transfer, and organizational learning in creating a common understanding of the goal of disaster assistance in international projects sensitive to the possibility of dependency.

This agreement demonstrated an important step in productive interorganizational coordination between Ecuador and the United States on a critical technical problem. Further, it demonstrated important interorganizational coordination within the U.S. Mission in Ecuador to utilize the technical capacity of the Army Corps of Engineers (Department of Defense) to meet the humanitarian goals of international disaster assistance (Department of State).

In summary, three distinct networks of organizational interaction developed in relation to the problems of isolation and transportation created by the earthquakes in eastern Napo Province. These included: (1) the network of national governments that contributed support to the Ecuadorian Air Force in its maintenance of the aerial bridge between Quito and Lago Agrio, (2) the network of religious and voluntary organizations that linked the communities of Indians and colonists to national and international sources of disaster assistance, and (3) the network of Ecuadorian and U.S. governmental organizations involved in technical assistance for road construction through remote areas of eastern Napo Province. Critical, however, from the standpoint of achieving interorganizational coordination was the relatively low degree of communication and coordination among the three networks, even though each developed in response to the common problem of isolation and transportation for inhabitants of eastern Napo Province.

Returning to the concept of an emerging disaster-management system, linkages developed through both formal and informal contacts among the three disaster operations networks. The set of networks evolved from the practical requirements of action in disaster response and recovery. Taken together, they offer an initial basis in experience and adaptive skills that may inform and reinforce an integrated disaster-management system for Ecuador. The set of networks is represented in Figure 8.3.

Strengths and Needs for Further Development in the Larger Network of Disaster Response and Recovery Operations

Strengths

Many strengths emerged from the set of organizational interactions that characterized the disaster response and recovery operations following the March 5, 1987, earthquakes. Five practices, in particular, deserve mention, as they either confirm basic principles of disaster management or indicate innovative practices developed in this disaster:

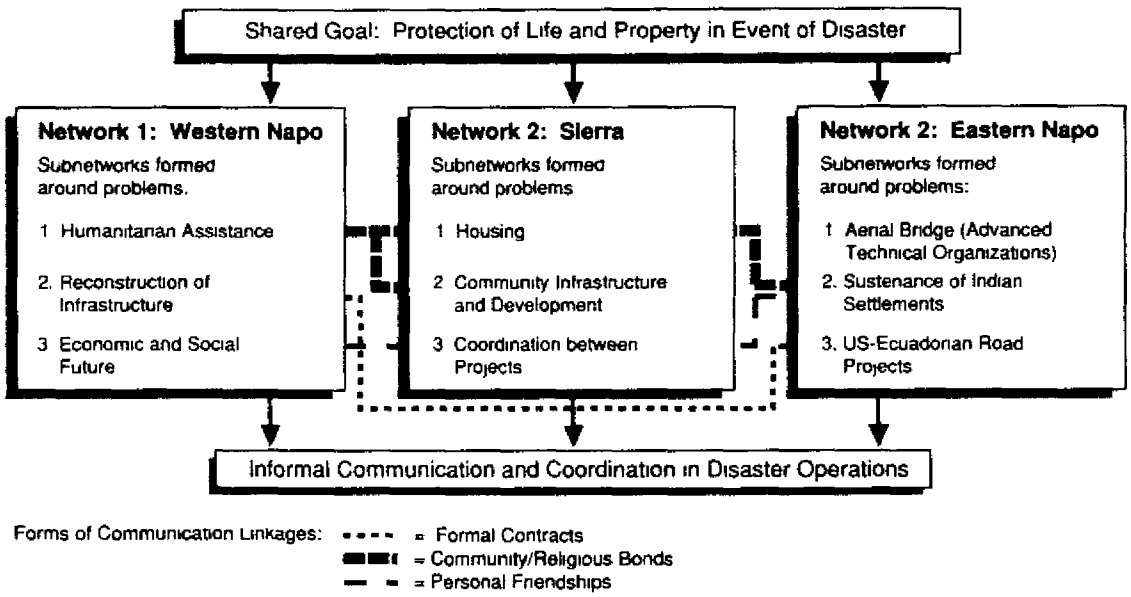

FIGURE 8.3 Evolving disaster-management system: March 5, 1987, Ecuadorian earthquakes

