Improving Postdisaster Humanitarian Logistics

Three Key Lessons from Catastrophic Events

JOSÉ HOLGUÍN-VERAS, MIGUEL JALLER, AND TRICIA WACHTENDORF

Holguín-Veras is William H. Hart Professor and Director, and Jaller is Research Associate, Volvo Research and Educational Foundations' Center of Excellence for Sustainable Urban Freight Systems and the Center for Infrastructure, Transportation, and the Environment, Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute, Troy, New York. Wachtendorf is Associate Professor, Department of Sociology and Criminal Justice and Associate Director, Disaster Research Center, University of Delaware, Newark.

Publisher's Note: *Holguín-Veras is a 2013 recipient of a U.S. White House Champion of Change Award for "exemplary leadership in developing or implementing transportation technology solutions to enhance performance, reduce congestion, improve safety, and facilitate communication across the transportation industry…."*

Catastrophic events such as the 2004 Indian Ocean tsunami, Hurricane Katrina in 2005, the 2010 Port-au-Prince earthquake, and the Tohoku tsunami in 2011 reinforce the critical importance of postdisaster humanitarian logistics (PD-HL), not only in transporting and distributing supplies to the affected populations but in the larger response effort. Conducting efficient and effective PD-HL operations in the aftermath of such events is a huge challenge.

The world today is embedded in complex sociotechnical systems—networks of individuals conducting technical activities through a set of supporting systems, such as transportation, communications, and finance. The impacts of a catastrophe on these components and systems are severe, as individual members of the social networks may be killed, injured, or displaced; the equipment and materials needed to conduct the technical activities may be destroyed or may lack the necessary inputs to run; and all of the supporting systems are likely to be inoperable or to function at a fraction of their normal capacity.

Catastrophic events present other unique and notable challenges. In the aftermath, large and dynamically changing volumes of critical supplies must be transported in a short time; great uncertainty prevails about the needs for critical supplies; the ability of the local civic society to organize a response is compromised; large portions of critical local assets are destroyed; and huge flows of nonpriority donations arrive at the site, distracting resources from more critical tasks (*1*–*3*).

Moreover, a poor understanding of catastrophes affects the nature and efficiency of a response. Because catastrophic events are rare, only a minuscule percentage of responders have experience in postcatastrophe logistics and operations. In addition, the events are extremely dynamic and can quickly transition from stage to stage. Lastly, catastrophes are extremely difficult to study—travel to the area is required soon after to observe the unfolding response.

Fieldwork that has spanned such catastrophic events as the September 11, 2001, terrorist attacks on the World Trade Center, Hurricane Katrina, the Port-au-Prince earthquake, the Tohoku tsunami, the Joplin tornados, and Superstorm Sandy has yielded definite lessons. The focus here, however, is on the top three lessons learned from the Port-au-Prince

