absences or weaknesses of general social infrastructures and cultures necessary for the adequate functioning of any disaster relevant technology.

In some ways, the specifics of what we have been discussing can be more generally incorporated into the idea that certain social infrastructures and cultural frameworks need to be in place for any technology to be successfully used. More is needed for the adequate use of technology than its simple existence as a material or physical thing. This is one way of saying that what is required for adequate handling is a social infrastructure and cultural framework that guide the behavior of the users.

With some technologies, sometime the appropriate safety culture is totally lacking. There is not the necessary acceptance of certain values, norms and beliefs about the use of the technology. For instance, we ourselves have been to communities in developing countries (although the problem is not confined to them), where fire exit doors in hotels and auditoriums had been correctly built according to appropriate specifications, yet were locked, blocked, hidden behind heavy drapes, or otherwise made totally unusable. In

those situations, it is possible to see that the correct architectural and engineering factors were not accompanied by necessary conceptions of safety and accident prevention, which are implicit social necessities for appropriate use of such a fire technology. In such settings, the greater presence of any technology cannot accomplish much. In one very recent situation, the emergency management agency had bought many of the most up to date hard and software computer related technologies that could be used for disaster preparedness, but turned to **DRC** to ask in what ways they could be used for such planning! The related culture itself could not be bought and therefore was absent.

Sometimes the required social relationships, especially among organizations, are weak.

For example, one existing problem in disaster management in many countries is that local emergency agencies are not accorded the legitimacy they need to do their work by other community organizations. In particular police and fire departments as well as other crisis related groups usually control tasks and occupy territorial domains that overlap if not supersede that of the local emergency management agencies. Given this, a move toward greater use of computer related technology might accelerate the possibility of competition and conflict, especially if there is an imbalance in the resources already available to the different organizations involved.

As the first example illustrates, the physical technology typically evolves ahead of the nonphysical infrastructure. We have seen this at a more general level in the nuclear and chemical areas (e.g., the absence of a societal and organizational safety culture that partly resulted in the Bhopal disaster). Given this, consideration has to be given to the kind of social infrastructure and cultural framework necessary for the adequate functioning of systems that will be developed in the computer based revolution. We need research in particular to discover where there will be likely lags in the social/cultural dimensions that will create points of vulnerability.

10. The changing and different role of the private sector.

One of the other current macro level changes occurring is the move almost everywhere to a market type economy for producing goods and distributing services. However, there is a tendency especially in the West to assume that the private sector patterns present in Western societies are universal ones. That is not necessarily the case. If this is so, there may be different implications for the information/communication revolution depending on the prevailing pattern. Such differences, including whether the private or public sector control and use the newer technologies could affect all aspects of disaster planning and crisis management.

In many Western type societies, organizations in the private sector have a relatively limited number of stakeholders to which they must respond; government agencies are legally responsible for protecting citizens in general. Private groups although often having specialized resources do not have the almost unlimited access to the full range of resources available to governmental agencies in whatever social system is involved. Private sector entities except within their own organizations and even that only within limits, cannot "order" anyone to do anything. Governments at all levels have formal authority and resources to "force" compliance to many "orders."

These features do not exist elsewhere. This is partly masked in the seeming world wide move toward privatization. However in present day China and Russia, for instance, the line between what are "private" and what are "public" entities is often very murky especially if real ability to exercise power is considered rather than whatever the formal arrangement may appear to be (military backed or run "private" corporations exist in both systems). In some developing countries also recent moves to privatization of certain organizations are not much more than changes in labels on what is public and what is private. Put another way, not only is the role of the private sector changing around the world, but there are also differences in the meaning of the private.

Furthermore, what comes under the public and private label can vary substantially. Let us note the following as examples. For instance, in Australia their coast guard operations are outsourced to private entities. Also, many response and recovery functions handled by governmental agencies in the United States are carried out in developing countries by international disaster relief and religious groups. Given what we just said above, what and how newer technologies are differently used by the public and private sectors, will result in rather different communications.

Overall, one other question we see in all of this is that the private sector is likely to encourage a competitive marketing situation. This is reinforced by the fact that some developed countries such as Germany, Japan and the United States have consciously entered the disaster technology area with the expressed purposes of increasing sales of their domestic producers to technological tools. The public sector, in contrast, is more likely to try to use technology for more cooperative humanitarian efforts. We have known for decades that competition among disaster relief agencies has been a serious problem (Kent 1988). It would be unfortunate if the computer based revolution would create a similar problem in disaster relevant information and communication. Some of the contradictory or inconsistent warning messages issued by public and private sector weather services in the United States (with the latter sometimes using more advanced technologies) show that there can be a significant problem stemming from whether the public or private sector use and control the newer technologies.