1. This disaster drew an extraordinary response in voluntary contributions from in-country organizations. An outpouring of goodwill is not unusual following a major disaster, but this response deserves mention because it was carefully mobilized and directed through the use of a nationwide television campaign with international transmission. Virtually all major organizations in Ecuador—public, private, and voluntary—participated in the "Crusade for Solidarity" to raise money and contributions for disaster assistance. The appeal, carefully structured, focused not on sympathy for the victims but on the national sense of unity in meeting the unexpected hardships of disaster. Measured by commitment to action as well as contributions, the campaign was very successful.

2. Review of disaster operations demonstrates again the fundamental value of respecting local institutions, practice, and knowledge in engaging local residents in the difficult tasks of rebuilding their lives. The productive work of the *mingas* in constructing new homes, the value of family and friendship ties in overcoming the despair of sudden loss, and the knowledge of local officials and field directors of development organizations in designing effective reconstruction strategies all indicate the importance of fitting the requirements of disaster management to local delivery systems.

3. The importance of prior networks of common goals, shared work experience, and professional association in facilitating the mobilization of resources and action across jurisdictional lines was vividly demonstrated by the ease with which communication traveled and action flowed *within* such networks as Catholic Relief Services, USAID/OFDA, Red Cross

societies, Ecuadorian and international military experience, and family and community ties. Each generates the critical factor of trust, so essential to decision making in the uncertain conditions of disaster. Conversely, the absence of common experience is illustrated in the frequent breakdown of communication and coordination *between* these networks, resulting in frustrating difficulties in the implementation of disaster-assistance programs.

4. Needs assessment is a time-honored technique, but how to do it promptly, accurately, and effectively to serve as a basis for urgent action constitutes a persistent problem in disaster management. The strategy of having cash grants available to place an interdisciplinary team of experts immediately in the field worked very well for Catholic Relief Services. Prior experience in the country, prior experience in disaster, and pooled knowledge from multiple disciplinary perspectives resulted in a solid information base that enabled CRS/CATEC to design a field program of emergency assistance and rehabilitation that proved very effective in Napo Province. The model merits replication.

5. A step-by-step approach of engaging the victims of disaster in the difficult process of rebuilding their own lives and communities was demonstrated repeatedly to be more effective than inviting dependency through continued distribution of aid without acknowledgment or return investment. The trauma of disaster is unsettling at best, and to people with marginal resources and uncertain futures, it can be devastating. A combination of care, technical assistance, and clear guidance through incremental steps worked very well in the community programs instituted in Cayambe through the community's Emergency Committee and the CRS/CATEC program in Napo Province. Conversely, the poorly coordinated distribution of relief supplies by external organizations often had adverse effects in disaster-stricken communities, resulting in negative competition for goods and greedy distortion of personal needs.

Needs

Clear needs for further development in disaster management were also demonstrated in this set of disaster operations. They include:

Improved Communication

Improving communication is the most critical need for increasing effectiveness in disaster management. Organizations cannot function well without knowing the needs, resources, limitations, and time sequence for action, both within their own spheres of responsibility and between the multiple organizations engaged in the process. This process can be accom-

plished only through open, interactive communication among the responsible leaders engaged in disaster response and recovery activities. Further, the process works best when it has been designed and practiced *prior* to the disaster event. Facilities, equipment, and training are needed to improve communication, especially at the local level of operations, where the burden of responsibility is highest but resources are most limited, and between jurisdictional levels of operation.

