

University of Delaware
Disaster Research Center

PRELIMINARY PAPER
#230

**IMPACTS OF RECENT U.S. DISASTERS ON
BUSINESSES: THE 1993 MIDWEST FLOODS
AND THE 1994 NORTHRIDGE EARTHQUAKE**

Kathleen J. Tierney

1995

IMPACTS OF RECENT DISASTERS ON BUSINESSES:
THE 1993 MIDWEST FLOODS AND THE 1994 NORTHRIDGE EARTHQUAKE

Kathleen J. Tierney
Disaster Research Center
Department of Sociology and Criminal Justice
University of Delaware

Paper presented at the National Center for Earthquake Engineering Research Conference on the Economic Impacts of Catastrophic Earthquakes--Anticipating the Unexpected, New York, New York, September 12 and 13, 1995.

IMPACTS OF RECENT DISASTERS ON BUSINESSES:
THE 1993 MIDWEST FLOODS AND THE 1994 NORTHRIDGE EARTHQUAKE

Kathleen J. Tierney
Disaster Research Center
Department of Sociology and Criminal Justice
University of Delaware

Abstract

This paper presents findings from two Disaster Research Center surveys on disaster-related business impacts. The first study, conducted in 1994, focuses on the ways in which the 1993 Midwest floods affected the operations of businesses in Des Moines/Polk County Iowa; the second project, which was recently completed, uses a similar methodological approach to assess the impacts of the 1994 Northridge earthquake on businesses in Los Angeles and Santa Monica, CA. Both studies utilize large representative samples that include both large and small firms and a range of business types. Topics discussed in the paper include physical damage to business properties; lifeline service interruption; rates of and reasons for business closure and relocation; use of insurance, Small Business Administration loans, and other sources of disaster recovery assistance; and proprietors' assessments of business recovery and well-being at the time the surveys were conducted.

Introduction

Since its inception, the field of disaster research has focused overwhelmingly on units of analysis other than businesses. The earliest systematic U. S. disaster studies, which were initiated just after the Second World War, documented the post-disaster responses of individual victims, households, community residents, and public sector organizations such as fire and police departments (for summaries and syntheses of early empirical research on disasters, see Dynes, 1970, and Mileti, Haas, and Drabek, 1975). While the field of disaster research has expanded considerably since that time, to include studies not only on post-impact response activities but also on hazard mitigation, disaster preparedness and recovery, the emphasis on individuals, household units, and public sector organizations has remained. For example,

a survey of the last five years of the International Journal of Mass Emergencies and Disasters and the journal Disasters found only a handful of studies on disasters and private-sector organizations. Even journals like Industrial Crisis Quarterly and the new Journal of Contingencies and Crisis Management, which could be expected to contain empirical research on disasters and businesses, have actually published very few relevant articles. Those studies that do deal with disasters involving businesses tend to focus not on the businesses themselves, but rather on how public-sector organizations cope with those types of events (see, for example, Harrald, Cohn, and Wallace, 1992, on the Exxon Valdez oil spill).

The availability of publications that provide guidance on various aspects of corporate crisis management has expanded, and a new journal, Disaster Recovery has been established specifically to provide such assistance to the private sector. While they contain useful information, such publications tend to rely either on single case studies or on findings from a small number of cases, rather than larger-scale, more systematic research. Often the connection between their recommendations and data on the actual experiences of businesses is unclear.¹

Studies do exist in the field of organizations that focus more specifically on business entities. Much of this literature deals with the management (or mismanagement) of complex technological

¹ For example, one recent book on contingency planning (Myers, 1993: 14) states that "Less than 25% of business organizations have a workable recovery plan," but does not present empirical data to support that conclusion.

systems. Perrow, for example, developed the theory of "normal accidents" (1984) to show how and why catastrophic events such as the Three Mile Island accident occur. La Porte and his colleagues (Roberts, 1989; La Porte and Consolini, 1991; La Porte and Rochlin, 1994) have carried out an extensive program of research on what they term "high-reliability organizations," i.e., private- and public-sector entities that face major operational challenges but nevertheless manage to function with very high levels of safety. While important and useful, these studies generally deal with either very rare catastrophic events or unusual organizations; they thus do not offer much insight on how typical firms handle the threat or occurrence of disasters, particularly natural disaster events.

Fortunately, there is a growing body of more-representative work that has begun to address how private-sector entities prepare for, respond to, and recover from disasters--or fail to do so. With respect to disaster preparedness, Quarantelli and his associates (Quarantelli, et al. 1979; Gabor, 1981) studied planning for chemical emergencies among both governmental agencies and chemical companies in 18 U. S. communities. The passage of the Superfund Amendment and Reauthorization Act in 1986 mandated the creation of local emergency planning committees (LEPCs) nationwide to (among other things) prepare for and respond to hazardous chemical releases; researchers have begun studying both their organizational characteristics and their effectiveness (Solyst and St. Amand, 1991; 1993; Lindell, 1994). A recent issue of Disaster

Preparedness and Management (1995) summarized a new study that found major firms in the United Kingdom generally unprepared for disasters.² Drabek (1991; 1994a; 1994b) has systematically investigated emergency planning (particularly evacuation planning) among tourism-oriented firms such as hotels, resorts, and restaurants.

Mileti, et al. (1993) studied the adoption of earthquake preparedness measures among a sample of 54 businesses in eight San Francisco Bay Area counties as part of a larger study on how the communication of earthquake risk information affects preparedness behavior. Barlow (1993) described the ways in which 20 business firms in the St. Louis area reacted to the false earthquake "projection" made by Iben Browning in 1990. Dahlhamer and D'Souza (forthcoming, 1996), using large, randomly-selected samples, documented the extent to which businesses in two U. S. cities (Memphis and Des Moines) have engaged in preparedness activities and tested a model explaining differential levels of preparedness among businesses.

Turning next to the emergency response period, very few studies in the social science literature have focused on the response of private-sector entities in disaster situations. However, Mitroff and his colleagues have done a considerable amount

² For example, three-quarters of those firms indicated that they would be unable to continue performing key functions if a disaster were to occur, and almost two-thirds had no backup system for protecting vital records. The companies surveyed were "Times Top 100" firms, and the article notes that the state of disaster preparedness among smaller companies is probably even worse.

of empirical work on the origins and management of crises in organizations (see Mitroff, Pauchant, and Shrivastava, 1988; Mitroff, et al., 1989; Mitroff and Pearson, 1993). Clarke (1990; 1993) has studied the Exxon oil spill to better understand why organizations fail to plan adequately and respond effectively to major crisis events, and Shrivastava (1986) has analyzed the societal and organizational sources of the Bhopal tragedy.

With respect to how disasters affect businesses in the short- and long-term, studies on the actual and potential economic impacts of disasters generally calculate effects at large levels of aggregation, such as regional or national economies, using general economic modeling approaches such as input-output analysis and social accounting (see Kawashima and Kanoh, 1990; Boisvert, 1992; Cole and Razak, 1992; Cochrane, 1992; Rose and Benavides, 1993). While useful for understanding large-scale economic effects, such research does not address disasters effects on individual firms.³ (For an extensive review of this literature, see Jones and Chang, 1995).

To date, studies focusing specifically on business-level effects have been rather narrow in scope. Durkin (1984) studied small businesses that were affected by the 1983 Coalinga earthquake in order to identify factors that facilitated or impeded recovery. He found the businesses that had the most difficulty recovering

³ These studies also tend to be limited in the kinds of impacts they consider, focusing, for example, only on losses due to lifeline service interruption or only on indirect economic effects.

were those that were marginal or already in financial difficulty at the time of the earthquake; that leased rather than owned their business properties; that lost expensive inventories; and that were heavily dependent on foot traffic but were forced to relocate due to earthquake damage.

