

1 **MATERIAL CONVERGENCE:**

2 **AN IMPORTANT AND UNDERSTUDIED DISASTER PHENOMENON**

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## **ABSTRACT**

28           The paper reports the research conducted by the authors on material convergence, which is one of  
29 the most important, and ironically one of the most understudied disaster phenomena. This spontaneous  
30 flow of supplies, equipment, and general donations to the impacted area brings much-needed relief as  
31 well as major complications to the operations. The paper reviews empirical evidence from disaster  
32 literature, and complements it with lessons learned from fieldwork conducted by the authors, to identify  
33 the problems created by the non-priority component of the material convergence. The paper ends with  
34 policy suggestions regarding the use of appropriate material convergence management and control  
35 strategies.

## INTRODUCTION

In 2011, 322 natural disasters impacted 244.7 million people worldwide, resulting in 30,000 deaths and a record \$366 billion in economic damage (Guha-Sapir et al., 2012). This staggering loss is not a statistical outlier; according to the Center for Research on the Epidemiology of Disasters, the human and economic impacts of natural disasters have increased during the last few decades (Centre of Research for the Epidemiology of Disasters, 2009). These disasters range from localized events impacting local communities, such as the tornado in Joplin, Missouri, to large scale catastrophes like the Port-au-Prince earthquake in Haiti, and the Tohoku disasters in Japan. Such disastrous events exemplified the vulnerability of modern society, prompting large humanitarian responses that confirmed both the importance and intrinsic complexity of humanitarian logistics (HL) operations.

The complexity of HL operations is determined, among other factors, by the magnitude of the triggering event, particularly whether or not the event is catastrophic. A catastrophe is a disaster in which:

- 1) “most or all of the community-built structure is heavily impacted... [and] facilities and operational bases of most emergency organizations are themselves usually hit;”
- 2) “local officials are unable to undertake their usual work role;”
- 3) “help from nearby communities cannot be provided;”
- 4) “most, if not all, of the everyday community functions are sharply and concurrently interrupted;”
- 5) “the mass media system especially in recent times socially constructs catastrophes even more than they do disasters;”
- 6) there are “mass out-migrations for protracted periods of time;” and
- 7) “the political arena becomes even more important” (Quarantelli, 2006; Wachtendorf et al., 2010a).

In non-catastrophic disasters, local communities, private sectors, and governments are able to cope with the initial impacts by providing a first wave of resources to aid the survivors. However, catastrophes are likely to destroy a large proportion of local inventories of supplies at businesses and households, which otherwise would have served as that first wave of aid. In addition to the spike in the impacted population’s demand for goods (disaster agent-generated demands), which may be worsened by precautionary or opportunistic buying in nearby areas, the response itself necessitates large quantities of goods and resources (disaster response-generated demands) (Dynes et al., 1972; Holguín-Veras et al., 2012b). Local procurement is almost impossible

62 given that the severed or destroyed private sector supply chains cannot help. The local distribution effort  
63 required to cover a large geographic impacted area with limited manpower and resources adds to the  
64 complexity of the problem. The final complicating element is that the local socio-technical networks—the  
65 collective of individuals, their interconnections, together with the technical activities they perform—that  
66 typically take charge of the response operations in smaller disasters cannot do so after a catastrophe  
67 because of impacts to the networks themselves. The net effect is an almost complete reliance on outside  
68 help; most of the supplies and logistics must be brought in from other regions. This makes for a  
69 completely different environment from the one faced by commercial logistics. Recent research has  
70 therefore highlighted the unique features of HL, and its differences from its commercial counterpart  
71 (Holguín-Veras et al., 2012b). A brief discussion of Holguín-Veras et al. (2012b) follows.

72 Holguín-Veras et al. (2012b) established that the term HL describes a broad spectrum of relief  
73 operations ranging from the regular distribution of critical supplies, such as distributing food to fight  
74 hunger, to the distribution of critical supplies after a disaster. The former is an example of what was  
75 termed “Regular Humanitarian Logistics” (R-HL), and the latter is referred to as “Post-Disaster  
76 Humanitarian Logistics” or PD-HL. Holguín-Veras et al. (2012b) analyzed and compared CL, R-HL, and  
77 PD-HL and concluded that understanding the differences between them requires consideration of the  
78 following characteristics: 1) objectives pursued; 2) knowledge of demand; 3) decision-making structure; 4)  
79 periodicity and volume of logistics activities; 5) the state of the social fabric and networks; 6) the type and  
80 status of supporting systems; and 7) the origination of the commodity flows. One of the authors’ chief  
81 conclusions is that these three modalities of logistic systems are part of a continuum of cases, with  
82 commercial logistics at one end and PD-HL at the other, and R-HL somewhere in between.

83 There is a fundamental distinction between the various forms of logistic endeavors in terms of the  
84 objectives pursued. While commercial logistics aims at minimizing private (logistics) costs, HL’s  
85 objective is to minimize social costs (i.e., logistics costs plus the economic valuation of the human  
86 suffering). The use of social costs for modeling purposes is rooted in welfare economics, as the disaster  
87 destroys the normal markets that assign value to goods and services. As a result of the lack of normal

88 economic transactions, the impacts of the relief aid distribution become externalities that are not  
89 internalized by the agents conducting the logistics operations, thus requiring the use of social costs. The  
90 impacts of the distribution of the aid take two forms. The first is a reduction in the level of suffering  
91 experienced by the recipients of the aid; suffering that was produced by their lack of access to a critical  
92 supply or service. The second is an increase in the suffering on the part of those individuals who do not  
93 receive aid at a point in time (Holguín-Veras et al., 2012c). The quantification of these impacts requires  
94 the use of the concept of deprivation cost, which is the economic valuation of the human suffering  
95 resulting from the lack of access to a good or service (Holguín-Veras et al., 2012c).

96 In commercial logistics, there are a small number of agents involved with defined roles and  
97 responsibilities, making routine decisions based on standard procedures. In PD-HL, there may be  
98 hundreds or even thousands of formal or informal/improvised supply chains that interact, overlap,  
99 cooperate, or even compete for scarce resources. In addition, these supply chains are conducting activities  
100 to meet uncertain and highly dynamic demands—with little or no information about what is needed, when  
101 or where—under uncertain and unstable supporting system (e.g., transportation, production, energy,  
102 communications) conditions. In most cases, the individuals involved in PD-HL operations deal with once-  
103 in-a-lifetime events, with no time for a continuous improvement process or learning.

104 Material convergence—the flow of supplies, general donations (solicited or unsolicited), and  
105 equipment that travels to the site of the disaster (Fritz and Mathewson, 1957)—is one of the most unique,  
106 overlooked, and poorly understood disaster PD-HL phenomena. While in commercial logistics the  
107 cargoes that are transported are under the control of the relatively small number of companies involved,  
108 the situation in PD-HL could not be more different. After a major disaster or catastrophe, large quantities  
109 of supplies and equipment are sent to the disaster area by thousands or tens of thousands of donors (e.g.,  
110 individuals, faith-based groups, non-profit organizations, companies, governments). The crux of the  
111 problem is that the materials and supplies converging at the disaster site include a large proportion of  
112 inappropriate or useless goods that create havoc in the disaster response. Multiple examples of this  
113 phenomenon are discussed later in the paper.

