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PROBLEMATICAL ASPECTS OF THE COMPUTER BASED INFORMATION/COMMUNICATION REVOLUTION WITH RESPECT TO DISASTER PLANNING AND CRISIS MANAGING

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*Some of the ideas expressed in this article were initially set forth a decade ago in Quarantelli (1997, 1999).

Preface

This paper focuses on a number of the major problematical or negative aspects of the computer based information/communication revolution of the last two decades or so. While much of what we write is equally applicable to many other areas of life where computers are central elements, we confine ourselves to the implications for disaster planning and crisis managing.

Given the focus and the title of our paper, we want to preface our remarks by giving five concrete examples of rather positive consequences in disasters and crises as a result of the information/communication revolution we will be discussing in most of the article. For instance, just before Katrina impacted New Orleans, a member of the mayor's staff set up an Internet telephone account. Two days after impact he found a working socket in the conference room of the hotel where the city had set up its operational center, and was able to link together eight telephone lines though his laptop computer. For the next five days, according to the Wall Street Journal "virtually all communications out of New Orleans by the city's top officials depended on that...laptop and this single Internet phone account." (Swope and Patton, 2005).

Then there are case studies of Hurricane Andrew, the Loma Prieta and Northridge earthquakes, and Hurricane Katrina which show that geographic information systems (GIS) were extensively used with worthwhile results in those disasters (see, Tierney, 1994; Dash 1997; Curtis, Mills, Blackburn and Pine, 2005; for still other cases see Pine, 1997). Also prior to the terrorist attack of 9/11, a key official in the New York City Office of Emergency Management said that "we rely heavily upon GIS for planning our reception centers and shelters planned for various hazard events along with location of all hospitals, alternative care facilities, nursing homes, points of dispensing meds, infrastructure fire and police stations, evacuation routes, bus routes, etc." After the attack, since the regular EOC was destroyed a major improvised effort was undertaken in a newly created EOC to set up a new GIS that actually worked very well (Rotanz, personal communication, 2001; see also Thomas, Ertugay and Kemec, 2007).

At a more general level, after disasters online fundraising is increasingly much more effective in generating more money than through other ways (e. g. half of the two billion dollars contributed for Hurricane Katrina and Rita was obtained through Web sites (see Pearlstein, 2006). And in the Asian tsunami of 2004 different relief providing organizations and individual seeking information about possible victims, learned much via the Internet and bloggers that they would never had learned about the catastrophe in a pre-computer rime.

These examples highlight the fact that we recognize that the revolution has used a variety of computer related tools for more effectively coping with both old and newer kinds of disasters and crises. So we do not challenge the idea that disaster planning and managing has been considerably improved by the adoption of computer related technologies. We more than agree that:

> The convergence of computers and communications, and the accelerating growth of global information networking is . . . having a profound impact on the organization of disaster

> mitigation, planning and response and on the underlying matrix of research and knowledge transfer (Stephenson and Anderson, 1997: 305).

This point is reemphasized very strongly in the later state-of-the-art review of hazards and disasters that the National Research Council undertook in 2006 (see especially pp.248-316).

However, from a sociological perspective, all social phenomena must have some *negative* effects for someone, somewhere. Therefore in this paper we raise problematical aspects of the continually accelerating cyberspace revolution; that is, the possible and probable consequences of an unwanted nature or which, as a minimum should raise questions for any interested party. This kind of analysis does not deny 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.

As indicated in the end note, the data used for this paper were derived from a variety of sources. In addition we use some unpublished observations drawn from some Disaster Research Center (DRC) studies.

A Revolutionary Social Change

In terms of world history, we are in a time period of very rapid social change. The social landscape and features of this century are markedly different from the early part of the last century. The most important structures and activities of human life are drastically changing (Smelser, 1991; McMichael, 2007). Massive transformations are occurring in the cultural, economic, educational, familial, political and scientific spheres. For example, there are basic alterations occurring in the role and status of women alongside the emergence of new family and household patterns, the globalization of popular culture and scientific endeavors, and the spread at least nominally of democratic ideologies and governmental structures.

However, in this paper we describe and analyze only one of these major changes, namely the information/communication revolution brought about by developments and innovations in computer and related technologies. Or as predicted 35 years ago, our focus is on the shift "from mechanization to cybernation" (Meadows, 1971: 12). This can be seen in the ubiquitous presence in everyday routines of cell phone cameras, iPods, mini-camcorders, satellite dishes, Blackberry handsets, laptops, scanners, HDTV, digital cameras, DVDs, and other multi-media pieces of equipment and other audiovisual devices. The common element is the computer or it as 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 and text messaging, the electronic use 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, as well as other activities possible through the Internet (see National Research Council. 2006).. And this revolution is far from over. As others have observed: "The two billion people who live in the two million villages of the developing world live in a technological time wrap. The vast majority of them have never used a telephone, let alone the Internet" (Garriott, 1998).

