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IT-enabled Interorganizational Information Sharing Under Co-opetition in Disasters: A Game-Theoretic Framework

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Abstract:

Increasing uncertainty in the business world requires organizations to establish temporary, IT-enabled interorganizational information exchanges on short notice. Information sharing among disaster relief organizations represents an extreme case of these ad hoc interorganizational information exchanges, and therefore provides a good reference point for analyzing firms' strategic competitive and cooperative considerations (co-opetition). While ad hoc IT-enabled interorganizational information sharing is particularly crucial in facilitating efficient disaster response, little research has outlined the main barriers and benefits of participation in these ad hoc information relationships, with the existing literature often overlooking the competitive aspects. We demonstrate that the ad hoc humanitarian context of natural disasters provides additional insights to existing understandings of information sharing costs and benefits under co-opetition. An elaborated game-theoretic model is developed that provides a theoretical foundation for empirical and modeling research on IT-enabled interorganizational information sharing, under co-opetition in disaster relief, as well as in other business contexts.

Keywords: co-opetition; IT-enabled interorganizational information exchanges; ad hoc information sharing; supply chain; non-profit organization; NGO; disaster relief; game theory

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I. INTRODUCTION

Managing interorganizational and international collaboration has garnered substantial scholarly attention [Romano, Pick and Roztocki, 2010]. At the forefront of this research is the recognized role that IT-enabled information sharing plays in the success of coordination and cooperation [Chen, Rao, Sharman, Upadhyaya and Kim, 2010]. However, the vast majority of research on interorganizational information sharing is based on the premise of a relatively stable and consistent economic and political environment, supported further by the development of long-term trusting relationships [Klein and Rai, 2009].

Unfortunately, the world is not always stable or predictable, which inhibits the ability to establish and continuously develop relational capital between interorganizational partners. Growing political unrest and increasing globalization create substantially more stressful socio-economic conditions, and the political frictions that can result can disrupt established supply chains. Environmental unpredictability and shocks (e.g., supra variant economic cycles, political conflict) often encourage temporary alliances among business firms [Marino, Lohrke, Hill, Weaver and Tambunan, 2008], which makes firms more susceptible to increased risks of opportunism [Luo, 2007]. In these disruptive situations, firms find that they must move in a tricky gauntlet of cooperation and competition often referred to as "co-opetition" [Brandenburger and Nalebuff,1996; Lee and Panteli, 2010; Loebbecke, Van Fenema and Powell, 1999].

Nowhere is the need to establish cooperative, ad hoc, interorganizational relationships more prevalent than in the case of natural disasters [Leidner, Pan and Pan, 2009]. In such conditions an integrated, interorganizational disaster response is called to immediate action, and then disbanded when the need subsides. Often a wide range of prominent institutional players, including private companies, will join in relief efforts to meet societal expectations [Gao, 2011]. Significantly, even in this context with urgent consensus for action, the incentive to share information across organizational boundaries is not always paramount; indeed, sharing may diminish the ability of an organization to subsequently compete for resources [Kovacs and Spens, 2010], or even offer relief services safely or efficiently.

This article centers on IT-enabled information sharing for what is termed "ad hoc interorganizational relationships," so called due to their responsive emergence to a precipitating event. The first section elaborates on a game-theoretic framework for information sharing under co-opetition. Special considerations for ad hoc conditions are then highlighted, notably how time pressures increase the difficulty of learning, managing, and participating in information-sharing regimes. Due to sparse prior theorizing in the area of ad hoc information sharing under co-opetition, a qualitative method employing an extreme case context provides a grounding for uncovering information exchange characteristics, here in the context of disaster response [Yin, 1994]. Our extreme case approach also illustrates how the disaster response context represents a situation driven by co-opetition conditions [Kovacs and Spens, 2010], countering prevalent perspectives which seem to assume that humanitarian needs will trump organizational constraints on actors.

Moreover, predominant theory in co-opetition argues for a 'long-term' perspective and trust as antecedents of information exchange [Schrader, 1990]. Well-established relational and peer governance are further recommended to encourage information sharing [Busquets, 2010]. However, the ad hoc nature of disaster response does not suggest a future long-term relationship, nor provide the experience to evaluate peers either experientially or by reputation. Rather, the voluntary participation in an IT-enabled, ad hoc, interorganizational information exchange is experienced under the unique context in which a shock motivates immediate increased information sharing in a co-opetition environment.