114 Fundamentally, material convergence is a complex problem, with multifaceted logistical  
115 challenges: a huge quantity of items, an extremely heterogeneous flow, arriving within a short timespan to  
116 an area with limited space, resources, and personnel to process and distribute them to their intended  
117 recipients, people in great need. The intrinsic challenges involved are increased exponentially due to the  
118 sheer magnitude of useless supplies and materials within the overall mix. Vehicles transporting the  
119 supplies congest the entry points to the disaster area, impeding the flow of high-priority supplies, at a time  
120 when transportation networks are still crippled by the event. The main issue is that a significant portion of  
121 the material convergence brings no benefits to the disaster victims, and may even pose risks (e.g., expired  
122 medicines). Moreover, the arrival en masse of supplies that have a market value depresses local markets,  
123 negatively impacting local production at a time when reigniting economic activity is essential. A major  
124 handling effort is often required to inventory and sort the goods, as they tend to be poorly packed. These  
125 efforts require large amounts of resources that are scarce, and needed for other more essential tasks.  
126 Although this phenomenon has been identified in all major disasters (Fritz and Mathewson, 1957; Boileau  
127 et al., 1978; Wettenhall, 1979; Scanlon, 1991; Neal, 1994; Holguín-Veras et al., 2007; Jaller, 2011), it has  
128 not received commensurate attention in the HL literature.

129 The objective of this paper is to contribute to the study of this important phenomenon and its  
130 impacts on PD-HL. The analyses are based on the fieldwork conducted by the authors at recent disasters  
131 (e.g., Hurricane Katrina, Port-au-Prince earthquake, Tohoku disasters, Joplin tornado, and Hurricane  
132 Irene), and historical accounts. Another important objective is to raise awareness about this problem as  
133 experience shows that the impacts of material convergence are still an issue today as when they were first  
134 formally documented in the 1950s (Fritz and Mathewson, 1957). There is an urgent need to attract  
135 attention to the problem generated by the non-priority component of the material convergence as this is  
136 the only way to take the necessary steps to mitigate the problem. To do so, the paper puts suggests  
137 procedures to handle material convergence, to expedite the flow of critical supplies and decrease the  
138 proportion of useless goods reaching the impacted area.

139           The rest of the paper is organized as follows: Section 2 discusses the evidence and nature of  
140 material convergence; Section 3 focuses on the analysis of the logistical impacts of material convergence.  
141 The paper ends with a summary of key findings and policy suggestions in the conclusions section.

## 142                           **MATERIAL CONVERGENCE: EVIDENCE AND NATURE**

143           Convergent behavior was identified in the first sociological study of a disaster: Prince’s doctoral  
144 research on the Halifax ship explosion (Prince, 1920; Scanlon, 1991). Fritz and Mathewson (1957)  
145 developed the first taxonomy of the phenomenon, defining “convergence” as the movement toward the  
146 disaster area, and identifying variants including personnel convergence (“movements of individuals...”),  
147 informational convergence (“movement or transmission of symbols, imageries, and messages...”) and  
148 material convergence (“the actual movement of supplies and equipment...”) (Fritz and Mathewson, 1957).

149           Strictly speaking, material convergence includes the supplies and equipment sent by all of the  
150 entities that respond to a disaster, including governments, relief agencies, companies, churches, local  
151 community groups and individuals. A typically overlooked feature of this phenomenon is its  
152 heterogeneous nature—including everything from life-sustaining critical items to such useless items as  
153 wedding gowns, costumes, flags, and even dangerous supplies such as expired food and medication.  
154 According to the Saber Donar campaign (Learn How to Donate) (Saber Donar, 2011b)—sponsored by a  
155 coalition of international organizations including the World Food Program, the Pan-American Health  
156 Organization, Oxfam International, the International Federation of the Red Cross, and others—37% of the  
157 medicines sent to El Salvador after the January-February 2001 earthquakes were completely inappropriate  
158 (Saber Donar, 2011a). The heterogeneity and volume of the flow are what make material convergence  
159 such a challenging problem. The heterogeneity of items reflects the diverse nature of the donors (i.e.,  
160 individuals, groups, companies, and even public sector agencies), their radically different perceptions of  
161 the needs on the ground, and their varied levels of access to supplies. The problem is that large numbers  
162 of donors send to the disaster area whatever they have on hand, under the assumption that anything and  
163 everything could be of use.

164           Clearly, significant portions of the convergent flows are very important to the beneficiaries, and  
165 to the response itself. However, the problems produced by useless and inappropriate donations—which  
166 are typically referred to as “unsolicited donations” though the term “in-kind donations” is also used—are  
167 of such seriousness that most discussions of material convergence tend to focus on them. It is important to  
168 mention that, although the term “unsolicited donations” and “in-kind donations” have become  
169 synonymous with useless or inappropriate donations, the authors firmly believe that it is incorrect to do so.  
170 The reason is that meaningful portions of “unsolicited donations”/“in kind donations” are indeed useful. It  
171 is therefore more appropriate to focus on the intrinsic usefulness of the item donated, rather than whether  
172 or not it was “solicited” or “unsolicited” by the local authorities, or “in kind” or “monetary”. To this  
173 effect, the classification developed by the Pan American Health Organization (PAHO) is useful.

174           PAHO classifies donated items as: *urgent or high-priority (HP)*, those items that are required for  
175 immediate distribution and consumption; *non-urgent or low-priority (LP)*, those not immediately needed  
176 that may be useful later on, requiring storage for later use; and finally, *non-priority (NP)*, those items that  
177 should not have been sent to the disaster site (Pan American Health Organization, 2001; Holguín-Veras et  
178 al., 2012b). The bulk of the problems produced by material convergence are the result of the large  
179 volumes of NP flows, and to a lesser extent the LP donations, that arrive at disaster sites.

180           The heart of the problem with NP donations is that they: “...often complicate unnecessarily the  
181 logistics of relief operations...;” “...frequently, [are] items that have not been asked for...;” “...do not  
182 respond to the needs of the affected population...;” “...their handling leads to a waste of time and  
183 resources...;” “...are useless or irrelevant...;” “...those...considered useless due to their condition  
184 (damaged, expired, totally inappropriate) should be discarded as soon as possible, particularly to make  
185 room for useful supplies...;” “...require their own logistics in terms of transport, temporary storage, and  
186 waste management...;” “...do not have adequate labeling to meet the necessary specifications for their  
187 identification per common international denomination, have brand names unknown in the country, lack  
188 expiration dates or are in languages unknown in the receiving country...;” “...donated amounts exceed  
189 needs, and cause problems of adequate storage...;” “...it is hard to reject them if they are useless...;”



190 “...discarding these items should be taken very seriously: they are not "simply garbage." It is often more  
191 convenient to keep them in storage until they can be discarded safely, rather than discarding them where  
192 people may recover them, or where they could constitute a public health hazard...;” “there is also a  
193 diplomatic or public relations difficulty, since the public—including the donors—are not pleased to see  
194 supplies discarded that in their opinion are needed to satisfy the needs of the affected population, although  
195 in reality they are not appropriate for human use or consumption...;” “...these materials may be  
196 incinerated, buried, or otherwise disposed of...” (Pan American Health Organization, 2001). There is  
197 remarkable agreement among almost all major relief organizations and the research conducted on the  
198 subject confirming the negative impacts of NP flows (Fritz and Mathewson, 1957; American Red Cross,  
199 2010; Destro and Holguín-Veras, 2011; Jaller, 2011; Holguín-Veras et al., 2012a; Holguín-Veras et al.,  
200 2012d; Jaller and Holguín-Veras, 2012). Not surprisingly, some responders refer to the arrival of NP  
201 donations as “a second tier disaster” (Newsweek, 2002). In most cases, as suggested by PAHO, the best  
202 decision regarding NP donations is to simply destroy them, though most relief groups do not take that  
203 step for fear of alienating the donors that they depend on to support their operations.