Questions and Issues They Raise

We address a dozen questions and issues they raise for planning and managing disasters and catastrophes. The first six might seem relatively obvious, although most have not been explicitly addressed in the literature. The other six are either counterintuitive or on issues that might superficially seem to be of minor importance. However, our rationale for where we start is well indicated in the following comment by someone else.

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 Certainty of Computer System Related Disasters.

There is one future problem that we are certain will have to be increasingly addressed in the future. Despite the self correcting features that are an inherent part of such systems, the development of computers and their ever wider use will undoubtedly lead to one *new* kind of disasters, that is, *computer system disasters.* 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 managerial strategies (see Quarantelli, Lagadec and Boin, 2006).

Let us illustrate the general problems generated in these kinds of new disasters from one of the first such large-scale crisis. A minor fire disabled a major Bell Telephone switching center in Hinsdale, Illinois, near Chicago. The telephone outage because of linked computers affected both voice and data communications for more than a half million residents and business customers in six metropolitan suburbs for time periods ranging from two days to three weeks. In addition, local and long distance communications for both telephone and computer networks were also seriously affected since the involved center was a focal point of major telecommunication links. The outage, led to the shutdown of the major International airport of Chicago (O'Hare) with a cancellation of about fifth of the outgoing flights that day thus creating an extensive backlogs of passengers in other cities (Pauchant et al, 1990, 1992).

Also this system failure:

> 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 phones in the affected areas, and hundreds of businesses located in the area or

> others not located in the affected area but conducting businesses with those that were.

In addition:

> The outage affected businesses and individuals in ways they had never experienced. For example, retailers could not verify credit cards. Many automatic cash disbursing 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 book could not be recorded in the system since its loans were routed through Hinsdale (King, 1989).

At roughly the same time there was a comparable computer related social disruption in Japan (Takanashi et al, 1988).

To be sure the great majority of computer system failures and disruptions are rather limited in their negative effects. They never reach the level of being even a community disaster. On the other hand, at the other extreme there are computer-related disasters that have national and even international or global implications. For example, in 1997 and 1998 there were a series of episodes that illustrated well the linkage between computer and phone systems, and the consequent frequent problems in one as the result or failures or disruptions in the other. (Markoff, 1997; Kalish, 1998). Other press accounts reported:

> 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: C:1)

Of course not all potential computer related problems fully materialize. There is the well-known example of the Y2K or Millennium Bug problem. While an apocalyptic occasion never happened, it did evoke protective activities (Connell, 2002).

As we have discussed elsewhere, computer related disasters are actually part of the newer kinds of crises that emerged at the end of the last century and have accelerated at the start of the 21st

Century. We have called these "trans-system social ruptures" (TSSR). So far no computer system disaster has reached the symbolic level that Bhopal did for chemical catastrophes or Chernobyl did for nuclear catastrophes. But it is only a question of time before we have a computer catastrophe (for the difference between disaster and catastrophes see Quarantelli, 2008)

2. A Maximization of 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 from the military intelligence area, where one can also find good illustrations of very serious consequences.

The computer based revolution, at one level, seems certain in many situations to produce more incorrect as well as accurate information than can be handled during crises. As Michael has written:

> 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 complexities 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. In more cases more information deepens a feeling of uncertainty (1985: 34).

In addition, all data or information at some point has to be assessed and interpreted. For instance, the US National Weather Service, despite its massive technologically generated input continues to have this problem in issuing flood and hurricane warnings as was illustrated by what happened in Hurricane Katrina in August 2005. The problems of *interpretation* or *meaning* as well as *evaluation and assessment* cannot be solved by the addition of more technology. The use of 'artificial intelligence" might help, but cannot provide ultimate answers. As was said two decades ago in a 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 the same symposium another speaker said:

> 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 *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 the situation at hand.

This last speaker then went on to say:

> . . . 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).

Our simple point is that it always takes human being (usually in a group context) to assess information, no matter how it has been obtained or gathered. The greater the volume of such data, the more difficult any efficient and effective assessment will be. Since the communication revolution almost insures information overload, the more problems will surface.

3. The Greater Likelihood of the Diffusion of Inappropriate Disaster Relevant Information.

For our purposes in this paper, we do not discuss the deliberate sabotage of the information flow (for a discussion of such activities by organized criminal syndicates and terrorist groups, see Trim.2005; also Brudis, 2006). Instead our interest here is less in deliberately bogus information (likely in conflict but not in consensus crises, see Quarantelli, 1993, 2005), than in the *diffusion of inaccurate or misleading* communication. For many reasons this will be facilitated by the availability of new computer technologies. More access will mean more likelihood of greater and quicker diffusion of incorrect information, which is even now a problem (usually thought of as the spread of "rumors" although relatively minor to what the future will bring).

A discussion now a decade old 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 find a global audience (Editorial, 1996).