Increased Coordination of Action

Increasing coordination between the multiple organizations engaged in disaster operations is critical to improving performance. The functions of communication and coordination are complementary, and both are consistently vulnerable to failure in uncertain, complex disaster environments. A shared knowledge base of information, resources, skills, and participants in the disaster-management system is critical to enable specific organizations to adjust their performance, respectively, to others engaged in the process of coordinated action toward the common goal of rescue of human life and restoration of property.

Advanced Information Functions

Information functions for the wider set of organizations involved in disaster management need to be developed more fully and more systematically. In this disaster, many organizations conducted separate information searches, but there was difficulty in sharing information and especially in obtaining timely, accurate information from rural disaster sites. Representation of information in a common format and transmission of information to multiple participants in a timely manner also are critical functions in improving the communication and coordination processes central to effective performance in disaster management.

Revised Concept of Disaster Assistance

The allocation of assistance to victims of disaster is especially sensitive in communities with marginal economic standards. The design and distribution of assistance need to be reconsidered in terms of the opportunities it creates to rebuild lives and homes in stronger, more productive ways. Organizations that incorporate planning for a stronger future with immediate relief from the destruction of disaster are effective in mobilizing not only individual families but wider participation in community programs to reduce vulnerability to disaster.

Organizational Learning in Disaster Management

Evaluation of performance in disaster operations and constructive feedback to participating organizations is essential in developing the capacity of these organizations to mitigate conditions that may contribute to future disasters. Developing a communitywide orientation toward reduction of risk and knowledge of emergency procedures is a vital step toward fostering responsible civic action in a zone of high risk from earthquakes and other natural hazards such as landslides and floods. This feedback is essential for international organizations as well, for they play a critical role in disaster operations in developing countries. Because organizing effective participation at the international level is necessarily more complex, feedback in a careful, constructive format is especially valuable. Without design, organizations are unlikely to learn from past experience, and may repeat ineffective performance in future disasters.

Recommendations for Further Research

The fundamental problem confronting organizations in disaster operations is to design effective action in this uncertain, complex environment. Four recommendations for future research appear especially promising in developing organizational capacity to improve performance in this difficult, dynamic environment. Each focuses on information content and exchange as the most productive and least expensive means of improving capacity for organizational learning and interorganizational coordination in disaster conditions. They are:

1. The design and development of an interactive information system for decision support in disaster management. Such an information system would be based on an interdisciplinary knowledge base with provision for interactive communication among multiple users. This research would utilize new developments in information, radio, and telecommunications technology to address recurring problems of communication and coordination.
2. The design of interorganizational and interjurisdictional simulated-disaster-operations exercises as a means to explore the limits and capacities of human decisionmaking processes in disaster environments. Such exercises might utilize an interactive information system to explore the linkage between information technology and organizational learning in complex environments.
3. Inquiry into the design and development of networks as appropriate organizational forms for the rapid mobilization, implementation, and evaluation of action in disaster management. Such networks might cross disciplinary, organizational, and jurisdictional lines and would be designed to facilitate action in this complex environment. The basis for each network

would be shared knowledge of particular problems in disaster operations or phases of disaster management. A network of networks might organize this information in a model of disaster management which, in turn, could be incorporated into a computerized, interactive information system.

4. Inquiry into economies of resource management that would facilitate interorganizational participation. Resources might be allocated to solve specific problems, such as transportation, and organizations with relevant skills, equipment, and capacity to address this problem could draw against the account established for designated participants in that network. A computerized information system would facilitate the monitoring of expenditures for a multiorganizational project.

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NOTES

1. Hoy, Quito, Ecuador, March 10, 1987, p. 1. President León Febres Cordero Ribadeneira stated that " . . . this is the most serious disaster in the history of Ecuador as a nation."

2. These functions are nontechnical terms that describe practical activities undertaken by any manager in confronting a novel set of events that requires organiza-

tional action: searching for the best information available to assess the situation before taking action; communicating that information to the relevant persons or organizations involved in, or affected by, the proposed action; and evaluating the effects of the actions taken in order to determine the next appropriate steps. For a fuller discussion of these terms, see Chris Argryis. 1982. Reasoning, Learning and Action. San Francisco: Jossey-Bass.