204 Low-priority (LP) supplies can also create enormous complications when they arrive in quantities  
205 that exceeds the needs in the ground. The case of the blankets in Japan (Holguín-Veras et al., 2012b), and  
206 bottled water after the Port-au-Prince earthquake as reported in (Holguín-Veras et al., 2012a) are quite  
207 telling, because in both cases the items were needed at the start of the crises. However, a week after the  
208 tsunami in Japan, when the weather warmed up, the blankets were no longer needed. In Port-au-Prince, so  
209 much bottled water arrived that local relief groups had great difficulty finding adequate storage space for  
210 it; the same situation was reported in Japan (Holguín-Veras et al., 2012d) and Joplin, Missouri.

211 The complications produced by low or NP material convergence have been reported in all  
212 disasters, as illustrated by the sampling of eyewitness accounts, below:

- 213 • **1953 Arkansas tornado:** “All this clothing and food and all this vast store of supplies started  
214 moving ... There was no place to put it ... No buildings to put it in ... That created a big  
215 problem ... We got a tuxedo, a nice one ... One other big building...probably 100ft long and

216 60ft wide, with 14ft ceiling... was filled in 12 hours.” “60% of it was not good; it shouldn’t  
217 have come to the area at all.” (National Opinion Research Center, 1954).

218 • **1992 Hurricane Andrew:** “Excessive donated clothing created major problems... not  
219 appropriate for the tropical climate (e.g., winter coats). Excessive food donations created  
220 further emergency management problems.” (Neal, 1994).

221 • **2001 World Trade Center:** “Chris Ward is snaking through a tunnel of cardboard crates,  
222 past boxes ... The problem is, very little of it was needed.... Little of the cargo reached the  
223 intended recipients, as they simply had no use for it...The propensity of Americans to ship  
224 stuff to national disasters has become such an overpowering reflex that rescue workers now  
225 have to divert considerable resources to ensure the largess does not get in the way. Some even  
226 describe the torrent of sundries as a ‘second tier disaster’ ” (Newsweek, 2002).

227 • **2004 Hurricane Charley:** “One of the most outrageous things I have seen is a truck load of  
228 sex toys that arrived at one of the distribution centers in Florida...” (Holguín-Veras, 2011).

229 • **2005 Gulf Coast:** “Donation management is the most difficult part of every disaster,” he said  
230 of the unsorted mountains of clothes. “We have a little bit of everything.” (Corpus-Christi  
231 Caller-Times, 2005). “Sometimes generosity can go awry.”..... Collection sites along the  
232 Mississippi Gulf Coast became “nothing more than dump sites” (The Times-Picayune, 2005).

233 • **2010 Haiti:** “Nobody seemed to know exactly what was on the boat [that arrived in Port-au-  
234 Prince with no instructions about what to do on arrival], or who actually sent it. One rumor  
235 was that it was from Costa Rica...”; “The boat, it turned out, had mostly packs of water  
236 bottles, which is nice and everything, but water isn't really what Haiti needed right after the  
237 quake. There was plenty of water. Sanitation equipment or rice would have definitely been  
238 more useful. This is one example of aid that just might have been hurting more than it was  
239 helping.” (National Public Radio, 2010). Although hampered by geographic isolation,  
240 material convergence created problems in the response to the Port-au-Prince earthquake.  
241 Interviews conducted by the authors revealed that ten containers of European refrigerators

242 were of no use in Port-au-Prince because of the power outage and the use of a different  
243 voltage (Holguín-Veras, 2010b). When participants in the response to the Haiti earthquake  
244 were asked to identify the major logistical problems they faced, unsolicited donations always  
245 came at the top, adding that “people send things that they do not know if are needed or not...”;  
246 “not suitable”; “expired”; “whatever could fit in a box, it is a dump policy”; “people don't  
247 follow proper protocols” (Holguín-Veras and Jaller, 2010d); “donations were hard to control”;  
248 “a lot of inappropriate donations”; “about 80% of clothing donations were useless” (Holguín-  
249 Veras and Jaller, 2010a); “..big bottleneck and create a big problem”; “shiploads of these  
250 from different organizations, even countries”; “those donations can slow down the  
251 distribution of priority goods, useful goods”; “they need storage, handling, resources”  
252 (Holguín-Veras and Jaller, 2010c); “donations need to be controlled and be subject to  
253 standards”; “donors need to provide transportation (to the impacted area)” (Holguín-Veras  
254 and Jaller, 2010b); “washcloths arrived before water, and Senators before surgeons”  
255 (Associated Press, 2010b).

256 • **2010 Floods in Colombia:** Examples of NP items included a tiger (carnival) costume, used  
257 wedding and party gowns, and even three Spanish flags. “It seems like people were taking  
258 this opportunity to get rid of all their junk...”; “We have received some demeaning donations  
259 like a box full of used underwear...”; “It is offensive to send these type of things to the  
260 victims...” commented a Red Cross volunteer in Barranquilla, Colombia (Ovalle, 2011).

261 • **2011 Tohoku Earthquake, Japan:** Interviews conducted during fieldwork in Japan  
262 indicated, yet again, the problems caused by NP donations. Individuals interviewed  
263 complained about: “too many blankets”; “too much clothing”; “a lot of broken bikes...”;  
264 “people got offended when we told them that we did not need these goods...we had to ask  
265 them to ‘postpone’ the donation to a better time.(Holguín-Veras et al., 2011a; Holguín-Veras  
266 et al., 2011b; Holguín-Veras et al., 2011c; Taniguchi et al., 2011). One of the distribution  
267 centers visited had in excess of 700 metric tons of bottled water, sufficient to satisfy the needs

268 of 350,000 person/days, and 2 million face masks –almost enough to give one mask to each  
269 person living in the entire Tohoku region. Other distribution centers had similar volumes that  
270 so greatly exceeded needs as to become a problem. It is important to mention that the NP  
271 donations came, in spite of the fact that they were discouraged as part of the local disaster  
272 response procedures (Holguín-Veras et al., 2012e).

273 • **2011 Joplin tornado, Missouri:** A field trip to the impacted area revealed numerous cases of  
274 excessive material convergence: “We have been overwhelmed by disorganized generosity...”;  
275 “we have enough water to fill more than two swimming pools”; “about 70% of what we got  
276 was clothing” commented a volunteer from a faith-based organization active in the disaster  
277 response. When asked about clothing, the interviewees responded “We received about 9  
278 semi-trailers with clothing...”; “How to stop the flow?”; “about 70% of the clothing we  
279 receive is unusable” (Jaller and Brom, 2011c). One of the directors of operations for a large  
280 organization put the number of items of usable clothing at 1 in 500 and that “only from 10-15%  
281 gets ever distributed”, adding that people “need to know the implications of what they are  
282 doing” (Jaller and Brom, 2011b). At every warehouse and organization visited, the research  
283 team found an excess of donated water, “We have too much water, we don’t know what to do  
284 with it... we need the space...” (Jaller, 2011; Jaller and Brom, 2011a; Jaller and Brom, 2011c;  
285 Jaller and Brom, 2011b; Jaller and Brom, 2011d).