The reporting going around the world that occurred in Hurricane Katrina, especially the stories of anti social behavior in the New Orleans area, clearly presented a very inaccurate picture of what was going on (see, Thevenot and Russell, 2005) as well as ignoring the much prevalent prosocial behavior (Rodriguez, Trainor and Quarantelli, 2006). In retrospect too it is clear now that the world wide depiction of recent catastrophes such as the Asian tsunami and the Pakistan were far from being totally accurate and often presented an unbalanced picture of what actually happened and what did not happen (e.g. See Scanlon's writings on the handling of the dead in the tsunami).

As Stephenson and Anderson noted nearly a decade ago, even in developed societies:

> . . . data quality has proved to be a significant problem with all resource data-bases 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 (1997: 313).

In addition, problems can be compounded by the availability of real time information that discourages delaying responses. However, research has consistently shown that a timely response is one thing but a quick response can be something else. For example, 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 sole useable road was completely blocked.

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

4. The Probability That The "Rich Will Become Richer" In Dealing With Disasters.

Proponents of the revolution have argued that it will make for radical democratization of social life (e.g., Ess, (1996). Anyone who knows the history of technological innovations knows that this is a very common theme at the advent of many major technologies: in the last century this was said of films, radio and television, for example. However, studies also show that most technological developments usually make, comparatively speaking, *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 major 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 new technologies:

> 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. 1995:1).

This is also occurring in the disaster area. At the national level, disasters occur most frequently (depending on criteria used, up to 80-90%) in developing societies. By definition these societies 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 although the situation has markedly improved since 2000). But even last year, Ethiopia a country of 73 million people had only 435,000 phone lines plus 97,800 mobile phones (Silverman, 2005). There are many reasons to think that such countries will lag even more in the future, although this does not preclude eventual adoption of some technologies. But even in this, there can be complications. As Peters notes:

> We've heard all sorts of airy-fairy 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 isn't one. During the Ebola outbreak in Zaire, we sent a satellite phone with our people so they could tell use what they needed most urgently. In Kitwit, a city of 250,000 people, there were no E-mail, fax or regular electricity. There was no radio station to deliver health messages. They had to be delivered, instead by bicyclists 00000with megaphones (1997:46).

And of course many rural districts in developing countries are often good examples of resource poor areas in disaster vulnerable localities.

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 (and as Hurricane Katrina dramatically surfaced, these exist even just two years ago within major American metropolitan areas such as New Orleans). There are often huge differences in the interest, knowledge, competency and access regarding computers and related technologies that different neighborhoods have (Poole, 1996). Even today while a majority of American households have computers, many are used primarily by children and younger people. This has led t o the view that:

> . . . there is a growing 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).

A survey in 2006 in the United States, found 74 percent of whites using the internet, compared to 67 percent of African-Americans, suggesting a diminution in the divide (although these figures clearly indicate that millions of American households were not linked to the Internet). However, the report on those figures noted that subtler qualitative differences in use remained and that "a new dimension of the digital divide might be opening because groups that were newer to the Internet tended to use less-advance hardware and had slower connection speeds"; it was also observed that instant messaging and downloading music was also another indication of different and different usage patterns (Marriott, 2006).

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 worst off than the better off people. Improvements in technology, because they are time wise differentially adopted, cannot change that.

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A series of ongoing field studies by DRC illustrate rather well several of the points just made. The study is focused on the diffusion of digital technology among local Oklahoma emergency managers. So far this research has found a digital divide—those who have ready access to digital technology and those who do not. The divide is associated especially with such factors geographic location and population density (e.g. high speed Internet connection is not always available in rural areas). It is projected that while the digital divide may disappear, the DRC researchers believe it will be replaced by a learning divide (some will lack skills for computer/Internet use), and a content divide (less educated may not be able to comprehend technical content) (see Donner, 2005; Rodriguez, Diaz, Donner, Santos and Marks, 2005) and we would say as well as other divides such as culture, class, and ethnicity).

5. The Possibility That Technological Innovations Will Be So Overemphasized That What Is A "Means" Will Be Turned Into An "End" In Itself.

Too strong an emphasis per se can have several unfortunate consequences. For one, what should be "*means*" are at times into "*ends*" with the accumulation of more and more technology particularly at the operational level. This is not a new problem. In the 1960s-1980s, DRC studies found that many crisis oriented community agencies after disasters thought that what was needed were more communication "means" such as radios and walkie-talkies, and pushed for their acquisitions. However, the field research evidence 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 problems are not solvable by more communication equipment.

Dash illustrates a similar recent problem from her 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 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 with products to sell (and in some societies by cultural values that see technology as the ultimate solution to all kinds of problems). We can currently see these factors operative in the spread of geographic systems (GIS), even granting the usefulness of the technology (see Thomas, Ertugay and Kemec, 2006). More important, difficulties or problems that are of a "social" or "human" nature such as knowing what questions to ask, requires "social" solutions, not technological ones.

In this context, an emphasis on technology will also reinforce an already existing tendency in disaster planning/managing. This is to apply technology too those problems most easily addressed by the existing technology, or to downplay those that cannot be so easily addressed. This also can be seen in disaster research, where there is an inclination at times to do studies (such as quantitative surveys) 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 availability of certain methods to determine the question to be studied. Any use of computer-related technologies in the disaster area should similarly be determined by the problems that need solutions, and not vice versa.