Kroll et al. (1991) analyzed the short-term impacts of the Loma Prieta earthquake on businesses in Oakland and Santa Cruz. They found that while business disruption and building damage were correlated, businesses also suffered losses because of damage to the transportation system, damage to inventories, problems with customer and employee access, and shipping delays. Businesses in the trade and service sectors were most vulnerable to disruption, and smaller firms suffered proportionately greater losses in the earthquake than larger ones. Business improved for some firms, such as those involved with construction, indicating that in addition to generating losses earthquakes and other disasters can boost activity in some sectors of the economy.

Other studies have focused more specifically on the Small Business Administration's disaster loan program, the principal source of Federal assistance for disaster-stricken businesses. French et al. (1984), in their study of short-term community recovery following the Coalinga earthquake, found the slowness with which loans were processed and the interest rates charged created dissatisfaction among business applicants. Dahlhamer (1992) studied SBA loan decision-making for business applicants from four communities that were affected by the 1987 Whittier Narrows

earthquake. He found that loan outcomes (both rates of approval and the interest rates charged) were influenced by such factors as proprietor age and ethnicity, the community in which the business was located, and the financial health of the business. Among his conclusions were that the businesses that experience the best outcomes in the governmental disaster loan application process are those that would also find it relatively easy to qualify for loans in the commercial sector.

Gordon and Richardson's analysis (1995) of the business interruption effects of the Northridge earthquake is the study that most closely resembles the research presented in this paper. That project involved telephone interviews with a sample of 389 firms at 504 sites; the sample was stratified by location and economic sector. The topics covered in the telephone interview included physical damage to business properties, including damage to building contents; business interruption, including both complete business closure and periods during which businesses operated at less-than-normal capacity; typical employee commuting patterns and earthquake-induced changes in those patterns; and how the earthquake affected business shipping and receiving activities. Survey results were used with the Southern California Planning Model to estimate employment and business output effects.

The Gordon and Richardson study found that 80% of the businesses in their sample experienced some degree of earthquake-related business interruption. The estimated aggregate business losses (i.e., job losses and reductions in dollar outputs) were

just under \$6 billion. About one-third of these losses were directly felt in the impact region; intraregional job losses were felt most by businesses in the retail trade, health services, and finance, insurance, and real estate sectors. By their estimate, business interruption losses accounted for approximately 23% of the total losses resulting from the earthquake.

Earlier, these same researchers had conducted a study to estimate the business interruption effects of a magnitude 6.8 earthquake occurring on the Newport-Inglewood Fault (Gordon and Richardson, 1992). The actual Northridge business interruption effects were significantly lower than those estimates--about 18% of their projections for lost output and approximately 29% of estimated job losses for the hypothetical Newport-Inglewood event.⁴

Disaster Research Center Studies on Businesses and Disasters

Prior to the research discussed here, DRC conducted a survey on hazard awareness, perceived vulnerability to earthquake-induced lifeline service interruption, and disaster preparedness among the proprietors of a representative sample of 737 businesses in Memphis, Tennessee, a community that is at risk from earthquakes that could occur in the New Madrid Fault Zone. The survey found that owners considered electricity the most important utility service for their businesses; a high proportion indicated they

⁴ In discussing the differences between the projected Newport-Inglewood losses and those resulting from the Northridge event, the authors point to the fact that the areas that would be most severely impacted by a Newport-Inglewood earthquake are much more heavily industrialized than those affected by the Northridge temblor.

would have to close immediately if they were to lose electrical power in a disaster situation. Business owners were moderately aware of the earthquake problem in the New Madrid region, with just over half stating they believed a damaging earthquake was likely in the region within the next ten years. Businesses had engaged in disaster preparedness activities, but only to a very modest degree; of 17 different disaster preparedness measures asked about in the survey, the average number actually undertaken by businesses in the sample was 4. The actions most likely to be taken were obtaining first aid kits, learning first aid, and attending meetings or obtaining written material on earthquake preparedness. The Memphis survey was conducted in July, 1993, and it is likely that many of these preparations were stimulated by the 1990 Browning earthquake prediction scare (for other reports on the Memphis study, see Nigg, 1995; Tierney and Nigg, 1995; and Dahlhamer and D'Souza, forthcoming).

The Memphis business study focused on a projected rather than an actual disaster event. In contrast, the study results summarized here concern the actual business impacts that resulted from two of the most damaging disasters in U. S. history, the Midwest floods of 1993 and the 1994 Northridge earthquake. The floods that struck the heartland of the U. S. during the summer of 1993 killed 48 people and resulted in direct damages totaling an estimated \$20 billion. A total of 525 counties in nine states, including all 99 counties in Iowa, were covered by Federal disaster declarations (NOAA, 1994). Des Moines, Iowa's state capital, was

chosen as the site for the Midwest flood business survey because it was extensively damaged and disrupted by the flooding. In July of 1993, floodwaters inundated the Des Moines Water Works, leaving 300,000 residents without potable water. Electrical power stations were flooded, resulting in power outages that affected 35,000 households and the entire downtown business district. The New York Times (July 18, 1993) labeled Des Moines the hardest-hit city in the flood zone because of the extent and duration of the flooding and the degree to which lifeline services and community activities were disrupted.

The Northridge earthquake currently ranks as the nation's most costly natural disaster. The earthquake, which killed 57 people and injured over 10,000 in the three-county impact region, resulted in an estimated \$30 billion in losses, including \$12-13 billion in insured losses. The number of earthquake-related claims filed by disaster victims and the amounts disbursed through various assistance programs are the largest ever for a U. S. disaster. More than half a million households applied for Federal housing assistance following the earthquake, and approximately 200,000 households and more than 50,000 businesses have applied to the Small Business Administration for loans to cover earthquake-related losses. The cities in which the Northridge earthquake survey was conducted, Los Angeles and Santa Monica, both experienced extensive business damage; the city of Los Angeles accounts for the overwhelming majority of the losses sustained in the earthquake.

Survey Methodology

The Des Moines and Northridge business surveys used almost identical methodological approaches. Both involved mail questionnaires just over twenty pages in length. In Des Moines, a two-stage stratified sampling method was used to select businesses; the stratifying variables were business type and size. Businesses were aggregated by Standard Industrial Codes into five major sectors: wholesale and retail sales; manufacturing, construction, and contracting; business and professional services; finance, insurance, and real estate; and "other" businesses, which included firms involved in agriculture, forestry and fishing, mining, transportation, communications, and utilities. In the second stage of sampling, businesses were randomly selected from among small (fewer than twenty employees) and large (twenty or more employees) firms in each sector. The Northridge sample was stratified by SIC sector, size, and Modified Mercalli shaking intensity (MMI).⁵ Included in the sample were businesses from the cities of Santa Monica and Los Angeles; for the analysis presented here, those two community samples were combined.⁶

The data were collected using a modified version of Dillman's (1978) "total design method," an approach that is widely used in

⁵ The MMIs in the study area ranged from 6 to 9. For purposes of stratifying the sample, zip codes in which the highest recorded shaking intensities were 6 and 7 were considered areas of low shaking, while those with recorded intensities of 8 and 9 were defined as high shaking areas. MMI data were provided by the Governor's Office of Emergency Services and EQE, Inc.