11. The distinctive features of many 21st Century disasters.

There is no doubt that in the next Century we will see a continuation of the kinds of disasters that have impacted human societies since they have evolved. The notion that they can be prevented or eliminated is a chimerical one. Nevertheless, the newer technologies, discussed in this paper, will enable a reduction in casualties, certain kinds of property damages and economic losses, and at times maybe even diminish the levels of psychological and social disruptions. However, this will necessitate addressing the problematical issues of the information/communication revolution we have been discussing.

Equally as important, what of the newer disasters of the future? That is, how well can the new technologies deal with the risks, disasters and crises of the future? The future is not simply a repeat of the past nor an extension of the present. The future will create some different challenges especially of a social rather than technical nature.

There are newer types of disasters emerging that have not been well thought through by researchers much less planners and managers in the area (Quarantelli 1996). There are at least three kinds of newer, sometimes interrelated, disasters. One as we will specifically discuss later is that the development of newer technologies is that they create the probability of their own disasters. In the next section we concretely illustrate massive computer system breakdowns. However apart from that, there are also possible genetic engineering accidents that could eventuate in catastrophic disasters. A relatively new second kind of disaster is where a crisis results in huge economic losses, extensive social disruptions and deep psychological stress, but no casualties or physical damages (such as in the nuclear accident at Three Mile Island or the chemical spill in Mississauga, a Toronto suburb that forced the evacuation over a three day period of 213 000 people). The third new kinds of risks are exemplified by the recent economic crises in South Korea or Thailand, or the negative weather effects of El Nino off Peru on countries far distant.

These last are occasions whose initialing origins are in one place and the effects usually are distant both in terms of social time and social space (for discussion about classifying such phenomena as "disasters" see especially the chapters by Dynes, by Rosenthal and by Stallings as well as the editor in Quarantelli 1998b).

From our perspective, there is a great deal of uncertainty on what the issues and questions might be with respect to the implication of the communication/information revolution for newer type disasters. Along some lines, a strong case could be made that the newer technologies should help improve disaster planning and crisis managing in many ways. However, in some ways, it is possible to visualize that the new technologies could compound difficulties in coping with newer types of disasters. So unlike the previous ten points where we have discussed negative effects or outcomes, in this area we are

unclear about the possible consequences of the revolution in dealing with newer forms of disasters. It is obviously something that needs systematic study.

For example, can we automatically assume that the newer technologies can better handle an increasing problem, namely that the effects of disasters are leaping more and more across national boundaries? This came to the fore in the radiation fallout in Western Europe from Chernobyl. It is also illustrated by the current massive fires in Indonesia affecting through smog much of Southwest Asia including highly developed urban areas in Malaysia and Singapore. Can we assume that because the technologies allow people to have greater access to information that the "right" messages are sent and received. As another example, when Hurricane Bertha approached the United States in 1996, there was a fivefold increase in weekly accesses to the World Wide site operated by the Federal Emergency Management Agency. Users went from about an average weekly access of 230,000 to about 1,250,000. But what did they learn? What did they use? Given how we know citizens tend to react to warning messages sent through more traditional means, we cannot simply assume that additional access is automatically "better" access. It may be, but at the moment we do not know. Research is needed.

For that purpose, we suggest that what needs to be examined are whether the newer disasters have qualities that affect the data or information about them that exist or could be processed. These qualities include such aspects as the separation of source and place of impact, the lack of casualties and property destruction, the very diffuse nature of the crisis, the cutting across in effects of many political and governmental boundaries, the often low profile nature of the risk except at the time of impact, etc. If these relatively distinctive qualities do exist, we cannot help but think that the information/communication revolution might have difficulties in handling the newer kinds of disasters

12. The certainty of computer system related disasters.

There is one future problem that we are certain will have to be addressed. Despite the self-correcting features that are part of such systems, the development of computers and their extensive use will undoubtedly lead to one *new* kind of disaster, that is, computer *system* disasters. These kinds of disasters are ever more probable in the future. Although what will ensue will not be totally different from what appears in more traditional crises, they will require innovative disaster planning and especially imaginative management strategies.

For example, since direct computer system disasters can "impact" in extremely widely dispersed areas (or even in terms of the temporal dimension) and at a distance from the initial starting point of the crisis; one consequence will be the cutting across of many community and other formal boundaries.