286 • **2012 Hurricane Sandy:** “...Residents sift through donated clothing left on the street Sunday  
287 for victims of super-storm Sandy in the Rockaways neighborhood of the Queens borough of  
288 New York...” (Schroeder, 2012). “...no more clothes...the way that we and others have been  
289 preparing the clothes for drop-off is not particularly helpful to those people who are so  
290 desperately in need...”; “...The National Guard (at least where we were) is only manning  
291 food and water donations. Everything else is essentially being dumped out back on the  
292 ground. Local residents are sifting through garbage bags and grabbing the few diapers and  
293 wipers that are there. There is no organization. (So, please no more clothes for now until we

294 figure out a better system.)...”; “...All the food went. As did all the toiletries, diapers, etc.  
295 Basically everything went except half a truck of clothes...”; “...Mr. Council Man told us to  
296 put all of the clothes back into the truck and try to take it somewhere else. This was  
297 tricky...she helped direct us to places that were makeshift spots organized by civilians. They  
298 didn’t want any more clothes...[they] had no way of dealing with the already overwhelming  
299 number of garbage bags of clothes...let’s hope it doesn’t rain anytime soon” (Vergel, 2012).  
300 “...While the response is heartwarming, some of that is also helping create a “second disaster  
301 after the disaster”...”; “...it’s really been a lot of stuff really affecting the disaster site...”;  
302 “...by the time the department’s 24-hour donation drive was done, a pile of clothes 7 feet  
303 high filled up a bay usually used to park a truck at department headquarters...” (Mulvihill,  
304 2012).

305 Regrettably, though the phenomenon of material convergence has been documented for a long  
306 time, there have been few attempts to formally analyze its effects on HL operations. Scanlon (1991), Neal  
307 (1994), Holguín-Veras et al. (2007), Destro and Holguín-Veras (2011), Jaller (2011) and Jaller and  
308 Holguín-Veras (2012) are among the few who have studied the subject. Destro and Holguín-Veras  
309 (2011)—who made the first quantitative analysis of the subject—estimated the material convergence  
310 generated by Hurricane Katrina using data extracted from post-processing of media articles. Their spatial  
311 interaction models indicate that the magnitude of the material convergence—and thus its potential impact  
312 on PD-HL—is positively correlated with donor income, and with the distance between the donor and the  
313 disaster. This implies that, should a Katrina-like disaster happen in the vicinity of large and wealthy urban  
314 centers, a huge volume of material convergence would be generated, requiring significant resources to  
315 handle it. Disaster response planning must consider the expected material convergence by designing  
316 operational procedures and analytical formulations that account for it.

317 While there are no data to quantify the volume of the NP flow, there are strong indications that it  
318 exceeds 50% of the cargo that arrives in the first weeks after the disaster. The interviews conducted with  
319 the logisticians involved in relief operations after the Tohoku earthquake indicated that “50% of the cargo

320 was no good...” and that “70% was non-priority...” These estimates were ratified during a visit to a large  
321 distribution center in Iwate Prefecture, where visual inspection revealed 40-50% of the space occupied by  
322 clothing. Once other NP items are added, it seems reasonable to estimate that the NP flow is in excess of  
323 50% of the total (Holguín-Veras et al., 2012e). These estimates are consistent with the literature (e.g.,  
324 “...60% of it was not good...” (Fritz and Mathewson, 1957).

325           For a number of reasons, NP convergence remains a major problem for PD-HL. In a significant  
326 number of cases, NP goods are sent by spontaneous donors who are not aware of the actual needs at the  
327 disaster site, and who do not check with local authorities or experienced relief organizations about how  
328 best to help out. In other instances, the NP donations are made by private companies that perceive the  
329 disaster as a marketing opportunity, or as a practical outlet for dumping unwanted inventories of supplies,  
330 or receiving a charitable contribution tax deduction. Given the endless number of potential motives, there  
331 are also numerous ways to influence donor behaviors for the better. Many of these donors do not  
332 understand, or believe, that they are creating a problem. A large relief organization organized focus  
333 groups with donors of NP supplies which revealed that the donors believe that they were doing nothing  
334 wrong, and that it is the responsibility of the relief organization to make good use of whatever supplies  
335 are donated. This puts relief organizations in a very delicate situation. On the one hand, they rely on  
336 donors to support their operations, particularly after a large disaster. On the other hand, a significant  
337 percentage of these donors tend to donate LP and NP goods, which creates complications that these  
338 groups would like to avoid. Statements made to the authors revealed a fear that restricting or refusing  
339 donations would be criticized, which in turn would negatively affect the willingness of the donors to  
340 support the organization. This places relief groups in a prisoner’s dilemma. If all relief groups collectively  
341 educate the public on how to donate, all of them would be better off. However, if one group does not  
342 cooperate—avoiding potentially offending donors—it may become the main beneficiary of the donations  
343 (both good and bad) coming from those donors who were turned off by the education campaign. This  
344 dilemma, in turn, leads all groups to reject the cooperative strategy of publicly confronting the problem.

345           There have been efforts to reduce the amount of NP supplies, including the International  
346 Federation of the Red Cross (IFRC)’s introduction of a Relief Mobilization Table (Gatignon et al., 2010).  
347 While the national societies of the IFRC used to push whatever they considered was needed to the disaster  
348 site, they now pick items from a ‘Needs Table’ on the IFRC website, that is based on a field assessment.  
349 Flows are pulled (needs-based) rather than pushed (availability-based). The fact that national societies  
350 took a lot of convincing to adhere to the new system shows how difficult the issue is, even within a single  
351 organization. Although this strategy has improved things, interviews with logisticians and representatives  
352 of numerous relief organizations indicate that NP convergence is still a major issue to be resolved.

353           Increasing empirical evidence suggests that information convergence influences material  
354 convergence. With the media’s arrival at the site, needs are portrayed in a way—both subjective and with  
355 an emphasis on the most newsworthy aspects—that generates material convergence of a kind that it is not  
356 always the best. The authors have found numerous examples of this phenomenon. For example, the media  
357 focus on the collapse of a school in China galvanized donor support to aid schools at the expense of other  
358 worthy but less visible projects (Wenchuan Earthquake Reconnaissance Team, 2008; Wachtendorf, 2010).  
359 Similarly, communities that had the most media attention after the Indian Ocean tsunami received most of  
360 the donations; less visible communities nearby were still waiting for help a month after the disaster  
361 (Wachtendorf et al., 2006). In the initial days of the 9/11 crisis, a TV news reported that search and rescue  
362 dogs were getting their feet burned by fires under the rubble, prompting untold numbers of pet stores  
363 (Jeffers Pet Stores, 2001), dog shoe manufacturers (Muttluks, 2002), and dog lovers to send dog shoes to  
364 the site in an amount described to the first author as a “tsunami.” After the Joplin tornado, a faith-based  
365 organization told the media that they had a shortage of (power) extension cords. Shortly afterwards,  
366 massive numbers of extension cords started to arrive, quickly overwhelming both the storage capacity and  
367 actual needs on the ground (Jaller and Brom, 2011c). In a case of internally displaced people (IDP) camps  
368 in Afghanistan, where it was reported that a lack of life-sustaining supplies had caused deaths among  
369 children (New York Times, 2012a), the camps were overwhelmed with shipments of supplies (New York

370 Times, 2012b). Clearly, a significant portion of the disaster relief flows seem to be generated or  
371 influenced by how the media frames the needs (Wachtendorf et al., 2010b).

372 Like three lanes of traffic merging into a one-lane tunnel, the large volumes of LP and NP  
373 supplies that arrive at a disaster site impede the flow of HP goods. Without traffic control, huge delays  
374 can affect all lanes. However, with controls whereby NP flows are diverted and LP flows are delayed or  
375 sent to storage to warehouses outside the disaster area, the tunnel capacity could benefit the HP flows  
376 (Jaller and Holguín-Veras, 2012). The fundamental insight is that, to maximize the beneficial impacts of  
377 the relief effort, the available transportation capacity should be allocated primarily to the transport of HP  
378 priority supplies. This important insight is consistent with the literature of optimal pricing of capacitated  
379 transportation facilities (Holguín-Veras and Jara-Díaz, 1998; Holguín-Veras and Jara-Díaz, 2008). Such  
380 control can happen by default, consensus, or by command, though the latter is not easily accepted.