⁶ Even though this paper occasionally refers to the Northridge earthquake study as the Los Angeles survey, the results presented here are based on data from both Los Angeles and Santa Monica businesses.

mail survey research and that consists of a scheduled series of questionnaire mailings, postcard reminders, and telephone calls. Based on DRC's earlier experience with mail surveys, the initial mailing of questionnaires was followed up by telephone calls to business owners after a reasonable amount of time for questionnaire completion has passed, and postcards and second reminder mailings were eliminated.⁷ Mailings for the Des Moines survey began in March, 1994, approximately nine months after the Midwest floods. The Northridge survey was begun in May, 1995, sixteen months after the earthquake. The initial sample sizes were 2,164 for Des Moines and 4,752 for the Northridge survey, which included both Los Angeles and Santa Monica businesses. Of the Des Moines businesses initially contacted, 1,079, or approximately 50%, returned the questionnaires. The Los Angeles data set consists of 1,110 cases, representing a response rate of just over 23%.⁸

⁷ In both surveys a substantial number of business owners contacted by phone indicated that they had not received the first mailing or had not bothered to fill it out. They were encouraged to participate in the study, and a second copy of the questionnaire was mailed to them.

⁸ The Los Angeles mail survey presented a number of distinctive challenges, including difficulties with obtaining accurate and complete addresses, language barriers, and general lack of business owner receptivity. Spanish- and Korean-speaking telephone workers were used in cases where language problems were encountered, and a Korean-language version of the questionnaire was produced and mailed to business owners who requested it. Non-responses may also have been due to business relocation out of the impact area or business failures. A preliminary analysis by zip code and MMI intensity does indicate, however, that response rates were virtually identical for high (MMI 8 and above) and lower shaking intensity areas. Further analyses are planned to thoroughly assess the representativeness of the Northridge sample.

Although the two studies involved different disaster agents, the mail surveys had the same general format and contained questions on the same set of topics. The instruments differed slightly in the amount of attention paid to certain topics; for example, the Des Moines survey asked more detailed questions about business lifeline use during normal (i.e., non-disaster times) than the Northridge survey. In many cases, questions were directly comparable across the two survey instruments; in other cases, questions were worded slightly differently but items were still roughly equivalent. The following areas were covered in both surveys: (1) business characteristics, including age of the business, length of time under current ownership, whether the firm owns or leases the business property, the construction type and age of the building in which the business is located, and the current number of employees; (2) the nature of the physical damage to the business, e.g., whether there was structural damage and whether the building housing the business was declared unsafe; (3) the extent and duration of disaster-induced lifeline (electricity, phone, water, natural gas, and wastewater treatment) service interruptions; (4) business closure, including the reasons why businesses closed and estimates of the cost of business closure; (5) business relocation, including why the business was forced to move, whether the move to the new location was temporary or permanent, and proprietors' satisfaction with the move; (6) use of and satisfaction with insurance and disaster assistance programs, including the SBA disaster loan program; (7) disaster preparedness

the Northridge sample; evidently, the businesses classified as "small" were actually quite small in both our samples. In both communities, the median number of employees tends to be highest for firms in the manufacturing and construction sectors and smallest for service-related businesses.⁹ Firm size, as measured by FTE, appears to have fluctuated moderately since the two disasters occurred. Des Moines and Los Angeles had almost identical proportions of businesses--just under 70%--that stated they were currently employing the same number of workers as when the disaster occurred. However, about 16% of Los Angeles businesses and 11% of those in Des Moines indicated they had fewer employees at the time the surveys were conducted than when the disaster struck.¹⁰

Whether the space a business occupies is owned or leased by the business is likely to be an important factor not only in the size of the disaster losses sustained but also in the owner's ability to obtain loans and generally control the repair and reconstruction process. The survey results reveal interesting patterns of property ownership. As indicated in Table 2, Los Angeles businesses were much more likely to be leasing space than their Des Moines counterparts--about 72%, as compared with 55%. In both samples, rates of non-building ownership tend to be highest

⁹ The range on this item was quite extensive; both the Des Moines and Northridge surveys included not only small businesses but also firms that are very large, with several thousand employees.

¹⁰ These measures of size, which were taken at a single point in time, do not take into account fluctuations in the number of employees that may have taken place between disaster impact and the time the surveys were conducted.

for smaller companies, particularly those in the wholesale and retail trade, service, and "other" categories, although in Los Angeles it appears that larger businesses in the finance, insurance, and real estate (F.I.R.E.) sector also have a marked tendency to lease rather than own their business properties.

The majority of businesses in both samples were individual proprietorships, rather than franchises or members of a chain, although rates of individual ownership were slightly higher for Los Angeles (74%) than for Des Moines (66%). At the time the surveys were conducted, fifty-five percent of Des Moines businesses and 43% of Los Angeles businesses had been operating under their current owners for ten years or less. The median age of businesses--that is, the total number of years in operation--was 15 years for the Los Angeles sample and 20 years in Des Moines.

Physical Damage

The direct physical damage caused by the flooding in Des Moines was not widespread. Just under 15% of Des Moines businesses were flooded in the summer of 1993, with both large and small manufacturing and construction firms and large companies in the F.I.R.E. sector reporting the highest rates of flooding (see Table 3). Most frequently reported were damage to the interior of the business property (69% of the businesses), to inventory or stock (63%), and to furniture and equipment (58 and 63%, respectively). One-fourth of the flooded businesses reported that the flooding caused structural damage to their buildings; however, in only a handful of cases was the damage so severe that the buildings were

declared unsafe.

Although relatively few businesses were directly damaged by flooding, the losses were very high for those businesses. The median dollar loss due to flooding was \$50,000, with large businesses in the "other" category and large manufacturing and construction firms reporting the most costly damage (see Table 4).

In contrast, approximately 57% of Los Angeles businesses reported experiencing some type of direct physical damage from the earthquake (see Table 5). Of those businesses that sustained damage, the most common type of damage reported was non-structural (68% of those reporting damage), followed by damage to furnishings (56%), equipment (52%), and inventory or stock (50%). Of those with damage, 39% indicated the damage was structural,¹¹ and in just under 15% of the cases the building was found to be unsafe by inspectors, i. e., either red- or yellow-tagged. Businesses in the F.I.R.E sector were more likely than those in the other four sectors to indicate their properties had been declared unsafe. Twenty-one businesses in the sample, or about 2% of the total, were in buildings that were red-tagged following the earthquake.¹² The median dollar losses due to earthquake damage were low compared with the flood losses in Des Moines--about \$5,000 for the sample as

¹¹ Such reports may not be entirely accurate, since it is difficult for those without specialized training to tell whether an earthquake has damaged a building structurally. Business proprietors who also owned the buildings in which their businesses were housed probably had more accurate information about structural damage than those who were leasing space.

¹² Five business properties had been inspected more than once and given red and yellow tags at different times.

a whole. The largest median dollar losses were reported by large manufacturing and construction firms and large firms in the F.I.R.E. sector (see Table 6).¹³

Lifeline Service Interruption

The main impact the Midwest floods had on Des Moines was the disruption of lifeline services, particularly water. As Table 7 shows, around 80% of all Des Moines businesses were without water as a result of the flooding, 40% lost sewer and wastewater treatment service, one-third lost electricity, and just over 20% lost phones. Water, sewage, and gas services were interrupted for a longer period of time than were electric and phone service systems, about twelve days on the average, compared with two days for electricity and phones (see Table 8).