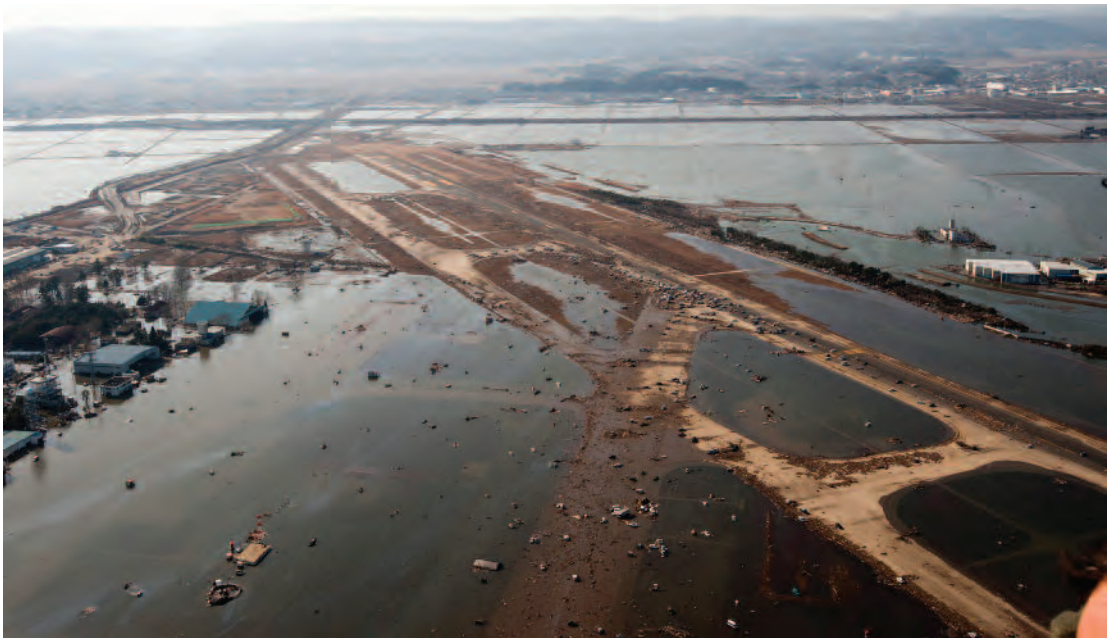

PHOTO: SAMUEL MORSE, U.S. AIR FORCE

Flooding at the Sendai Airport near the site of the March 2011 Tohoku tsunami.

and the Tohoku responses. These two events provide complementary lessons leading to a unified and comprehensive set of suggestions for improvement (*4–6*).

Lesson 1. Disasters and catastrophes are not the same; be ready for both.

Disasters of all sizes leave trails of destruction and human suffering that defy easy description or categorization. Individuals and families can experience impacts that are disastrous or catastrophic on a personal level; nevertheless, disasters are defined from a sociological and not from a personal perspective—the focus is on how communities and societies can best prepare for and respond to extreme events.

Defining Terms

Although the appropriate definition is a subject of debate (*7*), a disaster can be understood as "a nonroutine event that exceeds the capacity of the affected area to respond in a way that saves lives, preserves property, and maintains the social, ecological, economic, and political stability of the affected region" (*8*). In contrast, a catastrophe is "a high-consequence event that generates widespread and crippling impacts, [so that] the ability of the impacted society to respond is severely compromised" (*2, 9*).

The typical impacts of disasters and catastrophes are summarized in Table 1 (below). In disasters, the local capacity to respond is viable and depends on the state of the civic leadership, the availability of critical supplies, and the capacity to mobilize and distribute critical supplies. The response effort has access to multiple entry points in the disaster area, and the local distribution effort is simpler than in a comparable catastrophe.

In short, the local civic society is able to provide a meaningful first wave of resources in response to a disaster. Outside help complements the local effort beyond the initial 24 to 48 hours, as outlined in the National Response Framework (*10*).

By contrast, a catastrophe is likely to have had an impact on the local leadership, which may be unable

PHOTO: OXFAM

Pallets of water treatment gear are loaded onto an Oxfam aid flight to Haiti after the 2010 earthquake in Port-au-Prince.

TABLE 1 Comparison of Impacts: Disasters Versus Catastrophes

Characteristic	Disaster	Catastrophe
Leadership of civic society	Typically survives the disaster and is able to lead the response	In most cases, severely affected and unable to lead an effective response
Local stocks of supplies in businesses and households	Only partly destroyed; the surviving supplies may become part of the response	Mostly destroyed; the role of local supplies in the response is minimal
Demand for supplies	Increases with the needs of businesses, people, and the response; precautionary or opportunistic buying could be a problem	Huge increases because of the magnitude of the impacts; precautionary or opportunistic buying could be a problem in nearby areas
Private-sector supply chains	Partly impacted but functional, could help in response	Severed, destroyed, cannot help in response
Number of points of entry to the disaster area	Multiple points of entry provide responders with alternatives to enter the area	Only a few points of entry, complicating distribution efforts
Complexity of the local distribution effort	Challenging but manageable	Exceedingly complex, because of the size of the impacted area and the personnel required
Material convergence of nonpriority supplies	A nuisance that can be controlled	A major problem that distracts significant amounts of resources from critical tasks
Net result	Local help is key in initial days; outside help brings additional supplies	Outside help is the primary source of supplies