3. These assumptions are drawn from previous research in disaster management, problem solving, and organizational theory. They rely on the work of many authors, but especially Herbert A. Simon, The Sciences of the Artificial (Cambridge: The MIT Press, 1969, 1981); Allen Newell and Herbert A. Simon, Human Problem Solving (Englewood Cliffs, N.J.: Prentice-Hall, 1972); Russell Dynes, Organized Behavior in Disaster (Columbus, Ohio: Heath-Lexington. 1974); Harold Linstone, ed., Multiple Perspectives for Decision Making: Bridging the Gap between Analysis and Action (New York: Elsevier, 1984); Anthony Debons, as presented by Isabel Cilliers, Problems in information science, Information Age, Vol. 7, No. 3, (July 1985):150-155; John Holland, Adaptation in Natural and Artificial Systems (Ann Arbor: University of Michigan Press, 1975); and Louise K. Comfort, The San Salvador Earthquake, in Uriel Rosenthal, Michael T. Charles, and Paul t'Hart, eds., Beyond Crises (Chicago: Charles C. Thomas, 1989).

4. Hoy. Accounts of ecological, technical, economic, social, political, cultural, and international impacts of the earthquakes were reported daily in the two major Quito newspapers, Hoy and El Comercio, during March 1987 and continuing during the succeeding months. The author read both papers daily during the period of her field study, June 14 – July 15, 1987, and sought to obtain back issues of both papers for the month of March 1987. Regrettably, she was unable to obtain a complete set of back issues of El Comercio for this period. Consequently, the newspaper references in this analysis are drawn primarily from Hoy during March 1987, but refer to both newspapers during June and July 1987. To counter any possible bias from a single source, the author sought to find at least two references for critical points in the analysis.

5. See maps of disaster zones presented in earlier chapters.

6. United Nations Economic Commission for Latin America and the Caribbean (ECLAC). The Natural Disaster of March 1987 in Ecuador and its Impact on Social and Economic Development. Report #87-4-406, May 6, 1987, p.1.

7. Hoy, March 9, 1987. Lower figures were also reported in the house-by-house censuses conducted by the municipalities. In western Napo Province, the zone of primary impact from the disaster, the assessment team of CATEC/Catholic Relief Services also conducted a house-by-house census of need. CATEC (Corporación de Apoyo a la Tecnología y a la Comuniación) joined with Catholic Relief Services in designing and conducting an emergency assistance project in Napo Province. Both are voluntary relief organizations financed by contributions from Catholic parishioners and operating with an international mission of social service. However, there were no complete records of residents living in the area prior to the earthquake, leaving in doubt the actual number of persons killed in the disaster. Summary of Relief Program, Catholic Relief Services, Quito, Ecuador, June 15, 1987. Interview, Program Director, Catholic Relief Services, Quito, Ecuador, July 12, 1987.

8. Gen. Antonio Moral Moral, National Director of the Civil Defense, cited in Hoy, March 9, 1987, p.1. See also the United Nations ECLAC Report #87-04-406, op. cit., p. 1.

9. Hoy, March 10, 1987, p. 3A.

10. Interview, Padre, parish church, Borja, Ecuador, July 8, 1987; interview, President, Municipal Council, Baeza, Ecuador, July 8, 1987.

11. Hoy. Also, professional interviews with local government officials in Baeza, Borja, and El Chaco, July 9, 1987, and with the Project Director, Proyecto Emergencia in Napo Province, Catholic Relief Services/CATEC in Quito, July 12, 1987.