In Los Angeles, loss of electricity and phones were the most common lifeline impacts, reported by 61% and 54% of businesses, respectively. Additionally, nearly one-fifth of the sample reported losing either water or natural gas as a result of the earthquake, and about 4% lost sewer services (Table 9). Although phones and electricity were most likely to have been disrupted by the earthquake, they were also restored relatively quickly,

¹³ These relatively low median dollar losses for physical damage probably reflect several factors. First, minor damage, which was likely not very costly, was very widespread. Second, like the business population as a whole, a large proportion of the businesses in the sample were quite small and thus probably didn't have a great deal of valuable inventory on hand. As noted earlier, nearly three-quarters of the businesses in the survey leased rather than owned their business properties. Some businesses in the sample reported very high physical losses; the highest reported was \$14,000,000.

typically within twenty-four hours. Median restoration times for water and natural gas were about two days; restoring sewage services took an additional day for those businesses that were affected (Table 10).

The property damage and lifeline data indicate that the two disasters produced significantly different physical impacts. In Des Moines, flooding was confined to a relatively small number of businesses, but lifeline service interruption--particularly loss of water and sewer services--was both widespread and lengthy in duration. In Los Angeles, a much higher proportion of businesses reported physical damage; those that experienced lifeline service interruption were most likely to lose electricity and phones, but those services were resumed rather quickly following the earthquake.

Business Closure and Relocation

Both the floods and the earthquake forced a large number of businesses to shut down. In Des Moines, 42% of the businesses surveyed reported that they had to close for at least some period of time. Rates of closure were particularly high for large businesses categorized as "other"--a classification that includes both farming enterprises and utilities--both small and large manufacturing and construction firms, and large businesses in the service sector (see Table 11).

The median length of time businesses in Des Moines were forced to cease operations was four days. However, the range was considerable, with business interruption extending an average of 5

days for both small and large businesses in the service sector and as long as ten days for small enterprises grouped in the "other" category.

Asked to indicate why their businesses had to close, proprietors most frequently cited loss of water (mentioned by approximately 64% of those whose businesses closed), loss of electricity (about 42%), loss of sewer or wastewater services (35%), and loss of customers (34%). Other common reasons for business closure included loss of phones, the inability of workers to reach the business to report for work, and the inability of the business to deliver products or services (Table 12). The most important factors forcing businesses to close were loss of water, flooding of the business property, and loss of electricity.

In the Northridge sample, approximately 56% of the businesses surveyed closed for some period of time as a result of the earthquake. In general, small businesses appear to have been more likely to close than large ones. The one exception is large firms in the F.I.R.E. sector, 63% of which had to shut down for at least some period of time (Table 13).

On average, businesses in the Northridge sample were closed for a shorter time than those in Des Moines--about 2 days. The duration of business interruption appears to have been roughly comparable across sectors, except for small service-related businesses; the median length of time these businesses were closed

was three days.¹⁴

The reasons given for business interruption resembled those in Des Moines in some ways and differed in others. In the Northridge sample, the most common reason for closing was the need to clean up damage at the business, cited by about two-thirds of the owners whose businesses closed. Also significant were the loss of electricity (about 59%), the inability of employees to come to work (56%), loss of telephone service (50%), and damage at owners' homes that took precedence over damage at the business (44%). Other frequently-mentioned reasons for closing were loss of customers, the need to shut down while the business underwent structural damage assessment, the inability to deliver products or services, and loss of machinery and office equipment (Table 14). Asked to choose the most significant among their various reasons for closing, owners cited the need to clean up damage, the loss of electricity, an insufficient number of employees to operate the business, and the need to have the building structurally assessed. The median dollar loss due to business closure was \$5,000 (see Table 15). Losses were highest for large manufacturing and construction and large F.I.R.E. firms.¹⁵

Just under 8% of the businesses in the Des Moines sample were forced to relocate as a result of the floods. For the overwhelming

¹⁴ Of the 583 businesses in the Northridge sample that closed, two never reopened.

¹⁵ As was the case with physical damage, the range on this question was quite broad. Many businesses lost only a few thousand dollars, but there were businesses that reported losses due to business interruption of well over \$1 million.

majority (88%) of those businesses, the move was only temporary. About 5% of the businesses in the Northridge survey had to relocate due to the earthquake, and for two-thirds of those businesses the move was temporary rather than permanent.

Insurance and Other Forms of Business Recovery Assistance

Both the Des Moines and Northridge surveys contained a number of items on business insurance coverage and other types of assistance businesses could have used to obtain resources to assist with recovery. Table 16 compares rates of hazard insurance coverage for small and large businesses in the two communities. In Des Moines, just under 8% of the businesses surveyed had flood insurance at the time of the 1993 floods. Large businesses were significantly more likely to have such insurance than small ones. The data reveal few sectoral variations, except that large F.I.R.E. and manufacturing firms were much more likely than other businesses to have flood insurance coverage. About 20% of Los Angeles businesses had earthquake insurance; as in Des Moines, large firms, particularly those in the F.I.R.E. and manufacturing sectors, were most likely to be covered. Rates of business interruption insurance coverage were comparable for the two samples--18% overall for Des Moines and 24% for Los Angeles. Again, it was large companies that were most likely to have this type of coverage (see Table 17).

In Des Moines, we asked whether businesses had used or tried to use various funding sources and other types of assistance, such as insurance, SBA loans, other government loans, bank loans,

private-sector and local government assistance programs, personal savings, help from a parent organization (for chains and franchises), and aid from family members and friends, in order to recover from flood-related damage and disruption. Interestingly, only 22% of the businesses in the sample had used or tried to use any of these resources. Those that did were most likely to have used or tried to use insurance, their own personal savings, or SBA loan assistance; however, each of these three sources were only used by approximately 10% of the sample. Clearly, a significant proportion of flood-related losses were simply absorbed by business owners.

The Northridge survey contained more detailed questions about the use of insurance and disaster assistance programs. As noted above, 20% of the businesses in the sample were insured for earthquake damage at the time of the earthquake. Of those that had insurance, 27% filed a claim. Of the remainder, some didn't file because they didn't have damage; others believed their damage wouldn't be covered or decided not to file for other reasons. Of the relatively small number that filed insurance claims (59 businesses in all) about half had received full payment on their claims at the time the survey was conducted. However, even for those that had been or were expecting to be reimbursed for their losses, the median estimate on the proportion of the total earthquake-related losses covered by insurance was about 50%. Nevertheless, most owners who used insurance were satisfied with the services they received.

One hundred nineteen businesses, or about 11% of the total sample, applied for SBA loan assistance for their business losses.¹⁶ Of this number, about half had received all or part of the loan amounts requested at the time of the survey, although a proportion of those did not get all the money they had requested and a small number (about 5%) decided not to use the loan funds that had been approved. About 30% of those who had applied for loans were turned down by the SBA, and 10% of the loans were still pending at the time the survey was conducted. For the businesses that had received SBA loan assistance, the median percentage of business losses covered was about 50%. All those who had applied to the SBA were asked how satisfied they were with the services they received; the sample was about equally split between those who were satisfied and those who were dissatisfied with the loan program.

As in the Des Moines survey, we asked whether respondents used or tried to use other types of recovery assistance, such as state or local government loans, private bank loans, assistance from friends or family, personal savings, help from a parent organization, and help from business associations. Only 26% of business owners had used or attempted to use any of these types of aid, and by far the most frequently cited source of recovery funds was personal savings, used by 17% of the businesses in the sample.