An interesting negative byproduct of an over-emphasis on technology is an often failure to develop non-technological back up systems. This occurred in New Orleans during Hurricane Katrina. One local emergency manager official appeared on television and bemoaned the fact that: "the phones don't work, not even the cell phones!" and so he could not do anything. To be fair a somewhat older local officials noted that his phones were also not working but that he had resorted to "what we had used in previous hurricanes, messengers and they are working well."

But an overdependence on technology often leads to little planning for its failure. An example is in 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 actually minor incident but occurred very close to where a large amount of phosgene and chlorine gas was stored. However, the plant operators had no idea with the collapse of their monitoring system if there was a new and major threat from the poison gases, and how dangerous the situation was or

could become. 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 magnitude of the new threat. As it turned out, the poison gases had not been released. But before that finding, there was major disruption of community life as thousands of nearby residents were evacuated in the middle of the night (Quarantelli, Phillips and Hutchinson, 1983). The absence of backup systems is not that rare.

Yet it is a fact that various electronic systems will often not work during major disasters because much communication equipment in impact areas will be disabled or limited, especially those dependent on electric power or telephones. This was noted decades ago as can be seen in this statement by an international disaster relief official with vast experience in crises in developing countries.:

> New technologies should be used whenever and wherever they may provide relevant information. This 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 (Lechat, n.d.: 2).

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

6. For A Variety Of Technologically Related Reasons, There Is Likely To Be A Reduction of Learning From Errors

Human beings and social groups can and do learn from *mistakes and errors.* To an extent, this is one major goal of disaster research. However, it appears that the computer revolution may reduce, along some lines, the possibility of learning from prior errors.

Rochlin, in particular, has 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). Hunter, in discussing him 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 aptly summarizes it: "taking away the easy part of an operator's tasks will make the hard ones more difficult" (1997: 100).

It may also seem odd, but the computer revolution will also result in an accelerated loss of relevant information from past disasters. In pre-revolutionary times, there is often a "paper" trail of organizational activities and of mass media reports. While such archival data are not always valid and accurate, 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 noted by librarians and archivists, and decried by historians who have noticed the disappearance of "soft" data especially in the change of governmental administrations. Our point is that the loss of the paper trail makes it much more difficult to learn from history in the way documents allowed us to do in the past.

The recent development of an Internet Archive is very laudable (see www.archive.org). This is an effort to collect in digital format, past and current texts, audio, moving images, software as well as archived web pages on the Internet and related sources. However, for a variety of reasons, what will be collected will be at best an uneven and small sample of what has been and is being produced and distributed. That is better than no record at all, and every scholar and historian should be in debt to those that started this archive in 1996, but there is no longer an extensive paper trail at all.

Actually even when information does not disappear in cyberspace that can also create problems. Thus, it has also been observed that outdated and perhaps misleading information can remain "cobwebbed" at times at WWW sites. Even now we are aware of past electronic discussions among those involved in a disaster where incomplete if not misleading statements were recorded when judged against the full body of the most recent social science disaster research. In fact, in an 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 disaster researchers consider an invalid approach or at least open to question (For an up to date discussions of the values and problems of ICS see Buck, Trainor and Aguirre, 2005).. Such texts are now 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 such errors, the opposite may happen.

To be sure, the same could be said about incorrect statements in published or written sources. However, there seems to be less caution or skepticism about electronic sources (particularly noticeable among younger people). One expert in the area has written: "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 also 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 mistake in planning for and managing disasters.

7. There Will Be An Even Further Unfortunate Diminution Of Nonverbal Communication.

It is very likely that computers have allowed most users to increase the quantity of their communicative interactions with others. At a personal level, we can attest to this increase: where letters would not have been exchanged, Email messages are sent.

However, quantity is one things, quality is another ((as we discuss in more detail later).. More of something is not necessarily better than less of something. This is not always understood as implied in the statement that: "instead of corresponding with 6 or 7 people, we have 150 E-mail partners " (J. Tierney, 1997: 47).

However, meaningful human communication is dependent in many ways on gestures, inflections, grimaces, body language and affective tones, etc, over and beyond the cognitive symbols involved (see Ekman and Friesen, 1978; Giddens, Duneier and Appelbaum, 2003: 112-129). 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 at present are not addressed in disaster planning and also have been ignored by disaster researchers. Because something is neglected does not mean that it is unimportant. However, we do have in the literature some studies of cockpit behavior in airplanes at times of emergencies that indicate 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 system manager who mainly has to monitor that it's 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 (Wilkin, 1996: 8).

Although not of a crisis nature, related to this is that some businesses that have tried using a "virtual office" have been abandoning it because in the words of an article in the financial pages of the New York 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 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 people with whom one is 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 emergency or crisis area, that visual communication through mechanical means can lead to desensitization to whatever information content is pictorially presented.