12. Hoy, March 10, 1987, p. 9. Interview, Field Representative, USAID/OFDA, Quito, Ecuador, June 28, 1987.

13. Interview, President of the Provincial Council, Imbabura, Ibarra, July 9, 1987. A census of damage to public buildings, infrastructure, and private homes was conducted by the Civil Defense councils of each canton in the province of Imbabura that suffered damage from the earthquakes. These cantonal reports were then forwarded to the Provincial Council of Civil Defense, Imbabura Province. The set of damage assessment reports was reviewed by the provincial government of Imbabura, and in turn, forwarded to the National Council of Civil Defense in Quito. These reports served as the basis for planning the reconstruction projects needed for the disaster zone. Essentially this same procedure was followed in all three zones of the disaster. Damage Assessment Reports, Provincial Government of Imbabura, Ibarra, Ecuador, March 19, 1987.

14. Professional observation, visit to Ibarra, Imbabura Province, Ecuador, July 9, 1987. See also news reports in Hoy, March 11, 1987, p.9A.

15. Professional observation and interviews, residents of Pedro Moncayo and President of the Municipal Council, Olmedo, June 19, 1987. See also news reports in Hoy, March 11, 1987.

16. Interview, President of the Municipal Council, Cayambe; July 9, 1987; interview, Secretary of the Municipal Council of Olmedo, July 9, 1987.

17. Interview, Padre, Misión Carmelita, Lago Agrio, Ecuador, June 29, 1987; interview, Director of the CEPE-Texaco Consortium, Quito, Ecuador, July 3, 1987. The CEPE-Texaco Consortium was established between the Government of Ecuador and Texaco Oil Company to manage oil production and shipment from a given location in eastern Napo Province.

18. Interview, Padre, Misión Carmelita, Lago Agrio, Ecuador, June 29, 1987; interview, Field Director for Indian Services, Catholic Relief Services, Quito, Ecuador, July 7, 1987.

19. The term "between" is used in a statistical sense to connote the type of variance that exists between member organizations of a given set, in contrast to the type of variance that exists "within" each member organization. In this analysis, the set of organizations includes all organizations that participated in the Ecuadorian disaster operations. Variance between organizations may be explained by distinctive characteristics or attributes of individual organizations. Variance within organizations is assumed to be distributed randomly. The total variance for the set of organizations is the sum of the between, or explained, variance and the within, or random, variance. This analysis is seeking to identify the types of characteristics that contribute to variance between organizations that participated in the Ecuadorian disaster operations.

20. Hoy, March 8, 1987, p.1; March 9, 1987, p.1; March 11, 1987, p.9A. These reports were confirmed in interviews during June-July 1987 with informed observers from both Ecuador and the United States, who had participated in disaster-assistance operations in March 1987. A survey of residents of the disaster zones also confirmed difficulties and delays in the distribution of disaster assistance. It is important to identify where the difficulties exist in the process, without making judgments as to cause, before the process can be redesigned for improved performance.

21. Interview, Coordinator, COEN (National Center of Emergency Operations), Quito, Ecuador, July 7, 1987. See also Secretaria General del Consejo de Seguridad Nacional, Dirección Nacional de Defensa Civil, Ley de Seguridad Nacional, 1987, p.1.

22. Interview, Comandante de Battallon de Selva, Lago Agrio, and Director of Civil Defense, Canton of Lago Agrio, Lago Agrio, Ecuador, June 30, 1987.

23. Interview, Coordinator, COEN, and director, National Council of the Civil Defense Authority, Quito, Ecuador, July 7, 1987.

24. Interview, National Director of Civil Defense, Quito, Ecuador, July 7, 1987.

25. Hoy, March 7, 1987, p. 6A.

26. Ibid.

27. Interview, Director of the national Emergency Committee and COEN; interview, national Director of Civil Defense, Quito, Ecuador, July 7, 1987.

28. Hoy, March 7, 1987, p. 6A.

29. Hoy, March 11, 1987, p. 1. Interview, U.S. Ambassador, Quito, Ecuador, July 6, 1987.

30. Interview, Comandadura de Defensa Civil, Province of Pichincha, Quito, Ecuador, June 17, 1987.

31. Pastor, Iglesia del Pacto Evangélica de Ecuador, Fondación Adelanto Comunitario Ecuatoriana, Quito, Ecuador, July 13, 1987.