### 381 *Nature of material convergence*

382 Understanding the nature of material convergence requires a look at the underlying factors that  
383 influence donation behavior, at both the individual and group/organizational level. Philanthropy has been  
384 studied from such fields as: social sciences, social psychology, biological psychology, neurology and  
385 brain sciences, sociology, political science, anthropology, evolutionary psychology, marketing,  
386 economics, and, engineering (Bekkers and Wiepking, 2010). Although an extensive body of research  
387 exists on philanthropy, an in-depth review is beyond the scope of this paper. From the early 1970s,  
388 philanthropy has been associated with the wellbeing or utility derived by individuals from giving and  
389 consuming (Schwartz, 1970; Hood et al., 1977), and major efforts have been devoted to analyzing  
390 questions of: who gives? what? how much? why? how? and to whom? (Bird and Bucovetsky, 1975; Hood  
391 et al., 1977; Andreoni, 2001; Schervish et al., 2002; Bryant et al., 2003; Andreoni, 2008; Andreoni and  
392 Miller, 2008; Bekkers and Wiepking, 2010; Havens and Schervish, 2010; List, 2011). Recently, scientists  
393 and economists have shown the benefits of using experimental economics to understand charitable giving,  
394 fund-raising, the determinants of altruism and how interdependences between individuals and  
395 organizations affect charitable contributions (List and Rondeau, 2003; Andreoni, 2007; Lange et al., 2007;



396 Andreoni et al., 2008; Andreoni and Miller, 2008; Rondeau and List, 2008; Andreoni and Rao, 2011;  
397 Karlan et al., 2011; List and Peysakhovich, 2011). These efforts have resulted in multiple theories, and, in  
398 some cases, contrasting conclusions.

399         However, in spite of the number of publications dealing with philanthropy, only a handful of  
400 publications have analyzed the factors that affect the likelihood of donations in the aftermath of disasters.  
401 Destro and Holguín-Veras (2011) analyzed the donations reported in the media after Hurricane Katrina,  
402 and estimated econometric models of both monetary and in-kind donations. They found econometric  
403 evidence that indicates that monetary donation amounts are a direct relation with family income per capita,  
404 population density, individual and corporate donations, and an inverse one with the percentage of  
405 unemployed population with only high school education with respect to total population, and distance to  
406 the impacted area. In addition, they found that in-kind donation amounts increase with median rent and  
407 population density, and decrease with distance to impacted area, percentage of younger population than  
408 twenty years, unemployed population over sixteen years, average family size This is consistent with the  
409 literature. Fong and Luttmer (2009) analyzed racial effects in charitable giving after Hurricane Katrina.  
410 The results show no clear relation between the likelihood of donation and race (objective race); however,  
411 subjective racial identification or ethnic proximity does relate. Steinberg and Rooney (2005) describe the  
412 results of a survey conducted after the events of September 11, 2001, and conduct multivariate analyses of  
413 the determinants of giving and volunteering. Results indicate that about 65% of all surveyed American  
414 households made financial contributions; 27.2% donated other goods such as food, clothing, or blood; and  
415 about 9% volunteered. Their findings are consistent with the literature. Schweitzer and Mach (2008)  
416 analyzed donations before and after the 2004 Asian Tsunami. Their results indicate that there were  
417 statistical similarities between donations made before and after the disaster. In addition, they found  
418 dynamics effects on individual donations triggered by the mass media portrayal of the disaster. In their  
419 analysis of corporate donations after the South Asian Tsunami, Hurricane Katrina and the Kashmiri  
420 earthquake, Muller and Whiteman (2008) suggest that corporate philanthropic disaster response varies  
421 systematically across regions; and, analyzed the effects of corporate donations due to home regional

422 effects and local presence effects, by which corporations give more importance to disasters closer to home,  
423 or in locations where they have local presence. They argue that this is the result of a possible sense of  
424 responsibility or a greater degree of tangibility. As a result, there are regional differences in the way  
425 corporations respond to specific disasters. The results suggest that in the aftermath of a catastrophic  
426 disaster, corporate donations are expected to be larger than those provided by individuals/households.

427         In general, the individuals who make donations of LP and NP supplies out of a genuine  
428 philanthropic interest, tend to make them through other organizations (Destro and Holguín-Veras, 2011).  
429 Thus, it is useful to analyze the nature of the organizations involved, and to think of donors as remote or  
430 virtual participants in the HL response. Deprived by distance of the opportunity to participate in the actual  
431 response, donors focus their energy instead on gathering the donations that they believe would help the  
432 survivors. (Obviously, this assumption does not apply to individuals and companies with other motives  
433 for donating.) Quarantelli and Dynes (Quarantelli, 1966; Quarantelli et al., 1966; Dynes, 1970) produced  
434 a taxonomy of the different types of social collectives, entities or organizations involved in disaster  
435 response operations. The taxonomy is a function of the nature of the tasks undertaken, and the post-  
436 disaster structure. See Table 1.

437         The tasks undertaken could be either regular or non-regular (Quarantelli, 1966; Quarantelli et al.,  
438 1966; Dynes, 1970). Regular tasks are those that would be routinely undertaken prior to the disaster,  
439 either old, routine, assigned, or everyday. Examples include: the fire department controlling fires, or  
440 hospitals treating injured people. In contrast, there are disaster-generated tasks, which may be new, novel,  
441 assumed or unusual for the groups undertaking them. Examples of organizations engaged in non-regular  
442 tasks include the US Army providing water to the affected population, churches sheltering evacuees, or  
443 teachers' associations handling and distributing supplies at an aid center.

444         In terms of structure, organizations could have old/established structures, or new/emergent ones  
445 (Quarantelli, 1966; Quarantelli et al., 1966; Dynes, 1970). Organizations with old/established structures  
446 have members that share pre-disaster social and working relationships. These groups could have different  
447 levels of organizational formality, ranging from highly structured systems, e.g., the military, to less

448 formal structures, e.g., a volunteer group. These groups existed as entities prior to the disaster, and the  
449 interactions between the different members continue during the disaster's regular and non-regular  
450 activities. Essentially, pre-disaster social bonds are maintained in post-disaster tasks. In contrast,  
451 new/emergent structures are those in which the structure is developed or comes into being during the  
452 disaster; either morphing from other pre-disaster structures or arising as a new entity, e.g., an informal  
453 search and rescue team formed by volunteers after the disaster. Although these emergent social entities  
454 may be partly planned, the actual group materializes during the disaster (Quarantelli et al., 1966).

455 As shown in Table 1, four distinct types of organizations are defined. Type I (established) are old  
456 organizations carrying out their regular tasks, such as the police controlling traffic in the impacted area.  
457 Type II (expanding) are new organizations performing regular tasks, which are more often than not the  
458 result of community or organizational planning, such as volunteers running a shelter. Type III (extending)  
459 are old organizations that undertake non-regular tasks, such as a construction company utilizing their  
460 assets on rescue operations. Type IV (emergent) organizations are new structures that engage in non-  
461 regular tasks, such as an ad hoc group made up of the city mayor and a local church leader working  
462 together to coordinate the overall response efforts (Quarantelli, 1966; Dynes, 1970).