At any rate, there would be the likelihood of even more of a diminution in the non-verbal dimension because of the computer-based revolution (see, for example, 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 as good as interpersonal sex may believe this, but we would venture they will have difficulty convincing the nonbelievers.

8. There Will Be Negative Consequences From the Probable Computer-generated Acceleration of Fads and Fashions in the Disaster Area.

The communications/information revolution will undoubtedly increase *fads and fashions* in the disaster area. These labels are technical terms drawn the sociological collective behavior literature (e.g., Miller, 2000) and refer to the extrinsic reasons for quick adoption of certain social innovations. However, it is important to note that the intrinsic merit or lack of merit of the use 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 the Incident Command System (ICS) as the best management model for crisis occasions (see the US Department of Homeland Security mandating the ICS as the model that all government agencies at all levels must implement).

These ever spreading ideas might eventually turn out to have some validity along certain lines, although at present the empirical approach does not seem to provide much systematic evidence in support of such ideas (for PTSD in crisis situations see Bowman, 1997; Tedeschi, Park and Calhoun, 1998: for the use of ICS in Katrina, see Neal and Gaetu, 2006). The point is that the acceptance of such ideas stems more from the faddish climate in which they exist than from research based evidence.

More important, there are more general dysfunctional consequences of fads and fashions disaster planning. 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 highest priority to mitigation, then questions and or challenges are unlikely to surface. The quantity of information and the s peed 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 particularly organizations with specific agendas and superior to the Internet, can "flood" the market with their views. In fact, not only can they, but they do . Put in another way, the "best" does not always win out in such a marketing situation.

9. Intra and Inter Level Organization 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. It is even worst at times of crises. Because of the heterogeneity of the diverse content, and the various social interests and cultural values they reflect, this often undermines the greater 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. What happens when it is lacking was very well illustrated by what happened recently in Hurricane Katrina and the earthquake in Pakistan, as well as the response to the 2004 Indian Ocean tsunami where Scanlon (2006) found the problem was exacerbated by overloads on call centers.

However, there is reason to think that the information/communication revolution under way may along certain lines could aggravate this ever-present problem in disasters. Part of this is related to the information overload and the quickness of the message flow that we 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.

However, additionally there could be more problems for several reasons. For one, the revolution will encourage in an untended way the undermining of "authority" and experts and lead to a "democratization" process, which argues that the views of anyone and everyone must be taken into account. (See Rushkoff, 1994, for a view of the positive and equalitarian consequences from the use of the new computer technology as well as a spreading of anti-establishment notions in popular culture). Challenges to traditional power and knowledge elites can be desirable and valuable at disasters as well as other times. In fact, we personally would like to see a greater openness among elites to such challenges. However, only someone who totally accepts the post-modernistic thesis that any that any view is as equally valid as any other, will see this as a completely desirable outcome for disaster planning and disaster research. Some people really do know more than others. Sport fans think they know more than managers and coaches, but they are not even close. The issue here comes close to the recent debate about the value of the content of Wikipedia, the free online encyclopedia, and that of the Encyclopedia Britannica (see Stross, 2006: BW 5).

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

> 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 retrain any meaning at all. (Botterell, 1995/1996: 43).

Apart from the unwarranted technological determinism implied in the statement, it overlooks that such notions as "decentralization" and "centralization" fundamentally have to do with social roles and positions, authority and power, and a welter of other social factors that sociologists and political scientists have learned much about. 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 settings 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 and extrapolations.

Also, traditional organizations are not necessarily always the prime social players at the height of disasters. The crisis time period of disasters is characterized by the emergence of many new informal groups, with the greater the disaster, the more likely there will be more such ad hoc groupings. In the immediate aftermath of the cyclone that hit Darwin, Australia, 24 totally new disaster-related committees emerged, as well as a slew of other new informal groupings. Research has consistently shown, not only that such groups and groupings appear, but more important that they are crucial to dealing with crisis-time major needs ranging from search and rescue to coordination of sector and overall response. (See Rodriguez, Trainor and Quarantelli, 2006 for what emerged in Hurricane Katrina). However, since these kinds of groupings are new to the situation and have no pre-impact existence, there use of computer related equipment will be rare at best. (However, electronic networks did spring up after the earthquake in Kobe, Japan that provided advice on how to contact friends and relatives). It is the traditional organizations and agencies that are far more likely to have such equipment available.

10. May Worsen the Distinctive Features Of Many Of The Newer Kinds Of 21^{stt} Century Disasters.

Without doubt in this century we will see a continuation of the kinds of disasters that have impacted human societies since they have evolved. Initially these were natural disasters that were joined in the last century by technological ones. But what of the newer kinds of disasters? How well can the new technologies deal with the newer risks and crises of this century. The future is neither 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 a technical nature.