It appears that in Los Angeles, as in Des Moines, the most common ways that business owners coped with their losses was to

¹⁶ This figure combines those applying for physical disaster, economic injury, and both types of SBA Loans.

absorb them or use personal savings to cover them. Although more than half of the businesses surveyed experienced some degree of earthquake-related damage, a relatively small number used insurance, SBA loans, or other sources of aid to recoup what they had lost. And even when these sources of assistance were used, the proportion of losses actually covered was only moderate.

Extent of Business Recovery

One of the key questions social science researchers seek to answer is the extent to which social units affected by disasters are able to recover. In general there has not been much research on disaster recovery processes and outcomes, and what has been done has focused primarily on households (see, for example, Bolin, 1982 and Bolin and Bolton, 1986)) and secondarily on communities (see Wright, et al. 1979; Rubin, Saperstein, and Barbee, 1985; Bates, 1982). Previous research on the long-term economic consequences of disasters (see, for example, Friesema, et al., 1979 and Rossi et al., 1983) measured post-disaster economic well-being by focusing on aggregate community effects, rather than on victimized businesses. There has been virtually no systematic social science research that looks at how individual businesses cope with the recovery process and what, if any, long-term consequences result from disaster victimization.

In both the Des Moines and Northridge surveys, we made an effort to obtain proprietors' assessments of business health at the time the survey was conducted, asking whether the business was worse off than just before the disaster struck, about the same as

it had been, or better off. Those results are summarized in Tables 18 and 19. In Des Moines (Table 18), 70% of the businesses surveyed indicated they were doing about the same as they had been just prior to the flooding. About 18% reported being better off, and 12% reported being worse off than before the flood. In Los Angeles, 52% of the businesses surveyed rated their well-being as comparable to what it had been before the earthquake. The remaining businesses were about evenly split between those that were worse off and those that were better off than before the earthquake. Large businesses in the "other" category were most likely to report being better off; small businesses, particularly those in the F.I.R.E. sector, were more likely than their larger counterparts to report being worse off since the earthquake (see Table 19).

The reasons given for business improvement were similar in the two communities. While many Des Moines owners pointed to overall improvements in the economy as factors in recovery, other respondents explicitly stated that the flooding had helped their businesses. The most common reason given for business improvement in Los Angeles was the stimulus provided by the earthquake itself, but many respondents also pointed to the upturn in the economy as a key factor.

Some preliminary bivariate analyses have been conducted to identify factors associated with business decline. In Des Moines, so few businesses were worse off that no clear patterns could be determined. However, in Los Angeles, both sector and size appear

to be related to how businesses fared after the earthquake; those in the wholesale and retail trade and service sectors, small businesses in general, and those that had been physically damaged were more likely than other businesses to report being worse off.

Conclusions

Other analyses using the Des Moines and Los Angeles data sets, including GIS-based analyses, are either ongoing or planned. DRC is also planning a follow-up study on a subsample of the businesses that were included in the Los Angeles survey, involving face-to-face interviews with approximately 100 business owners, to obtain more detailed information on the recovery process. However, it is possible to draw tentative conclusions even from the initial descriptive data reported here.

1. The two disasters had very different impact patterns. In Los Angeles, physical earthquake damage was quite widespread, affecting well over half the businesses in the sample. In contrast, in Des Moines, physical flooding was confined to a relatively small segment of the business community, but lifeline service interruption was very extensive, with water loss affecting eight out of ten businesses.

2. The disruption of lifeline services was a key factor in business interruption in both disaster events; loss of electricity in particular was mentioned by respondents in both cities as among the most important factors curtailing their operations. Hazard mitigation and disaster preparedness programs tend to emphasize the need to prevent and deal with direct physical damage. However, the

Des Moines data in particular show that business properties may escape direct damage and yet suffer extensive disruption as a result of lifeline service outages. More attention should be paid to preparing for and responding to "lifeline disasters."

3. Other factors besides direct physical damage and lifeline service interruptions also contributed to business interruption in the two disasters. Key among these were disruption in the flow of materials into and out of the business and the loss of customers. In addition to being concerned about disaster impacts to the business property itself, business owners must also take into account sources of business interruption that originate off-site, such as transportation system disruption.

4. Relatively few Des Moines and Los Angeles businesses had either hazard insurance or business interruption insurance to cover their losses. Large businesses were more likely to carry such coverage than smaller ones. Of those that did have insurance, a minority actually used it, and generally only a portion of their losses were covered. Our surveys did not examine in detail the reasons for non-utilization of insurance coverage, but this topic clearly merits further investigation.

5. The business owners surveyed also showed a tendency not to use Federal disaster loan assistance and other formally-designated sources of recovery aid. When such sources were used, they typically covered only a portion of the losses the business sustained. As with insurance, the Des Moines and Northridge studies raise questions about why more businesses didn't use such

programs. Reasons for non-utilization could include lack of awareness of various assistance programs, reluctance to incur additional debt, difficulties with providing the needed documentation, belief in the value of self-reliance and independence, or other factors.

6. Following the floods and the earthquake, business owners generally used their personal savings to offset their losses. It thus appears that one of the significant short-term effects of disasters is to drain profits and divert resources that could otherwise be used to finance business expansion.

7. The survey data indicate that disasters have disparate rather than uniform effects on businesses. Consistent with what other researchers have argued (see for example, Alesch et al., 1993), the Los Angeles data in particular suggest that small businesses are especially vulnerable to disaster-related losses and disruption. The two surveys also revealed evidence of sectoral differences in levels of physical damage, lifeline impacts, and rates and duration of business interruption. More research is needed to explore the reasons for these varying levels of vulnerability.

ACKNOWLEDGMENTS

Support for the Des Moines survey was provided by the National Science Foundation, SGER Grant No. 9425810001. Joanne M. Nigg is Co-Principal Investigator with the author on that project. Support for the Northridge Survey was provided by the National Center for Earthquake Engineering Research, Grant No. 93-6303. Neither funder is responsible for the findings and conclusions contained in this paper. Many thanks to James Dahlhamer, Nicole Dash, Lisa Reshaur, and Gary Webb for assistance with the analyses reported here.

REFERENCES

- Alesch, D. J., C. Taylor, A. S. Ghanty, and R. A. Nagy. 1993. "Earthquake Risk Reduction and Small Business." In K. J. Tierney and J. M. Nigg (Eds.) Socioeconomic Impacts. Monograph prepared for the 1993 National Earthquake Conference. Memphis, TN: Central U. S. Earthquake Consortium.
- Barlow, H. D. 1993. "Safety Officer Accounts of Earthquake Preparedness at Riverside Industrial Sites." International Journal of Mass Emergencies and Disasters 11: 421-435.
- Bates, F. L. 1982. Recovery, Change, and Development: A Longitudinal Study of the 1976 Guatemalan Earthquake. Athens, GA: Department of Sociology, University of Georgia.
- Boisvert, R. 1992. "Indirect Losses from a Catastrophic Earthquake and the Local, Regional, and National Interest." In Indirect Economic Consequences of a Catastrophic Earthquake. Report to Congress. Washington, D. C.: National Earthquake Hazards Reduction Program, Federal Emergency Management Agency.
- Bolin, R. C. 1982. Long-Term Family Recovery From Disaster. Boulder, CO: Institute of Behavioral Science, University of Colorado.
- Bolin, R. C. and P. Bolton. 1986. Race, Religion, and Ethnicity in Disaster Recovery. Boulder, CO: Institute of Behavioral Science, University of Colorado.
- Clarke, L. 1990. "Oil Spill Fantasies." Atlantic Monthly, November: 65-77.
- Clarke, L. 1993. "The Disqualification Heuristic: When Do Organizations Misperceive Risk?" Research in Social Problems and Public Policy 5: 289-312.
- Cochrane, H. 1992. "Overview of Economic Research on Earthquake Consequences." In The Economic Consequences of a Catastrophic Earthquake. Washington, D. C.: National Academy Press.
- Cole, S. and V. Razak. 1992. Social Accounting for Disaster Preparedness and Planning: An Application to Aruba. Buffalo, NY: National Center for Earthquake Engineering Research, State University of New York at Buffalo. NCEER Report No. 93-002.
- Dahlhamer, J.M. 1992. Small Business and the Whittier Narrows Earthquake: Loan Request Outcomes in the U.S. Small Business Administration Disaster Loan Program for Businesses. Master's Thesis. Department of Sociology, University of Delaware.
- Dahlhamer, J. M. and M. J. D'Souza. Forthcoming, 1996.