463 Although caution must be exercised when making general statements about expected donation  
464 behavior—particularly in relation to a complex and poorly understood subject like material  
465 convergence—it seems safe to establish a set of working hypotheses about the different types of groups  
466 identified in Table 1 and their contributions to material convergence. The first hypothesis is that  
467 organizations that regularly gather and distribute donations in response to a disaster are more likely to  
468 have a better sense of the actual needs than an organization for which these tasks are new (non-regular).  
469 Thus, it could be expected that established and expanding organizations would generate a flow of cargo  
470 (or solicit donations) with a relatively higher percentage of HP goods. Conversely, since for extending  
471 and emergent organizations PD-HL is a non-regular task, these groups are likely to generate flows of  
472 cargo less suited to the actual needs, with relatively large proportions of LP and NP supplies. Should this  
473 conjecture be confirmed, it would mean that the level of familiarity of the task could provide an indication

474 of the relative amounts of HP, LP, and NP supplies that these groups are expected to generate. From this  
475 perspective, one could assume that the flows of established and expanding organizations are *regular*  
476 flows, while those from extending and emergent organizations are *non-regular* flows. Obviously, this  
477 does not mean that established and expanding organizations would not send inappropriate donations; or  
478 that emergent and extending organizations would not send high priority supplies. It simply says that they  
479 have different probabilities of doing so. Moreover, there is a great deal of nuance and complexity; while  
480 established and expanding organizations may be expected to donate primarily HP supplies, the reality is  
481 that if they collectively send supplies in excess of the actual needs, the usefulness of those supplies will  
482 rapidly decline. This was the case with blanket donations after the Tohoku disasters, the bulk of which  
483 came from established organizations. In light of these considerations, the paper assumes that the material  
484 convergence generating behavior of these organizations could be characterized by a set of probabilities—  
485 to be determined empirically—that measure the fractions of HP, LP, and NP supplies generated.

## 486 **LOGISTICAL IMPACTS OF MATERIAL CONVERGENCE**

487 To formulate appropriate corrective measures, it is essential to understand the logistical impacts  
488 of material convergence. Figure 1 shows a schematic of the flows converging to the disaster site as a  
489 series of lines emanating from the donor sites; the different flows are depicted by different dotted lines.  
490 The figure shows the entry points and end sites inside the disaster area, where the impacts of the material  
491 convergence are most acute. Although in a major disaster there could be tens of thousands of donor sites,  
492 and hundreds of end sites inside the disaster area—for clarity Figure 1 only shows ten of the former and  
493 two of the latter. The impacts produced at both entry points and end sites are discussed next.

### 494 ***Impacts at entry points***

495 “Entry points” are the locations at which the disaster area can be accessed. These could be located  
496 in the region surrounding the disaster area (e.g., the highways leading to New Orleans after Hurricane  
497 Katrina, the Port-au-Prince airport after the Haiti earthquake), or hundreds of miles away (e.g. for Haiti,  
498 the Santo Domingo airport in the Dominican Republic, and the border crossing between Haiti and the

499 Dominican Republic). Some of the flows go through multiple entry points, such as cargo planes that  
500 arrived at Santo Domingo impacting both the airport and the border crossing at Jimaní. In localized  
501 disasters there could be numerous entry points as the impacted area could have multiple connections to  
502 the rest of the area, whereas in large disasters and catastrophic events the number of entry points is  
503 typically small as these tend to be the transportation links that connect the impacted area to the rest of the  
504 country. At entry points, convergent flows may be inspected by government officials who check the  
505 cargos, the manifest, bills of lading, or any other shipping documentation available, deciding whether to  
506 grant access to the disaster area. In cases where access to the disaster area is not controlled—e.g. after the  
507 Port-au-Prince earthquake—NP items are allowed to travel unimpeded to the disaster area. This  
508 essentially shifts the problem from the entry point to the end site, by far the worst outcome possible.

509         Material convergence impacts entry points in different ways, including the congestion produced  
510 by vehicular traffic. Although there are no reliable estimates of the traffic associated with the material  
511 convergence, the Haiti disaster provided anecdotal evidence of the congestion problem. Two days after  
512 the disaster, the number of planes wanting to land at the Port-au-Prince airport skyrocketed from an  
513 average of about 25 flights per day (Shaughnessy, 2010) to more than 120 takeoffs and landings  
514 (Associated Press, 2010a). Due to landing capacity constraints, there were sometimes two dozen planes  
515 circling the airport for more than two hours; many had to be diverted to Santo Domingo or Florida  
516 (Associated Press, 2010a). In the words of some of the participants: “...when the quake hit, the global  
517 crush of compassion turned the Haitian capital’s airport into a virtual baseball catcher, with pitchers  
518 throwing balls from all directions at the same time...” (Associated Press, 2010b); “...the airport is  
519 actually overwhelmed by aid...”, (Sheridan and Branigin, 2010).

520         To ensure that critical supplies could land, the US Air Force air traffic controllers, who took over  
521 the airport, imposed a priority landing system to avoid the risk of a complete airport shutdown (New York  
522 Times, 2010). Scores of planes that did not meet the criteria for priority landing were diverted 180 miles  
523 away to the Santo Domingo airport, where they also created major logistical problems. After lengthy  
524 international flights, these cargo planes had to be allowed to land because they were running short of fuel.

525 The Dominican authorities had no choice but to ensure that the planes were promptly unloaded so that  
526 they could leave as soon as possible, otherwise they would quickly clog taxi areas and warehouses,  
527 leading to the shutdown of a critical airport that normally receives thousands of tourists. Thus, the cargo  
528 had to be sorted, transported to Haiti, or discarded if unusable, all at the Dominican Government's  
529 expense because most donors had not made provision for the transport to Haiti, or identified suitable  
530 recipients willing to accept their donations (Holguín-Veras, 2010a). The situation at the Jimaní border  
531 crossing (between Haiti and the Dominican Republic) was similar. Witnesses reported more than a  
532 hundred trucks on peak days, waiting for the border to open. The road leading to the border crossing,  
533 designed for a much smaller volume, had only one lane per direction with narrow shoulders, hence any  
534 inspection of the cargo of a truck delayed the entire queue waiting to enter Haiti.

535         The port in Port-au-Prince—severely damaged by the earthquake—was spared the onslaught in  
536 the first days of the emergency. However, once a floating pier was anchored at the port, the convergent  
537 traffic dramatically increased. The Mexican government announced that its Navy would transport to Haiti  
538 all of the donations that its people cared to send. Not surprisingly, this free transportation increased the  
539 volume of NP material convergence tremendously. During the year following the disaster, these ships  
540 made about 20 trips to Port-au-Prince (El Universal, 2011)—eight during the first six weeks—  
541 transporting mostly NP donations to the great consternation of the HL experts working on the response.  
542 The authors had the opportunity to observe the cargo unloaded from one of these ships: an assortment of  
543 unlabeled boxes of unknown contents, and food products not consistent with the dietary habits of Haitians.  
544 As was true at the Santo Domingo airport, the local responders had no choice but to unload the ships, sort  
545 the cargo, put it to the best use possible, and discard the rest. When asked if they had suggested the  
546 Mexican government to stop bringing these donations, the interviewed HL experts indicated that they  
547 could not risk offending the government of an important country which could play a key role in future  
548 relief operations. This incident provides a clear example of the complexity and sensitivity that surrounds  
549 efforts to control material convergence.