Recently increasing attention has been paid to these new kinds of disasters and crises. There are a variety of these kinds of newer, sometime interrelated disasters and crises. As we mentioned in section #1, the development of the newer technologies creates the possibility of their own disasters, namely massive computer system breakdowns. In addition there are also possible

genetic engineering accidents that could eventuate in catastrophic kinds of occasions never seen before. However, the newer kinds of disasters in this century do not depend solely on the development of new agents as in the two examples just given; they can involve sources such as health risks that have long existed but which are transformed in the new social setting of the current world. Many scholars see these phenomena as rather unique given that the initiating origins are in one place but the effects usually are distant both in terms of social time and social space (for a 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, 1998).

Stated in ideal type terms, there are at least six distinctive characteristics of such happenings: 1) the phenomena jumps across international and national political boundaries such as SARS did. 2) the phenomena spreads very fasts---SARS went from a rural area in China to metropolitan Toronto, Canada in 24 hours. 3) initially there is no known central or clear point of origin. 4) potentially there is if not actually huge number of victims—in principle the whole world, as do most computer viruses. 5) traditional local community "solutions" are not obvious. And 6) although responding organizations and groups are major players, there is an exceptional amount of emergent behavior and the development of many informal, ephemeral linkages. (see Quarantelli, Lagadec and Boin, 2006).

From our perspective, there is a great deal of uncertainty on what the major issues and questions might be with respect to the implications of the communication/information revolution for the newer type disasters. Along some lines it could be argued that the newer technologies should help to improve disaster planning and crisis managing in many ways. After all, the new do share some common aspects with old types of disasters and we know as said in the very first paragraph of this paper that there have been very positive features in the use of the new technologies even in major disasters and catastrophic situations.

However, in some ways it is possible to visualize that the new technologies could compound difficulties in coping with the new types of disasters. For example, can we automatically assume that the newer technologies ca better handle an ever increasing problem, namely that the effects of disasters are leaping more and more across national boundaries? While observed before, the problem caught the attention of researchers in the radiation fallout in Western Europe from Chernobyl and massive fires in Indonesia affected through smog much of southwest Asia including highly developed urban areas in Malaysia and Singapore. Also, can we assume that because technologies allow people to have greater access to information that the "right" messages are sent and received? Some of the happenings in Katrina certainly raise questions about that (see Rodriquez, Trainor and Quarantelli, 2006).

As another example, when Hurricane Bertha approached the United States in 1996, there was a fivefold increase in weekly accesses to the web site operated by the Federal Emergency Management Agency (FEMA). Users went from about an average weekly access of 230,000 to 1,250,000. In 1998 when Hurricane Bonnie approached the United States there was a ten fold increase in access to the FEMA web site, reaching nearly two million contacts a day (FEMA, 1998). But what did they learn, what did they use? Given that we still believe that citizens tend to react to warning messages sent through more traditional means and then check with their

social peers about the validity of warnings, we cannot simply assume that additional access is automatically "better" access. It may be, but we do not really know. Research is needed.

For that purpose, we suggest that what needs to be examined are especially whether the newer disasters have qualities that affect the data or information about them that exist or could be processed. These qualities include such frequent 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 it manifests itself in a physical impact, etc. If these relatively distinctive features or qualities do exist, we cannot help but think that the h information/communication revolution might have some difficulties in responding to the newer kinds of disasters.

Finally, we should say that more attention needs to be given to the changing and diverse role of the private sector in the information/communication revolution. Since we have discussed this elsewhere (Quaraantelli,1997, 1999) we will here only note that both the newer disasters that are appearing and the newer computer based technologies that are more and more appearing, are increasingly dependent on private sector actions and initiative. In part, this stems from the move almost everywhere to a market type economy for producing goods and distributing services which we will now discuss.

11. The Changing and Different Role of the Private Sector Around the World.

Another current macro level change that is occurring is the move almost in every country in the world to a market type economy for producing goods and distributing services. However, the literature deals only with limited aspects of economic factors in disasters. Some work has been done on economic costs of disasters and catastrophes (see e.g., Albala-Bertrand, 2006). Also there is a small body of literature on how American businesses react to community disasters (e.g., W ebb, Tierney and Dahlhamer, 2002). But except for a few examples (such as our contrast of how hotel chains and religious groups better handled problems than government organizations in Hurricane Katrina, see Rodriguez, Trainor and Quarantelli, 2006) there has been almost no studies of the role of the private sector especially in terms of changes and expansions in the last few decades around the world. So while we can logically note where there might be problematical aspects; we can not root them in empirical data.

This can be seen in dramatic form in the last two decades in China and Russia where new forms of market economies were established (Appel, 2004; Shenkar, 2006). However there is a tendency to assume that private sector patterns that prevail in Western societies are universal ones. That is not the case. If so, there may be important 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 limited number of shareholders to which they must respond; in fact that responsibility is more nominal than actual. Government agencies are legally responsible for protecting citizens in general and while this

sometimes is also more nominal than real, at least on paper the responsibility for all does exist. Also private groups although often having specialized resources do not have the almost unlimited access to the full range of resources and services available to governmental agencies in whatever country is involved. Private entities, except within their own organizations and even that only within limits, cannot "order" anyone to do anything. Governmental organizations at all levels have formal authority and resources to force compliance to many "orders" especially at times of crises.