Photo: Taylor Torka/Caritas Goma

Collaborative aid networks such as Caritas—here providing assistance to Congolese residents displaced by war—are well-suited to respond to emergency events.

to lead the civic society and to organize aid efforts. The material capacity to respond is likely to be severely compromised—local inventories of critical supplies are usually destroyed or out of reach, and the companies that manage local supply chains for critical supplies are unable to function. Moreover, the demands for the impacted population and for the response itself are much more intense than after a disaster; as a result, the local civic society cannot provide the first wave of resources.

Manning the Distribution

The most challenging component in the response to a catastrophic event is the local distribution of critical supplies at the points of distribution (PODs). This activity is relatively simple in disasters but in catastrophes is hugely complex, because of the large geographic areas to be served; the large number of PODs to be established, manned, and supplied; and the severe impacts on the transportation and distribution networks (*11*).

In the immediate aftermath of the Port-au-Prince earthquake, for example, manning and supplying the 150 to 200 PODs required 20,000 to 25,000 volunteers—approximately the size of an average U.S. Army division, which needs three to four weeks to deploy. In catastrophes that have an impact on large urban areas, therefore, the resources to man and supply the PODs cannot be provided by outside sources; only the local social networks can address the monumental challenge.

Lesson 2. Control material convergence and precautionary or opportunistic buying.

Material convergence—the spontaneous flow of supplies, donations, and equipment to the disaster area—is a unique, overlooked, and poorly understood phenomenon (*3, 11, 12*). The convergence contributes much-needed supplies, along with an astronomical amount of useless and inappropriate items, such as wedding gowns, used clothing, expired medications, and a range of products that have failed in the marketplace.

Material convergence comprises three groupings (*2, 13*):

1. High-priority supplies for immediate distribution and consumption,
2. Low-priority supplies that are not immediately needed but could be useful later, and
3. Nonpriority supplies that are not of any practical use.

Nonpriority items often are termed "in kind" and "unsolicited" donations, but in-kind and unsolicited donations can be useful; a large portion of the international aid that arrived at Haiti was both in-kind and unsolicited, as international donors sent critical supplies without being asked by the Haitian government.

The impacts and problems associated with material convergence were first identified almost a century ago (*3, 11, 12*). Recent rough estimates indicate that

about 5 to 15 percent of the cargo arriving at the site consists of high-priority supplies, about 25 to 35 percent are low-priority supplies, and nonpriority supplies make up a staggering 50 to 70 percent.

Controlling Nonpriority Supplies

The flow of nonpriority supplies is the most problematic component of material convergence. Nonpriority supplies consume resources that could be applied to more important tasks, create major complications to the response, and offer little to help the survivors or the response. Disaster responders refer to the flow of useless, nonpriority goods as "a second-tier disaster" (*14*). These supplies "often complicate unnecessarily the logistics of relief operations," "frequently… have not been asked for," "do not respond to the needs of the affected population," "lead to a waste of time and resources," "are useless or irrelevant," and "should be discarded as soon as possible…to make room for useful supplies" (*3, 11, 13*).

Research suggests that the media's portrayal of needs—mostly subjective and based on what is considered newsworthy—can generate nonpriority supplies (*3*). Moreover, vehicles carrying nonpriority supplies can clog the entry points to the area and usually require longer inspection times because of poor documentation. These vehicles often do not have a consignee and circulate until locating someone willing to receive the cargo; failing that, some drivers may dump the loads, creating health hazards.

Proactive Steps

Proactive steps are needed to increase the net benefits from material convergence by maximizing high- and low-priority flows and minimizing the negative impacts of nonpriority supplies. Disaster plans should explicitly consider material convergence—this is a critical first step. Second, strategies must be developed to reduce nonpriority flows. This may require education efforts aimed at potential donors, the media, and local leaders (*15*). Access controls should expedite the traffic of high-priority supplies, reroute low-priority supplies to storage locations, and prevent nonpriority supplies from reaching the affected area (*2, 3, 11*).