550 In addition to the congestion produced by the vehicles, the NP flow of supplies typically requires  
551 longer inspection times, increasing processing delays significantly. Critically, a large portion of the NP  
552 flow lacks proper documentation frequently arriving without a consignee, and consisting of poorly labeled  
553 boxes with mixed contents that require considerable processing time and effort to extract whatever useful  
554 supplies they may contain. These goods are typically assembled at donation drives by volunteers with no  
555 training in shipping or logistics; then hastily packed in a truck or shipping container, and sent to the  
556 disaster area in the hope they may benefit the survivors.

557 NP material convergence is also generated by large and prominent private companies that—either  
558 out of ignorance or a misguided sense of public relations/marketing—donate inappropriate products. Less  
559 than 24 hours after the Haiti earthquake, a plane landed in Port-au-Prince loaded with children’s toys  
560 donated by a Thai manufacturer, accompanied by a television crew from that country. After pictures and  
561 videos were taken, the planes and the television crew left, leaving several tons of toys on the tarmac  
562 where they remained for months, obstructing traffic (Holguín-Veras and Jaller, 2010a). Another egregious  
563 example was a shipment of several tons of a highly caffeinated drink and potato chips that arrived at the  
564 Port-au-Prince airport to great fanfare. Due to the prominence of the donor, key staff members from the  
565 relief agencies were asked to participate in a ‘thank you’ ceremony. Indeed, prominent companies  
566 frequently use their political influence with governments to ensure their donations are “accepted” by the  
567 local responders. There were also reports of planes with solar-powered talking bibles (Reuters, 2010).  
568 Meanwhile, a French portable hospital and planeloads of doctors with medical supplies were diverted to  
569 the Dominican Republic (Associated Press, 2010b). After the tornado in Joplin, Missouri, several tons—  
570 thousands of bottles—of a beverage arrived that had apparently been pulled of the commercial market  
571 because it did not sell well. Months afterwards, untold amounts of the beverage remained in the  
572 warehouses of numerous relief groups as most who tried it deemed it “undrinkable” (Jaller and Brom,  
573 2011c; Jaller and Brom, 2011d).

574 As a result, government officials manning the entry points are forced to choose among  
575 alternatives that are far from ideal. They can thoroughly inspect the vehicles, including those without

576 proper documentation and/or consignee, to prevent the criminal element from taking advantage of the  
577 situation to smuggle contraband, drugs or weapons. This consumes significant resources and delays HP  
578 shipments. The second possibility is to simply deny passage to any vehicle without proper documentation  
579 or consignee. This requires the provision of space for detours, and potentially opens the door to  
580 accusations of impeding humanitarian aid. The third option entails cursory inspections of the vehicles,  
581 which avoids massive delays but fails to stop the criminal traffic. In cases where local officials bow to  
582 pressure and opt for the third alternative, which happens frequently, the problems caused by the flow of  
583 NP material convergence are simply transferred to the end sites.

#### 584 ***Impacts at the end site***

585         The term “end site” refers to the place where the material convergent flows terminate their  
586 journeys, where the flows interface with the impacted region. The potential end sites are endless: a formal  
587 warehouse operated by an established organization, an improvised staging area in the parking lot of a  
588 commercial center, an informal processing point at a local church, or a site where drivers dump their  
589 cargo when they cannot find anyone to take it. In most cases, since the end sites are either in the disaster  
590 area or close to it, they may have been impacted, and transportation and communication networks may  
591 not be fully functional.

592         With roads blocked by damage or debris, trucks carrying NP supplies increase congestion,  
593 aggravating citizens already traumatized by their experience, and disaster respondents who are working to  
594 help get things back to normal. The absence of a consignee magnifies the problem. Dominican  
595 Government officials indicated that during the days after the earthquake “about 60 to 70% of the planes  
596 came with no consignee...” The cargo was succinctly described as “Aid for Haiti.” In the absence of a  
597 contact at the disaster site, drivers are simply instructed to give the cargo to any group that can make good  
598 use of it. If left unchecked, these wandering trucks seeking a willing recipient create congestion in the  
599 disaster area. Often failing to find anyone that accept the supplies they dump their cargoes in any open  
600 area, preventing a more beneficial use of the space and putting the local population at risk. Rotting piles  
601 of unwanted supplies become a magnet for insects, rats, and other disease carriers. For example, days



602 after the Joplin tornado a truck driver who arrived with a "...truckload of cat food..." called radio station  
603 KZRG to find out where to take the shipment. The startled radio announcer is heard saying "A truckload  
604 of cat food? Well...I don't actually know..." (National Public Radio, 2011). Obviously, several tons of  
605 cat food may not be a first priority need for a city where 8,000 houses have recently been destroyed  
606 (National Weather Service, 2011). After Hurricane Andrew: "Truck drivers with loads of clothes drove  
607 straight to severely damaged areas... they often did not know where to deliver the donated clothes, so  
608 they unloaded them on the side of the road. The heat and usual afternoon summer rains quickly turned the  
609 piles into heaps of stinking, rotting cloth." (Neal, 1994).

610           Disaster response agencies have taken some remedial steps to minimize the negative impacts of  
611 NP material convergence. For instance, the Federal Emergency Management Agency (FEMA) advises  
612 city governments to establish donation management procedures that are typically coordinated with the  
613 Volunteer Organizations Actives in Disaster (VOAD) network. FEMA, in collaboration with private  
614 companies and foundations, funded a national disaster relief coordination program called the National  
615 Donations Management Network Program (Federal Emergency Management Agency, 2011). This system  
616 is designed to help manage unsolicited donations and volunteers, connecting state and local governments  
617 with donors; VOAD at state and national levels, and FEMA. This Internet based system allows for the  
618 logging, tracking, sharing and matching of in-kind donations and volunteers with needs, and provides a  
619 portal for the referral of financial donations. It offers a promise to reduce the NP donations to the  
620 impacted area. However, interviews with relief organizations after the Joplin tornado and after Hurricane  
621 Irene indicated that the software is rarely used, though some large donors use it.

622           The resources required to handle NP flows are considerable. For instance, one-third of the 60  
623 workers at a large warehouse in Iwate Prefecture (Japan) visited by the lead author were assigned to  
624 sorting the clothes that had been donated. Similarly, a recent visit to an organization active in the Joplin  
625 Missouri tornado response showed that about 50% of the personnel were assigned to handling the flow of  
626 used clothing. Interviews with emergency responders at other organizations revealed that many of them,  
627 from lack of experience, initially accepted the non- and LP supplies. However, they were rapidly

628 overwhelmed by the massive flow of cargo and were forced to refuse the unwanted supplies. Obviously,  
629 using such manpower for the processing of useless NP supplies is a waste of human resources.

630 As discussed, material convergence and particularly its NP component can negatively impact the  
631 PD-HL process. Based on the findings from the research conducted, the following sections discusses  
632 concluding remarks and proposes some policy suggestions.

## 633 **CONCLUSIONS AND POLICY SUGGESTIONS**

634 The research reported in this paper focuses on the important and overlooked phenomenon of  
635 material convergence, which is the spontaneous flow of supplies and equipment that is sent to the disaster  
636 area by donors of all kinds (e.g., individuals, community groups, companies, government agencies).  
637 Material convergence is comprised of a highly heterogeneous mix of supplies, which could be classified  
638 into high-priority (HP), the supplies that are needed in immediately; low-priority (LP), which are those  
639 that must be stored for later use; and non-priority (NP), that are the supplies that should not have been  
640 sent to the disaster site. Obviously, the HP and LP supplies are of benefit to either the survivors, or the  
641 response itself.