These features do not exist everywhere. This is partly masked in the seeming world wide move toward privatization. For instance, in present day China and Russia, the line between what are "private" entities and what are "public" entities is often very vague and murky, particularly if ability to exercise real power is considered rather than whatever the formal arrangement may appear to be.

Military backed or run "private" corporations exist in both social systems as well as many other countries around the world. In some developing nations recent moves to privatization of certain organizations are not much more than changes in labels on what is called public and private. Put another way, not only is there any increasing role for private sector changing in many non-Western parts of the world, but there are also differences in the meaning of the private.

Furthermore, what comes under the public and the private label can vary substantially as can be seen in the following examples. For instance, in Australia their coast guard operations are outsourced to private entities. Also, many response and recovery functions handled by governmental agencies are carried out in developing countries by international disaster relief and religious groups, many of them NGOs (non-governmental). And in the conflict area, the US government and military have turned over many even war time activities to what in the old days used to be called private mercenaries. Given what we have said earlier, what and how newer technologies are differently used by the public and the private sectors, will result in the communication of rather different information.

In addition, one other question we see in all of this is that the private sector is likely to encourage a competitive marking situation. This is reinforced by the fact that in some developed societies such as Germany, Japan and the United States there has been a conscious entering into the disaster technology area with the expressed purpose of increasing sales by their domestic producers of technological tools. The public sector, in contrast, is more likely to try to use technology for more cooperative humanitarian efforts.

It has been known for decades that competition among international disaster relief agencies has been a serious problem (Kent, 1988). It would be unfortunate if the computer based revolution might 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 sectors use and control the newer technologies.

12. The Ever Increasing Quantity in the Production and Dissemination of Computer Related Information Has Considerably Outpaced the Increase in the Quality of the Information Generated.

There are at least three major questions we discuss below that are raised by this observation. One, in what sense can we talk about a quantitative increase? Two, can quality ever catch up to the quantitative side? And three, does not the quantitative-qualitative divide underlie most of the other eleven problematical aspects we have previously discussed?

Our attention to this whole matter was triggered by an article written by a sociologist, Wolf Dombrowsky, the leading German disaster researcher and a second generation pioneer scholar in the field. Referring to disaster researchers, he writes: "the Internet has changed our modes of working, writing, organizing, and teaching" (2002: 309). He enumerates an almost endless list of programs, techniques, procedures and methods either spawned and/or facilitated and made more accessible for use in collecting and distributing disaster information and data.

At one level, Dombrowsky is partly indicating the quantitative consequences of Moore's Law (Moore, 1965). This is the notion in laymen terms that computer capability and complexity was doubling every two years (this was updated recently by other experts to 18 months). Many of the recent programs, etc. cited by Dombrowsky could not have existed a few years earlier.

In one sense, from one point of view, Moore is talking of computer hardware; Dombrowsky of computer software.

However, what is missing from the discussion is the third component, the persons and groups that create and use the hardware and software. In all three cases, there is no question there has been huge quantitative increases. However, the increases have not been equivalent across the board. The hardware has outpaced the development of the software. As a recent article this year said: "Faster chips are leaving programmers in their dust" (Markoff, 2007). But ignored as said earlier, is that human beings use the hardware and software, and they lag even further behind than the software developers.

Let us illustrate this last point in a concrete example. Bloggers who set up their own easily accessible web sites are less than a decade old. Hurricane Katrina probably generated more operative bloggers than ever before in any prior disaster or catastrophe. We monitored in real time a number of such sites at the height of the crisis. Here and there were sites that passed on relevant observations, useful suggestions, and correct information. But in our view, very many sites were very bad in terms of what they were communicating, passing on incorrect rumors (e.g., stories about looting and anti-social behavior that had no basis in fact), and suggestions on what to do or where to go that were misleading or at least inappropriate (e.g., contradicting official recommendations).

The quantity of what was made available to anyone who wanted to "listen" was far superior to what was qualitatively processed and distributed. Dombrowsky although talking more about the use of software semi-implicit noted that the vast amount of data and information currently available is often weak from a qualitative point of view. Unfortunately it is difficult to see how

this gap between the quantitative and qualitative can be reduced, especially since there is no equivalent of the engineering criteria for good hardware for the human component in the process. In the abstract, one could possibly advance criteria for good bloggers. But in reality the human and group factors are very complex and dynamic. It is no accident that the social sciences have not developed or evolved as well and as rapidly as the physical sciences; their task is far more complex.

Finally, as a concluding point, we should note that the quantitative- qualitative divide underlies many of the other eleven issues and problematical aspects that we discussed earlier. The problem in many cases is that quantity can not make up for or substitute for quality. This is not taking a pessimistic position. Those scholars and researchers dealing with the issues in this paper can still do much to develop better qualitative information and data. But there may be an inherent limit to what can be done.