"Determinants of Business Disaster Preparedness in Two U. S. Metropolitan Areas." International Journal of Mass Emergencies and Disasters. Available from the Disaster Research Center, University of Delaware, Newark, DE.

Dillman, D. 1978. Mail and Telephone Surveys: The Total Design Method. New York: Wiley.

Disaster Preparedness and Management, no author. 1995. "Britain's Top Firms Unprepared for Disasters." Disaster Preparedness and Management 4: 38-39.

Drabek, T. E. 1991. "Anticipating Organizational Evacuations: Disaster Planning by Managers of Tourist-Oriented Private Firms." International Journal of Mass Emergencies and Disasters 9: 219-245.

Drabek, T. E. 1994a. "New Study Shows that Growing Tourist Industry Is Inadequately Prepared for Emergencies." Hazard Technology 14: 17, 21.

Drabek, T. E. 1994b. Disaster Evacuation and the Tourist Industry. Boulder, CO: Institute of Behavioral Science, University of Colorado.

Durkin, M. E. 1984. "The Economic Recovery of Small Businesses After Earthquakes: The Coalinga Experience." Paper presented at the International Conference on Natural Hazards Mitigation Research and Practice, New Delhi, October 6-8.

Dynes, R. R. 1970. Organized Behavior in Disaster. Lexington, MA: D. C. Heath.

French, S. P., C. A. Ewing and M. S. Isaacson. 1984. Restoration and Recovery Following the Coalinga Earthquake of May, 1983. Working Paper #50. Boulder, CO: Institute for Behavioral Science, University of Colorado.

Friesema, H. P., J. Caporano, G. Goldstein, R. Linberry, and R. McCleary. 1979. Aftermath: Communities After Natural Disasters. Thousand Oaks, CA: Sage Publications.

Gabor, T. 1981. "Mutual Aid Systems in the United States for Chemical Emergencies." Journal of Hazardous Materials 4: 343-356.

Gordon, P. and H. W. Richardson. 1992. Executive Summary: Business Interruption Effects of a Major Earthquake in the Newport/Inglewood Fault Zone (NIFZ). Los Angeles: Planning Institute, School of Urban and Regional Planning, University of Southern California.

Gordon, P. and H. W. Richardson, with B. Davis, C. Steins, and A. Vasishth. 1995. The Business Interruption Effects of the

Northridge Earthquake. Final report to the National Science Foundation. Los Angeles: Lusk Center Research Institute, School of Urban and Regional Planning, University of Southern California.

Harrald, J. R., R. Cohn, and W. A. Wallace. 1992. "We Were Always Reorganizing...": Some Crisis Management Implications of the Exxon Valdez Oil Spill." *Industrial Crisis Quarterly* 6: 197-217.

Jones, B. G. and S. E. Chang. 1995 "Economic Aspects of Urban Vulnerability and Disaster Mitigation." Ithaca, NY: Department of City and Regional Planning, Cornell University.

Kawashima, K. and T. Kanoh. 1990. "Evaluation of Indirect Damages Caused by the 1983 Nihonkai-Chubu, Japan Earthquake." Proceedings of the Fourth International Research and Training Seminar on Regional Development Planning for Disaster Prevention, Nagoya, Japan, October 4-5.

Kroll, C. A., J. D. Landis, Q. Shen, and S. Stryker. 1991. "Economic Impacts of the Loma Prieta Earthquake: A Focus on Small Business." Berkeley, CA: University of California at Berkeley, University of California Transportation Center and the Center for Real Estate and Economics. Working Paper No. 91-187.

La Porte, T. R. and P. M. Consolini. 1991. "Working in Practice But Not in Theory: Theoretical Challenges of High-Reliability Organizations." *Journal of Public Administration Research and Theory* 1: 19-47.

La Porte, T. R. and G. Rochlin. 1994. "A Rejoinder to Perrow." *Journal of Contingencies and Crisis Management* 2: 221-227.

Lindell, M. K. 1994. "Are Local Emergency Planning Committees Effective in Developing Community Disaster Preparedness?" *International Journal of Mass Emergencies and Disasters* 12: 159-182.

Mileti, D. S., J. E. Haas and T. E. Drabek. 1975. *Human Systems in Extreme Environments: A Sociological Perspective*. Boulder, CO: Institute of Behavioral Science, University of Colorado.

Mileti, D. S., J. D. Darlington, C. Fitzpatrick, and P. W. O'Brien. 1993. *Communicating Earthquake Risk: Societal Response to Revised Probabilities in the Bay Area*. Boulder, CO: Natural Hazards Research and Applications Information Center, University of Colorado.

Mitroff, I. I. and C. M. Pearson. 1993. *Coping With the Unthinkable*. New York: Jossey-Bass.

Mitroff, I., T. Pauchant, and P. Shrivastava. 1988. "The Structure of Man-Made Organizational Crisis: Conceptual and

Empirical Issues in the Development of a General Theory of Crisis Management." *Technological Forecasting and Social Change* 33: 83-107.

Mitroff, I. I., T. Pauchant, M. Finney, and C. Pearson. 1989. "Do (Some) Organizations Cause Their Own Crises? Cultural Profiles of Crisis Prone Versus Crisis Prepared Organizations." *Industrial Crisis Quarterly*, 3: 269-283.

Myers, K. N. 1993. *Total Contingency Planning for Disasters*. New York: John Wiley and Sons.

National Oceanic and Atmospheric Administration. 1994. *Natural Disaster Survey Report: The Great Flood of 1993*. Washington, D. C.: U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration.

New York Times. 1993. "Clinton Tours Floods and Considers Sending Troops." July 18: 1; 22.

Nigg, J. M. 1995. "Business Disruption Due to Earthquake-Induced Lifeline Interruption." Paper presented at the Sino-U. S. Symposium/Workshop on Post-Earthquake Rehabilitation and Reconstruction, Kunming, Yunnan, People's Republic of China, May 24-26, 1995.

Perrow, C. 1984. *Normal Accidents: Living With High-Risk Technologies*. New York: Basic Books.

Quarantelli, E. L., C. Lawrence, K. J. Tierney, and T. Johnson. 1979. "Initial Findings from a Study of Sociobehavioral Preparations and Planning for Acute Chemical Hazard Disasters." *Journal of Hazardous Materials* 3: 79-90.

Roberts, K. H. 1989. "New Challenges in Organizational Research: High-Reliability Organizations." *Industrial Crisis Quarterly* 3: 111-125.