Precautionary or opportunistic buying is another behavior that affects disaster response, particularly in surrounding areas. Anticipating shortages, individuals and businesses rush to purchase critical supplies of food, water, fuel, and electricity generators. This removes from the market critical supplies that are best positioned—in terms of proximity—to help the survivors and the response itself. Rationing of critical supplies or other forms of demand management would be beneficial to the response. Before a disaster, the private sector should be engaged to facilitate these procedures.

Lesson 3. Integrate the civic society in disaster preparation and response efforts.

Effectively integrating the civic society into all facets of the disaster cycle, particularly in the preparation and response, is probably the most important lesson. Examples from Haiti and Japan illustrate this critical point (*4–6*).

Tapping into Networks

After the Port-au-Prince earthquake, large and experienced international organizations had problems distributing critical supplies to survivors. The massive amount of aid that arrived in Haiti piled up at the port and airport and did not reach the population in need with the speediness required by the circumstances. Even the United Nations was unable to find trucks to transport supplies (*4*).

This crisis of connectivity started when the earthquake effectively decapitated the local leadership. When the massive flow of aid arrived in Haiti, the international relief groups could not connect with local leaders. Without the leaders' connections to local truckers and social networks, the relief groups attempted to distribute the supplies themselves, but because of personnel constraints, the agencies could open far fewer PODs than were needed to serve nearly

United Nations Photo by Sophia Paris

Young residents of a temporary camp in Léogâne, Haiti, distribute water from a truck. The United Nations created a registry of local truckers in Haiti to implement the efficient flow of aid and supplies.

2 million beneficiaries. The crisis subsided two weeks later, when the United Nations created a registry of local truckers, opening access to local equipment, personnel, and know-how.

Collaborative aid networks (CANs) were able to put in place efficient and effective PD-HL operations. CANs are large social networks established for other purposes; two notable CANs in the Haiti relief efforts were the Servicio Social de Iglesias and CARE–Caritas RD, the social arms of the evangelical and the Catholic churches, respectively.

The CANs were able to undertake PD-HL with efficiency and ease, through large networks of committed volunteers already on the ground. Haiti and the Dominican Republic have an estimated 30,000 Catholic and evangelical churches; each church, a node in the larger network, has a leader and followers with strong connections to the rest of the CAN, increasing resiliency.

Moreover, because the CANs are spread out in the disaster area, they are ideally positioned to become the backbone of the local distribution effort. Intuitively, the leaders understood this, mobilized their networks, and used many of the churches as PODs, organizing the local population and the PD-HL effort effectively.

Private-Sector Resources

The response to the Tohoku tsunami provides important lessons in integration with the private sector. The PD-HL operations after the tsunami did not go well. The nuclear crisis consumed almost all of the government's attention while the humanitarian crisis gathered momentum.

The PD-HL operation started almost a week late, after members of parliament angrily complained; the government asked the Self-Defense Forces (SDF) to distribute critical supplies to survivors. The government refused offers of assistance from several private-sector companies, however, citing a lack of fuel for the return trips—although the SDF could have brought in fuel for this purpose.

Meanwhile, the commercial supply chains that routinely transported supplies to the impacted and surrounding areas followed usual procedures after a disaster and stopped deliveries until conditions could be assessed; this deprived both areas of much-needed supplies and aggravated the humanitarian crisis. At this critical juncture, a few food and retail companies ignored the warnings and took the initiative to deploy hundreds of trucks loaded with food, water, and other supplies to avert the humanitarian crisis.

This example provides a potent argument for effectively integrating private-sector input and resources in PD-HL preparations and response procedures. Private-sector companies produce and transport supplies, own transportation assets, and have the local knowhow that can make a difference in the aftermath of a large disaster or catastrophe.