Let us illustrate from an incident in Hinsdale, Illinois where a minor fire disabled a major Bell Telephone switching center in the Chicago area (Pauchant et al. 1990, 1992). This

telephone outage because of its links to computers affected both voice and data communications for more than a half million residents and business customers in six metropolitan suburbs over periods ranging between two days and three weeks. In addition, local and long distance communications for both telephone and computer networks were also severely affected since the involved center was an aggregation point for major telecommunications links. The outage, besides temporarily leading to the shutdown of the major international airport for Chicago, O'Hare, cancellation of about a fifth of the outgoing flights that day, and creating extensive backlogs for passengers in other cities, also:

affected the normal operations of dozens of banks, hundreds of restaurants dependent on reservations, three large catalogue sales companies headquartered in the Chicago area, about 150 travel agencies, most of the paging systems and cellular telephones in the affected area, and hundreds of businesses located in the area or others not located in the affected area but conducting business with those that were At present a conservative estimate for the business losses and the repair costs of the accident are set at \$200-300 million

The outage affected businesses and individuals in ways they had never experienced. For example, retailers could not verify credit cards. Many automatic teller machines and the Illinois State Lottery's terminals stopped functioning. The 57-member Suburban Library System was confronted temporarily with piles of books, because returned books could not be recorded in the system since its liens were routed through Hinsdale (King 1989).

There have also been very comparable disruptive occasions in Japan (Takanashi et al. 1988).

Related to this are newspaper stories earlier this year that illustrate well the linkage between computer and phone systems, and the consequent frequent problems in one as the result of failures or disruptions in the other. For example, here are recent headlines and news story reports:

Network problem disrupts Internet . . . chaos prevails for hours . . . millions of E-mail message had been returned as undeliverable, and untold number of users had been unable to make contact with various World Wide sites whose addresses were temporarily garbled (Markoff 1997:1) . . . System blackout disrupts flights around country . . . it took two hours to restore the whole system . . . Phone outage affects nation . . . cut cable in Illinois disrupts businesses, closes oil market . . . Among major customers reporting outages were the New York Mercantile exchange . . . Columbia Presbyterian Medical Center also in Manhattan, and WMAR-TV in Baltimore. . . big businesses in 66 major cities (Kalish 1998: A14)

Other press accounts report:

. . . Satellite outage interrupts pager service nationwide . . . millions of users affected by Galaxy 4's glitches . . . 80 percent to 90 percent of the 40 million to 45 million U.S.

page users lost service . . . In addition to the syndicated programs, CBS radio and television, the Chinese Television Network and the CNN Airport Network send feeds through Galaxy 4 (Satellite 1998: A3) . . . AT & T yesterday fixed its broken data-transmission network, after 24 hours of failure that crippled much of the nation's credit card authorization system and thousands of bank machines and computer terminals . . . most federal government agencies were also affected . . . Medicaid claims, defense contracting State Department communications and the Federal Communications Commission all experienced data slowdowns or shutdowns (Mills 1998: C11)

The system breakdowns so far have produced a variety of economic, social, psychological and political "costs." Given the way such disastrous occasions burrow into the very innards and links that increasingly help integrate modern societies, the price (which goes far beyond monetary costs) will undoubtedly grow in future similar happenings. Furthermore, it will probably be only a matter of time before there will be occurrences that will also produce the casualties and material damages associated with more traditional kinds of disasters.

Of course, there is the potential apocalyptic nature of the Y2K or so called Millennium bug problem. As one expert notes:

the heart of the problem is that we don't know what is it don't know (Art Botterell on nets-em@ fu.ca, July 7, 1998)

As some have noted that it is unclear if the Millennium bug will result in only several low probability-high impact problems or many high probability-low impact effects (Mike McGuire on nets-em@sfu.ca, July 6, 1998).

CONCLUDING COMMENTS

In conclusion, we should note that we are dealing with an especially dynamic and ever changing situation. For instance, we are moving into a world where personal computers may be turned into television receivers, and allow broadcasters to deliver computer data along with television programs. Even in the disaster area, where the development of computer technology and its use is just at its beginning, nevertheless the changes that it is bringing are already notable.

Ever since 1516 when Sir Thomas More projected his ideal city state, *Utopia* (derived from the Greek word, **outopos**, meaning no place, which is a good metaphor for cyberspace), many have predicted the possible future. Many if not most predictions about past technological developments and their effects have been markedly incorrect, in both the positive and negative directions (Rosenberg 1995). For as Toffler has written:

Most people--including many futurists--conceive of tomorrow as a mere extension of today, forgetting that trends, no matter how seemingly powerful, do not merely continue in a linear fashion. They

reverse direction. They stop and start. Because something is happening now, or has been happening for three hundred years, is no guarantee that it will continue (1980: 129).

This should be kept in mind, but should not preclude us from projecting into the future.

Furthermore, if we do a good job, the actual future will be different from the projected future. There are many examples in the history of communications that show that technology does not determine the behavior of human beings, but just the reverse(Bijker, Hughes and Pinch 1987; MacKenzie and Wajchman 1985). Our view agrees with those who argue that the rates, directions and specific forms of technological change and its effects are social as well as technical.

The evidence for this is overwhelming; economic, cultural, political and organisational factors--all of which we subsume in the term 'social'--have been shown to shape technological change (Edge 1995: 15).

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