Rose, A. and J. Benavides. 1993. "Interindustry Models for Analyzing the Economic Impacts of Earthquakes and Recovery Policies." Paper presented at the 40th North American meetings of the Regional Science Association International, Houston, TX, Nov. 11-14.

Rossi, P. H., J. D. Wright, S. R. Wright, and E. Weber-Burdin. 1983. *Victims of the Environment: Loss from Natural Hazards in the United States, 1970-1980*. New York: Plenum.

Rubin, C. B., with M. D. Saperstein, and D. G. Barbee. 1985. *Community Recovery from a Major Natural Disaster*. Boulder, CO: Institute of Behavioral Science, University of Colorado.

Shrivastava, P. 1986. Bhopal: Anatomy of a Crisis. Cambridge, MA: Ballinger Publishing Company.

Solyst, J. And M. St. Amand. 1991. Emergency Planning and Community Right to Know Act: A Status of State Actions--1991. Washington, D. C.: National Governors' Association.

Solyst, J. and M. St. Amand. 1993. Emergency Planning and Community Right to Know Act: A Status of State Actions--1992. Washington, D. C.: National Governors' Association.

Tierney, K. J. and J. M. Nigg. 1995. "Business Vulnerability to Disaster-Related Lifeline Disruption." PP. 72-79 in Proceedings of the Fourth U. S. Conference on Lifeline Earthquake Engineering. New York: American Society of Civil Engineers, Technical Council on Lifeline Earthquake Engineering, Monograph No. 6.

Tierney, K. J., J. M. Nigg, and J. M. Dahlhamer. Forthcoming, 1995. "The Impact of the 1993 Midwest Floods: Business Vulnerability and Disruption in Des Moines." In R. T. Sylves and W. L. Waugh, Jr. (Eds.), Cities and Disaster: North American Studies in Emergency Management. Springfield, MA: Charles C. Thomas.

Wright, J. D., P. H. Rossi, S. R. Wright, and E. Weber-Burdin. 1979. After the Clean-Up: Long-Range Effects of Natural Disasters. Thousand Oaks, CA: Sage Publications.

Table 1

Median Number of Employees (Full-Time Equivalents) by Sector

Sector	Los Angeles	Des Moines
Wholesale and Retail Trade	5.0	6.0
Manufacturing and Construction	28.0	12.0
Business and Professional Services	3.0	5.0
Finance, Insurance, and Real Estate	11.0	7.5
Other	17.0	10.5
All Businesses	6.0	7.0

Table 2

Percent of Businesses Leasing Space by Sector and Size

Sector and Size of Business	(N)	Los Angeles	(N)	Des Moines
Wholesale and Retail Trade:				
Small	(212)	80.7%	(156)	60.3%
Large	(54)	61.1	(56)	53.6
Manufacturing and Construction:				
Small	(36)	75.0	(90)	54.4
Large	(72)	50.0	(71)	28.2
Business and Professional Services:				
Small	(326)	78.5	(261)	60.5
Large	(61)	68.9	(85)	44.7
Finance, Insurance, and Real Estate:				
Small	(80)	71.3	(106)	59.4
Large	(48)	79.2	(63)	55.6
Other:				
Small	(86)	67.4	(72)	59.7
Large	(75)	61.3	(55)	50.9
All Businesses:	(1110)	71.9	(1015)	55.0

Table 3

 Percent of Businesses Flooded by Sector and Size (Des Moines)

 Sector and Size
 of Business

 Wholesale and
 Retail Trade:

Small (N=160) 13.8%

Large (N=56) 12.5

 Manufacturing and
 Construction:

Small (N=93) 17.2

Large (N=74) 37.8

 Business and
 Professional Services:

Small (N=262) 13.4

Large (N=87) 12.6

 Finance, Insurance,
 and Real Estate:

Small (N=105) 8.6

Large (N=65) 16.9

Other:

Small (N=72) 8.3

Large (N=58) 12.1

 All Businesses: (N=1032) 14.7

Table 4

Median Dollar Losses Due to Flood Damage
by Sector and Size (Des Moines)

Sector and Size
of Business

Wholesale and
Retail Trade:

Small (N=13)	\$40000.00
Large (N=6)	60000.00

Manufacturing and
Construction:

Small (N=9)	50000.00
Large (N=25)	215000.00

Business and
Professional Services:

Small (N=19)	6000.00
Large (N=8)	50000.00

Finance, Insurance,
and Real Estate:

Small (N=5)	30000.00
Large (N=4)	115000.00

Other:

Small (N=3)	50000.00
Large (N=4)	288500.00

All Businesses: (N=97)	50000.00
------------------------	----------

Table 5

Percent of Businesses Reporting Earthquake Damage
by Sector and Size (Los Angeles)

**Sector and Size
of Business**

**Wholesale and
Retail Trade:**

Small (N=208) 64.4%

Large (N=52) 48.1

**Manufacturing and
Construction:**

Small (N=35) 54.3

Large (N=72) 43.1

**Business and
Professional Services:**

Small (N=326) 62.0

Large (N=61) 63.9

**Finance, Insurance,
and Real Estate:**

Small (N=80) 57.5

Large (N=49) 63.3

Other:

Small (N=85) 43.5

Large (N=75) 50.7

All Businesses: (N=1096) 57.2

Table 6

Median Dollar Losses Due to Earthquake Damage
by Sector and Size (Los Angeles)

Sector and Size of Business	
Wholesale and Retail Trade:	
Small (N=120)	\$5750.00
Large (N=22)	27500.00
Manufacturing and Construction:	
Small (N=15)	4000.00
Large (N=30)	30000.00
Business and Professional Services:	
Small (N=182)	3500.00
Large (N=25)	10000.00
Finance, Insurance, and Real Estate:	
Small (N=39)	10000.00
Large (N=25)	50000.00
Other:	
Small (N=33)	2000.00
Large (N=32)	5000.00
All Businesses: (N=543)	5000.00

Table 7

Percent of Businesses Reporting Lifeline Service Interruption
by Sector (Des Moines)

Economic Sector Gas	Electric	Water	Phone	Sewer	
Wholesale and Retail Trade	29.8% (N=228)	79.7% (227)	21.0% (224)	39.2% (227)	3.0% (167)
Manufacturing and Construction	41.1 (175)	82.4 (176)	32.2 (174)	34.5 (174)	12.4 (113)
Business and Professional Services	36.7 (357)	79.7 (359)	23.1 (355)	43.0 (358)	7.5 (241)
Finance, Insurance, and Real Estate	36.9 (176)	78.0 (173)	24.6 (175)	44.2 (172)	3.0 (101)
Other	25.2 (131)	82.3 (130)	13.0 (131)	33.8 (130)	6.2 (81)
All Businesses	34.6 (1067)	80.2 (1065)	23.1 (1059)	39.9 (1061)	6.4 (703)

Table 8

For Des Moines Businesses That Lost Service
Median Duration of Service Interruption (In Hours) By Sector

Economic Sector Gas	Electric	Water	Phone	Sewer	
Wholesale and Retail Trade	48	288	48	288	108
Manufacturing and Construction	48	288	72	288	480
Business and Professional Services	48	312	48	288	240
Finance, Insurance, and Real Estate	48	288	48	288	228
Other	36.5	288	48	288	240
All Businesses (N)	48 (346)	288 (799)	48 (221)	288 (393)	288 (35)

Table 9

Percent of Businesses Reporting Lifeline Service Interruption
by Sector (Los Angeles)