PHOTO: MATTHEW BRADLEY, U.S. NAVY

A Japan Maritime Self-Defense Force (SDF) sailor participates in cleanup efforts after the Tohoku tsunami. Exclusive SDF efforts faltered until supplemented by private-sector initiatives.

TABLE 2 Key Findings and Policy Implications (*17*)

Goal	Findings	Policy Implications
Integration with civic society	• Lack of pre-established links prevents the advantageous involvement of private sector, CANs, and the rest of civic society • Lack of designated leaders of PD-HL produces confusion and inefficiencies • Difficulties integrating outside help lead to major coordination problems, duplicated efforts, and unmet needs • Lack of training and of realistic exercises fails to involve the civic society	• Integrate private-sector groups, reputable CANs, and other key groups that could contribute to a logistics committee • Designate a point of contact for PD-HL with good relations within the civic society • Facilitate the integration of outside help—for example, divide the area into small districts to be assigned to outside groups • Develop exercises to train potential participants in PD-HL
Response plans	• Usually not suitable for large disasters • Do not consider catastrophes • Operations listed in plans are not scalable • Do not explicitly consider PD-HL	• Consider multiple scenarios for catastrophic events covering multiple jurisdictions • Design scalable response functions • Plan PD-HL operations in detail
Relief distribution and donations management	• In catastrophes, the bulk of supplies must be brought from outside the disaster area • Local distribution is a major challenge • Critical resources, such as fuel, are lacking • Excessive donations of low- and nonpriority supplies create problems • Precautionary or opportunistic buying is a major challenge	• Preposition supplies in lower-risk but nearby areas • Plan for local distribution • Ensure resources are available • Proactively engage the media to advise the public on how to help; make plans to control access to the disaster area • Proactively manage donations • Control precautionary or opportunistic buying via rationing or educational campaigns and agreements with private sector
Assessment and communication	• Lack of technologies to assess damage to infrastructure and impacts on population • Lack of communication and other supporting systems that operate in disaster environments	• Use satellite imagery, remote sensing, and geographic information systems for infrastructure assessment • Preposition communication equipment, such as satellite phones and generators

Integrating Key Segments

The experiences of Haiti and Japan underscore the benefits of integrating key segments of the civic society into disaster preparations and response procedures. In both cases, elements of the civic society stepped up to fulfill a need without any instructions or clear idea about how to proceed, without coordination with the public sector, and without practice or training.

The efficiency of PD-HL operations after catastrophic events could increase greatly with a structure that incorporates participation by various components of the civic society. Such simple steps as designating local nodes from the CANs to serve as PODs, training local leaders and members in first aid and disaster response procedures, and the like, could lead to a better prepared citizenry, enhanced community resiliency, and a more efficient PD-HL process.

Similarly, private-sector representatives could be engaged as part of a PD-HL committee, which would be activated as needed. Their know-how, contacts, and resources could make a critical difference to the populations affected by a large disaster. Companies involved in the trade of critical supplies with both a regional and a local presence are best positioned to help, as they have access to regional resources and know local conditions.

PHOTO: LIZ ROLL, FEDERAL EMERGENCY MANAGEMENT AGENCY

In the aftermath of Hurricane Sandy, the New York–New Jersey region received far more donated clothing than was needed; many months after the storm, piles of clothes still waited to be sorted.

Enhancing Readiness

Jurisdictions at risk of catastrophic events must take appropriate actions to implement the guidelines in the National Response Framework and to enhance readiness. FEMA's grants to foster planning for catastrophic events are a worthy first step (*16*). Table 2 (page 9) summarizes the chief findings of the authors' research encompassing several disasters, along with the key policy implications.

Acknowledgments

The research was funded through several National Science Foundation projects: Contending with Materiel Convergence (NSF-HSD/DRU 0624083); Field Investigation on the Comparative Performance of Alternative Humanitarian Logistic Structures (NSF-RAPID 1034365); Field Investigation on Post-disaster Humanitarian Logistic Practices Under Cascading Disasters and a Persistent Threat: The Tohoku Earthquake Disasters (NSF-RAPID); and Cyber-Enabled Discovery System for Advanced Multidisciplinary Study of Humanitarian Logistics for Disaster Response (NSF-IIS 1124827). The authors acknowledge and appreciate this support.