642 Unfortunately, large portions of the material convergence (the data available suggests between 50%  
643 and 70%) are NP supplies that create major complications for the response effort, particularly at the  
644 disaster area entry points and end sites because they arrive when the responders are struggling to restore  
645 things to normal, and when the transportation and logistical capacity to handle the massive flows of  
646 supplies are at their lowest point. Moreover, the NP supplies are problematic in other respects as they: are  
647 not needed; are useless or irrelevant; arrive in excess of actual needs; are culturally inappropriate or  
648 offensive; have surpassed expiry dates, are perishable, or are in poor condition; arrive without a known or  
649 appropriate site for efficient distribution; require significant handling; require their own logistics; do not  
650 have adequate labeling or arrive in a condition impossible to efficiently inventory/identify; cause  
651 problems of adequate storage; cannot be rejected as they can lead to diplomatic or public relations  
652 difficulties; may need to be incinerated, buried or disposed of (Pan American Health Organization, 2001).

653           The donors and their motivations to send these supplies are as varied as the supplies themselves.  
654 Although for reasons of space, it is not possible to enumerate all possible motives, it is important to  
655 mention a few. There is the case of individuals, community groups, churches, and private companies that  
656 share a genuine interest in helping, and lack awareness about what is actually needed at the site and the  
657 negative impacts that their donations could produce. These donors tend to send whatever supplies they  
658 have at hand under the mistaken belief that anything and everything is useful. Less altruistic motives can  
659 be seen with private companies that perceive the disaster as a marketing opportunity, either donating  
660 unwanted items for a charitable contribution tax deduction, or, more egregiously, using the disaster as a  
661 way to get rid of unwanted products that either did not sell well or are expired or about to expire.  
662 Changing donor behavior is essential to mitigate the negative impacts of material convergence. Research  
663 on how to influence donor behavior must be a high priority, given both the delicacy and importance of the  
664 issue. Awareness campaigns needed to induce donor behavior changes could, indeed, offend some donors,  
665 but not confronting the issue will lead to the perpetuation of the problem. Examples of these types of  
666 strategies include the guidelines provided by the Center for International Disaster Information (CIDI) in  
667 partnership with the United States Agency for International Development’s Office of Foreign Disaster  
668 Assistance (OFDA) on the best ways to support disaster relief (Center for International Disaster  
669 Information, 2012), or the “Saber Donar” campaign (Saber Donar, 2011b; Saber Donar, 2011a).

670           As this paper makes clear, the problems and issues associated with material convergence are as  
671 clear today as when they were first discussed by Fritz and Mathewson (1957), decades ago. The  
672 humanitarian community must work together to mitigate the “second-tier disaster” that can so  
673 dramatically complicate their relief efforts.

674           The research conducted has identified a number of important findings that ought to be  
675 incorporated into disaster planning and response procedures. To facilitate interpretation, the most salient  
676 ones, together with the corresponding policy suggestions, are summarized in Table 2. As shown, the  
677 findings have been organized according to their positions in the disaster response cycle. Needless to say,

678 the effectiveness of the suggestions could be greatly enhanced if they are incorporated in disaster  
679 planning activities. This will be of great help if the need arises.

680 Suggestion (1) in Table 2 implies that response plans should account for the fact that the amount  
681 of material convergence depends on the proximity to potential donors. The closer the disaster to a large  
682 and wealthy urban area, for instance, the larger the convergence that is likely to take place. The table also  
683 highlights, in suggestion (2), the imperative necessity to proactively engage the media so that the way in  
684 which they portray the actual needs helps, and not hinders, the response process. It should be said that  
685 while some researchers (Wachtendorf et al., 2006; Schweitzer and Mach, 2008; Wachtendorf, 2010) have  
686 tried to understand the impact of the media on material convergence, how to use the media to influence  
687 donation behavior is still an open question. The rest of the suggestions are reactive in the sense that they  
688 are the kind of activities that take place once the disaster happened. Of great importance are suggestions  
689 (3) to (6) as they could dampen NP material convergence at the source thus saving the donors the expense  
690 of transporting supplies that are not likely to be used. However, for these measures to be successful, local  
691 authorities must be ready to both engage the media, and put forward clear and succinct press releases that  
692 the media could disseminate. This is particularly important when dealing with the international media.  
693 Suggestions (7) to (9) are the last line of defense against the negative impacts of NP convergence.  
694 Because of the speed at which the convergence arrives, local authorities must start preparing for it as soon  
695 as practically possible. As suggested in the table, multi-stage access control procedures must be set in  
696 place. The main goal of such control process is to use the resources available to expedite the HP flows, by  
697 preventing the NP flows to enter the disaster area, and slowing down or sending to storage the LP  
698 supplies (Jaller, 2011; Holguín-Veras et al., 2012e; Jaller and Holguín-Veras, 2012). This necessitates  
699 making decisions concerning location of access control sites, identification of manpower and access rules  
700 that specify what flows are allowed to enter the disaster area.

701 The paper's chief conclusion is that a multi-disciplinary management and control approach is  
702 needed to maximize material convergence's potential benefits while minimizing its negative impacts on  
703 the response, and ultimately, on the welfare of the disaster victims. Towards this end, it is imperative that

704 further research efforts are spent on understanding material convergence, its origins and dynamics, and  
705 the role of the media in influencing donor behavior.

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**Table 1: Taxonomy of Organizational Structures**

		Post-disaster tasks	
		Regular	Non-regular
Post-disaster structure	Old (familiar)	Type I (Established)	Type III (Extending)
		New (unfamiliar)	Type II (Expanding)

Note: After (Quarantelli et al., 1966)

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**Table 2: Chief Findings and Policy Suggestions**

<b>Chief conclusions</b>	<b>Policy Suggestions</b>
(1) Material convergence increases with donors' wealth, and decreases with the distance between donor and disaster.	(1) The resources allocated to physical control of the material convergence must be commensurate with the amounts expected, which may depend on proximity to large donor areas.
(2) How the media portrays the needs has a large influence on the material convergence that is generated.	(2) Disaster response agencies and groups must try to educate the media <u>before</u> a disaster so that they are aware of the impacts that their reports could have on the response itself.
(3) The flow of material convergence is comprised of a highly heterogeneous mix of HP, LP, and NP supplies.	(3) Efforts must be made to minimize the flows of LP and NP supplies, ideally at the source of the donations. This will require proactive education and awareness campaigns aimed at the donors that produce large amounts of LP and NP supplies. (4) Information systems that advise on actual needs could be useful, particularly for and to large established organizations. However, since these advisory systems do not take into account the amount of supplies already in transit, they could lead to excessive donations of HP and LP supplies. (5) As major relief agencies have started doing, cash donations must be encouraged. (6) In cases where donors have access to physical donations with market value, they should be encouraged to sell them and donate the proceeds to reputable relief organizations. This will make good use of the supplies at hand, will avoid the cost of transporting the supplies to the site, and eliminate the numerous problems produced by LP and NP flows.
(4) NP supplies could exceed 50% of the cargo reaching the site, overwhelming responders when they have other more urgent tasks. (5) LP and NP supplies hamper the flow of HP supplies. (6) The negative impacts of LP and NP supplies at end sites are larger than at entry points.	(7) Access control must: prevent NP supplies from entering the disaster area, delay LP flows, and expedite HP supplies. (8) Multi-stage access control systems play a key role. Pre-screening locations before entry points could be used to stop NP flows, allowing only LP and HP donations to proceed (Jaller, 2011; Jaller and Holguín-Veras, 2012). At entry points, LP supplies could be stored or rerouted to other storage locations; while HP supplies are allowed to continue their journey. (9) To expedite the process, the supplies transported by established and expanding organizations—for whom post-disaster response is a regular task and are likely to have a solid idea about actual needs—could be waived inspections at access control locations.