32. Hoy, March 22, 1987, p.1. Interview, professor of sociology, Universidad Católica, Quito, Ecuador, June 22, 1987.

33. Professional observation of a *minga* in operation, Canton Cayambe, Ecuador, June 19, 1987.

34. Interview, Director, emergency assistance project in Napo Province, Baeza, Ecuador, July 8, 1987; interview, President, Municipal Council, Baeza, Ecuador, July 8, 1987.

35. Interview, President, Municipal Council, Cayambe, Ecuador, July 2, 1987.

36. This observation was made separately by several informed observers/participants in the disaster response and recovery process. Assurances of professional confidentiality prevent citing the sources directly. The same observations are documented in news articles published in Hoy, March 7–31, 1987.

37. Interviews with directors of local and provincial Civil Defense councils and directors of disaster-assistance projects, Quito, Olmedo, Cayambe, Baeza, Borja, and Lago Agrio, Ecuador, June 19–July 14, 1987.

38. Interview, Vice-president, Municipal Council and Coordinator of the Municipal Civil Defense Committee, Baeza, Ecuador, July 8, 1987.

39. Interview, Director, Proyecto Emergencia, CATEC/CRS, Quito, Ecuador, July 12, 1987; interview, President, Municipal Council, Baeza, Ecuador, July 8,

1987; interview; Program Director, Peace Corps Ecuador, Quito, Ecuador, July 10, 1987.

40. Hoy, March 7–31, 1987; interviews, disaster assistance volunteers, Baeza, Ecuador, July 8–9, 1987; and professional observation, Baeza, Borja, El Chaco, and Tres Cruces, July 8–9, 1987.

41. Hoy, March 7–31, 1987.

42. Hoy, March 10, 1987, p.9A.

43. These figures were reported by Civil Defense Ecuador in their final report on the disaster.

44. Hoy, March 7–31, 1987. These figures were documented from several sources, including the Office of the Director of Housing for COEN, Quito, Ecuador, July 13, 1987.

45. Interviews, President of Municipal Council, Cayambe; President, Municipal Council, Olmedo; President, Provincial Council, Imbabura, July 2, 1987.

46. Hoy, March 11, 1987, p. 1. Interview, President, Municipal Council, Cayambe, July 2, 1987.

47. Interview, Field Representative, USAID/Office of Foreign Disaster Assistance, Quito, Ecuador, June 28, 1987.

48. Interview, President, Municipal Council, Cayambe, July 2, 1987.

49. Interview, Padre, Catholic Church, Cayambe, June 29, 1987. Interview, Madre Superiore, Catholic School, Cayambe, July 2, 1987.

50. Interview, Catholic volunteer worker, Olmedo, Ecuador, June 27, 1987.

51. Interview, President, Municipal Council, Cayambe, July 2, 1987.

52. Interview, Program Director, Catholic Relief Services, Quito, Ecuador, July 12, 1987.

53. Interview, Director, COEN, Quito, Ecuador, July 7, 1987. Hoy, March 21, 1987, p.9A.

54. Interview, Comandante de Battallon de Selva and Coordinator, Civil Defense Council, Canton of Lago Agrio, Lago Agrio, Ecuador, June 30, 1987. Hoy, March 8, 1987, p.8A.

55. Interview, Field Director for Indian Services, Catholic Relief Services, Quito, Ecuador, July 7, 1987.

56. Interview, Padre, Misión Carmelita, Lago Agrio, Ecuador, June 29, 1987.

57. Interview, Field Director, Catholic Relief Services, Quito, Ecuador, July 7, 1987.

58. Hoy, July 13, 1987. Interviews, informed observers from both Ecuador and the United States, Quito, Ecuador, June 16–July 15, 1987.

59. Interview, Assistant Director for Latin America, Office of Foreign Disaster Assistance, Washington, D.C., September 1, 1988.

60. Hoy, July 15, 1987. Interview, professor of public administration, Universidad Católica, Quito, Ecuador, June 22, 1987.