Economic Sector	Electric	Water	Phone	Sewer	Gas
Wholesale and Retail Trade	59.4% (N=271)	17.3% (272)	51.9% (270)	5.6% (268)	18.0% (133)
Manufacturing and Construction	56.5 (115)	17.4 (115)	47.4 (114)	1.7 (117)	22.4 (58)
Business and Professional Services	61.9 (399)	19.3 (398)	53.2 (393)	3.9 (388)	15.9 (157)
Finance, Insurance, and Real Estate	62.9 (140)	23.6 (140)	61.2 (139)	6.5 (139)	20.8 (48)
Other	63.3 (166)	18.0 (167)	58.4 (166)	3.5 (165)	9.0 (78)
All Businesses	61.0 (1091)	19.0 (1092)	54.1 (1082)	4.4 (1077)	16.7 (474)

Table 10

For Los Angeles Businesses That Lost Service,
Median Duration of Service Interruption (In Hours) By Sector

Economic Sector	Electric	Water	Phone	Sewer	Gas
Wholesale and Retail Trade	24.0	72.0	24.0	120.0	72.0
Manufacturing and Construction	24.0	48.0	24.0	84.0	48.0
Business and Professional Services	24.0	48.0	24.0	96.0	48.0
Finance, Insurance, and Real Estate	24.0	72.0	24.0	78.0	48.0
Other	24.0	24.0	24.0	26.0	24.0
All Businesses (N)	24.0 (624)	48.0 (190)	24.0 (539)	96.0 (43)	48.0 (74)

Table 11

Percent of Businesses Closed or Inactive Due to Flood
by Sector and Size (Des Moines)

Sector and Size of Business	
<hr/>	
Wholesale and Retail Trade:	
Small (N=159)	42.1%
Large (N=56)	44.6
Manufacturing and Construction:	
Small (N=93)	51.6
Large (N=72)	54.2
Business and Professional Services:	
Small (N=260)	42.3
Large (N=87)	52.9
Finance, Insurance, and Real Estate:	
Small (N=105)	35.2
Large (N=64)	48.4
Other:	
Small (N=72)	26.4
Large (N=58)	77.6
All Businesses: (N=1026)	42.4

Table 12

Reasons for Business Closure (Des Moines)

	Percent
Loss of Water	63.6 %
Loss of Electricity	41.7
Loss of Sewer or waste water service	34.8
Few or no customers	34.4
Loss of telephone service	28.3
Employees unable to get to work	26.3
Could not deliver products/services	25.7
Evacuated due to threat or warning of flooding	21.4
Building was flooded	19.9
Could not get supplies/materials needed to run business	16.3
Loss of machinery/office equipment	15.4
Loss of Inventory	11.9
Building was declared	6.9
Damage of owners' own residence or other properties	6.9
Loss of natural gas	6.9
Could not afford to pay employees	6.7
Other	21.6
Number of Businesses that Closed (N=448)	

Table 13

Percent of Businesses Closed or Inactive Due to Earthquake
by Sector and Size (Los Angeles)

Sector and Size of Business	
Wholesale and Retail Trade:	
Small (N=212)	63.7%
Large (N=54)	40.7
Manufacturing and Construction:	
Small (N=36)	69.4
Large (N=73)	46.6
Business and Professional Services:	
Small (N=328)	60.7
Large (N=61)	47.5
Finance, Insurance, and Real Estate:	
Small (N=81)	56.8
Large (N=49)	63.3
Other:	
Small (N=86)	47.7
Large (N=74)	39.2
All Businesses: (N=1054)	56.1

Table 14

Reasons for Business Closure (Los Angeles)

	Percent
Needed to Clean Up Damage	65.2%
Loss of Electricity	58.7
Employees Unable to Get to Work	56.4
Loss of Telephone	49.8
Damage to Owner or Manager's Home	44.4
Few or No Customers	39.9
Building Needed Structural Assessment	31.5
Could Not Deliver Products or Services	24.0
Loss of Machinery or Office Equipment	23.7
Building Needed Repair	23.4
Loss of Inventory or Stock	21.9
Loss of Water	18.2
Could Not Get Supplies or Materials	14.9
Building Declared Unsafe	10.1
Could Not Afford to Pay Employees	9.5
Loss of Natural Gas	8.7
Loss of Sewer or Waste Water	5.3
Other	15.8

Number of Businesses that Closed (N=617)

Table 15

Median Dollar Losses Due to Business Closure
by Sector and Size (Los Angeles)

Sector and Size of Business	
<hr/>	
Wholesale and Retail Trade:	
Small (N=114)	\$7500.00
Large (N=18)	16000.00
Manufacturing and Construction:	
Small (N=18)	3800.00
Large (N=27)	40000.00
Business and Professional Services:	
Small (N=162)	4000.00
Large (N=17)	10000.00
Finance, Insurance, and Real Estate:	
Small (N=33)	8000.00
Large (N=16)	20000.00
Other:	
Small (N=38)	2550.00
Large (N=24)	17500.00
All Businesses: (N=484)	5000.00

Table 16

Percent of Businesses With Flood (Des moines) or
Earthquake(Los Angeles) Insurance By Sector and Size

Sector and Size of Business	(N)	Los Angeles	(N)	Des Moines
Wholesale and Retail Trade:				
Small	(206)	15.5%	(128)	7.8%
Large	(53)	26.4	(49)	10.2
Manufacturing and Construction:				
Small	(34)	8.8	(71)	5.6
Large	(73)	30.1	(64)	17.2
Business and Professional Services:				
Small	(319)	19.7	(210)	2.4
Large	(58)	27.6	(70)	11.4
Finance, Insurance, and Real Estate:				
Small	(78)	24.4	(89)	6.7
Large	(48)	35.4	(52)	19.2
Other:				
Small	(83)	13.3	(61)	1.6
Large	(73)	24.7	(47)	8.5
All Businesses:	(1075)	20.5	(858)	7.6

Table 17

Percent of Businesses With Flood Business Interruption Insurance
By Sector and Size (Los Angeles and Des Moines)

Sector and Size of Business	(N)	Los Angeles	(N)	Des Moines
Wholesale and Retail Trade:				
Small	(175)	18.3%	(131)	13.0%
Large	(48)	56.3	(48)	22.9
Manufacturing and Construction:				
Small	(32)	18.8	(72)	5.6
Large	(65)	50.7	(63)	41.3
Business and Professional Services:				
Small	(280)	17.7	(210)	10.0
Large	(47)	29.7	(63)	33.3
Finance, Insurance, and Real Estate:				
Small	(67)	25.4	(88)	17.0
Large	(40)	32.5	(52)	42.3
Other:				
Small	(67)	10.5	(60)	1.7
Large	(63)	28.6	(48)	27.1
All Businesses:	(884)	24.3	(851)	18.0

Table 18

Present State of Business by Sector and Size (Des Moines)

Sector and Size of Business	Worse Off	Better Off	Same
Wholesale and Retail Trade:			
Small (N=154)	13.6%	17.5%	68.8%
Large (N=55)	14.5	25.5	60.0
Manufacturing and Construction:			
Small (N=86)	11.6	17.4	70.9
Large (N=72)	20.8	16.7	62.5
Business and Professional Services:			
Small (N=253)	10.7	16.6	72.7
Large (N=83)	8.4	22.9	68.7
Finance, Insurance, and Real Estate:			
Small (N=99)	7.1	13.1	79.8
Large (N=62)	6.5	16.1	77.4
Other:			
Small (N=70)	17.1	11.4	71.4
Large (N=55)	12.7	29.1	58.2
All Businesses: (N=1017)	12.2	17.8	70.0