References

1. Holguín-Veras, J., N. Pérez, S. Ukkusuri, T. Wachtendorf, and B. Brown. Emergency Logistics Issues Affecting the Response to Katrina: A Synthesis and Preliminary Suggestions for Improvement. In *Transportation Research Record: Journal of the Transportration Research Board, No. 2022*, Transportation Research Board of the National Academies, Washington, D.C., 2007, pp. 76–82.
2. Holguín-Veras, J., M. Jaller, L. N. V. Wassenhove, N. Pérez, and T. Wachtendorf. On the Unique Features of Post-Disaster Humanitarian Logistics. *Journal of Management*, Vol. 30, No. 2012, pp. 494–506.
3. Holguín-Veras, J., M. Jaller, L. Van Wassenhove, N. Pérez, and T. Wachtendorf. Material Convergence: An Important and Understudied Disaster Phenomenon. *Natural Hazards Review*, 2013.
4. Holguín-Veras, J., M. Jaller, and T. Wachtendorf. Comparative Performance of Alternative Humanitarian Logistic Structures After the Port-au-Prince Earthquake: ACEs, PIEs, and CANs. *Transportation Research Part A: Policy and Practice*, Vol. 46, No. 10, 2012, pp. 1623–1640.
5. Holguín-Veras, J., E. Taniguchi, F. Ferreira, M. Jaller, and R. Thompson. The Tohoku Disasters: Preliminary Findings Concerning the Post-Disaster Humanitarian Logistics Response. Presented at 91st Annual Meeting of the Transportation Research Board, Washington, D.C. January 2012.
6. Holguín-Veras, J., E. Taniguchi, F. Ferreira, M. Jaller, F. Aros-Vera, and R. Thompson. The Tohoku Disasters: Chief Findings Concerning the Post Disaster Humanitarian Logistic Response. *Transportation Research Part E: Logistics and Transportation Review* (in preparation), 2013.
7. *Hazards, Disasters, and the U.S. Emergency Management System: An Introduction*. Federal Emergency Management Agency. http://training.fema.gov/EMIWeb/edu/hazdisusems.asp.
8. Pearce, L. D. R. An Integrated Approach for Community Hazard, Impact, Risk and Vulnerability Analysis: HIRV. School of Community and Regional Planning, University of British Columbia, Canada, 2000.
9. Wachtendorf, T., B. Brown, and J. Holguin-Veras. Catastrophe Characteristics and Their Impact on Critical Supply Chains: Problematizing Material Convergence and Management Following Hurricane Katrina. 2010.
10. *National Response Framework*. Federal Emergency Management Agency. www.fema.gov/national-response-framework.
11. Jaller, M. Resource Allocation Problems During Disasters: The Cases of Points of Distribution Planning and Material Convergence Handling. Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute, Troy, New York, 2011.
12. Fritz, C. E., and J. H. Mathewson. *Convergent Behavior: A Disaster Control Problem*. Special Report for the Committee on Disaster Studies, National Academy of Sciences, Washington, D.C., 1957.
13. *Humanitarian Supply Management and Logistics in the Health Sector*. Pan American Health Organization, 2001.
14. $75 Million of Stuff. *Newsweek*, February 18, 2002.
15. *Guidelines for Effective International Disaster Donations*. Center for International Disaster Information. www.cidi.org/guidelines.
16. *National Preparedness Grant Program*. Federal Emergency Management Agency. www.fema.gov/pdf/government/grant/fy2013_npgp_grant_program_overview.pdf.
17. Holguín-Veras, J., E. Taniguchi, F. Ferreira, M. Jaller, and R. Thompson. The Tohoku Disasters: Chief Findings Concerning the Post-Disaster Humanitarian Logistic Response, 2011.