Some General Observations

Let us conclude with three general observations relevant to what might happen in the future. For one, it is important to note that we are discussing an especially dynamic and ever changing situation. For example, we have very recently moved into a world where personal computers can now be turned into television receivers and allow broadcasters to deliver computer data along with TV programs, something just not possible only a few years ago. Even in the disaster area, where the use of computer technology is not that extensive, major changes are being proposed for more extensive uses as urged in several of the post-Katrina governmental investigations.

However, we should also note that at least since 1516 when Sir Thomas More projected his ideal city state, Utopia (derived from the Greek word *outopos* meaning no place, which is also not a bad metaphor for cyberspace), many writers, including serious scholars, have predicted what the future would bring. It turns out that many if not most projections about past technological developments and their social effects have been markedly incorrect, in both the positive and negative directions (Rosenberg, 1995). But as Toffler, a noted futurologist, 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 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: 29).

That should be kept in mind, although in no way should that preclude us from projecting into the future.

Finally, from our perspective it is important to avoid the notion of technological determinism. This is a rather contentious issue in the social sciences. Many, if not a majority of scholars, take the position that is often called "technological determinism." This is the view that innovations in technology are a major if not the crucial source of social changes and that the effects on social life goes from the innovations to the social setting. Depending on the nature of the technological

innovations, social changes follow. Many of the recommendations of the post-Katrina governmental investigations, implicitly at least, operate from that premise.

But there is an opposite theoretical view (for a discussion of different scholarly positions, see Feenberg, 2002). That is our position. We would argue that here are many examples in the history of communications that show that technology per se does not determine the behavior of human beings and social groups. Just the reverse is true (MacKenzie and Wajchman, 1985; Bijker, Hughes and Pinch, 1987; Segal, 1994; Pool. 1997)). We agree with those who argue that the rates, directions and specific forms of technological change and its effects are determined more by social rather than technical factors. As Edge has written:

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

What can be seen as the future of the communication/information computer-related revolution in the 21st Century depends in part where the analyst stands on the question of technological determination. Thus, in our view, if one wants to improve disaster planning and managing it is necessary first to make changes in the larger social setting.

A Concluding Observation

The twelve issues we have discussed are not necessarily the only ones that could be raised (e.g., there are legal, ethical and privacy issues we do not address but some of which are discussed in Kelman, 2005 and especially in the Philosophy of Risk Newsletter at its web site). In the long run those we discuss may turn out to be not all 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, we would be very surprised if what we dealt with in this paper does not turn out to be what researchers and scholars as well as disaster planners and crisis managers will be among the most salient questions and issues they will struggle with in the coming decades.

END NOTE

Besides what we learned from DRC field data, we primarily derived our observations from an intensive perusal of six bodies of literature, the majority of which have been published since 1995.

First, there was a set of non-scientific writings about the social effects of the growth of computer use, ranging from statements by pioneers in the area (Gates, 1996) and their enthusiastic followers (Gelernter, 1998; Tapscott, 1998; Amor, 2002; Anderson, 2003) to more growing critics of this trend (Burstein and Kline, 1995; Sale, 1996; Stoll, 1995; Rawlins, 1997).

Generally these writings are heavily anecdotal in treatment of data but show the expectations and assumptions of both advocates and critics.

Second, we examined the earliest scholar writings that advocated or discussed the use of the new technologies in disaster planning and research such as Chartrand and Punaro (1985), Committee on Science and Technology (1984), Marston (1986), Morentz (1984), National Academy of Sciences (1980), and Perley (1982). Seemingly unknown to most current disaster researchers, these writings are about 25 years old.

Third, we looked at some of the substantial literature on the diffusion of innovations (such as Rogers, 1995; Valente, 1995; Cooke and Mayes, 1996 Garson, 1997; Wejnert, 2002).

Fourth .we also looked at the social change literature (Beck. 1995; Jones, 1995; Schaeffer, 1997; McMichael, 2007) as well as the last decade of the journal, the *Futurist*, which reflects strongly futurist scholars. This and the previous set of literature provided the analytical thrust of our paper.

Fifth, we read the body of writings by disaster-knowledgeable authors on the central topic of our paper (Drabek, 1990; Anderson, 1995; Butler, 1995, 2002; Botterel 1995/1996; 1996a, 1996b; Fischer, 1998; Dash, 2002). There are relatively few research based articles of this kind although somewhat more speculative writings have been produced for at least two decades (see, e.g., Committee on International Disaster Assistance, 1978; Belardo, Howell, Ryan and Wallace, 1983; Chartrand, 1985; Marston, 1986)

Sixth, for statements of general propositions and research-based principles we used the ever increasing social science literature on disasters and crises (Mitchell, 1996; Porfiriev and Quarantelli, 1996; Sylves and Waugh, 1996; Hewitt, 1997; Turner and Pidgeon, 1997; Quarantelli, 1998; Mileti, 1999; Perrow, 1999; Alexander, 2000, 2002; Rosenthal, Charles and Comfort, 2002; Boin, A., P. 't Hart, E. Stern and B. Sundelius, 2005: Perry and Quarantelli, 2005; Rodriguez, Quarantelli and Dynes, 2006).

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