As macro-environmental shocks impact global markets, it is likely that sudden new co-opetition environments will continue to arise in the future, potentially for increasingly temporary periods as well. As one chief technology officer concluded from the severe disruptions from the Japanese quake: "businesses need to increase their usage of advanced technology... and to be able to dynamically reconfigure and optimize their supply chain processes" [Bates, 2011]. To achieve networks of organizations performing optimally in this context, the information-sharing regime must be sensitive to a system of self-organizing that is based not on individual actor needs, but that of interdependent actors who are both cooperating and competing [Wilkinson and Young, 2002].

An example of successful ad hoc information sharing in a co-opetitive environment is the reaction of Toyota's suppliers to a fire at Aisin Seiki—Toyota Japan's sole supplier of 98 percent of brake fluid proportioning valves—in 1997 [Cela Diaz, 2005; Simchi-Levi, Kaminsky and Simchi-Levi, 2008]. Two hundred suppliers worked together, shared information and knowledge, adapted and bought machinery, and managed to restore full production in less than seven days. As this example highlights, IT-enabled, ad hoc information sharing among suppliers can play an important role in mitigating the impact of disruptions in supply chains. However, managing co-opetitive horizontal relationships in supply chains can be very difficult [Wu and Choi, 2005]. This research sheds light on the reasons why companies can be unwilling to share information in the temporary, ad hoc context.

In addition to providing insights to the more general issue of information exchange in the context of ad hoc interorganizational relationships, the natural disaster research context is critical in its own right. Aid agencies' unwillingness to share information has been highlighted as a significant problem in the literature [Bharosa, Lee and Janssen, 2010; Day, Junglas and Silva, 2009; Maitland, Tchouakeu and Tapia, 2009]. Organizations like the UN encourage aid agencies to use IT to enable information sharing, but a comprehensive theoretical framework which outlines what fuels the considerable resistance to sharing is still missing. Therefore, delineating how a co-opetition framework applies to the humanitarian context is long overdue. Importantly, this framework acknowledges the existence of both competitive and cooperative demands on disaster relief organizations [Kovacs and Spens, 2010].

II. INFORMATION SHARING IN DISASTER RELIEF CONTEXTS

With the rising occurrence of man-made and natural disasters, efficiency is a watchword in the field of humanitarian logistics [Thomas and Kopczak, 2007]. One area of extensive inefficiency—missing coordination among players in humanitarian supply chains [Balcik, Beamon, Krejci, Muramatsu and Ramirez, 2010; Schulz and Blecken, 2010; Stephenson and Schnitzer, 2006]—defies straightforward progress. Yet, a key factor for effective coordination is acquiring and sharing information across the appropriate players in humanitarian supply chains, including non-governmental organizations (NGOs), governments, donors, and logistics providers [Kovacs and Spens, 2007].

Information is an essential, expensive, and critical component necessary for effective disaster relief preparation and response. Currently, information and knowledge is widely distributed, owned by different organizations, and not efficiently used [Kovacs and Spens, 2010; Zhang, Zhou and Nunamaker, 2002]. In addition, new groups and players form solely in response to a disaster, and they contribute additional confusion [Majchrzak, Jarvenpaa and Hollingshead, 2007]. Therefore, global agencies strongly advocate for improved information sharing among the participants in humanitarian relief. Of special interest is information sharing among NGOs in sudden onset emergency situations.

Horizontal cooperation and information exchange among aid agencies present their own unique challenges. High environmental uncertainty, partnership uncertainty, and task uncertainty lead to strong information-processing needs [Romano et al., 2010]. In disaster response, the ad hoc nature, time pressure, often-missing preparation, and destroyed information infrastructure associated with these events require flexibility and adaptability.

Under more ideal conditions, private firms often forswear the innovation opportunities that arise from greater information sharing or openness due either to a lack of expertise for absorptive capacity, or reluctance to expose competitive advantages [Drechsler and Natter, 2012]. The NGO disaster relief context provides a stark environment for revisiting these transparency barriers by emphasizing how time and financial limitations, along with the heightened uncertainties listed previously, may be key in an organization's willingness to pursue greater openness through information sharing. Furthermore, the NGO structure incorporates various bureaucratic features that can hinder adopting additional mission goals such as greater information sharing [Peterburgsky, 2012].

Sharing information in the disaster relief context certainly has an altruistic component in mission achievement. Generally overlooked, though, is that sharing information can have a competitive component if the shared information improves the attractiveness of rival NGO recipients in gaining donor funds (thus reducing an organization's willingness to share information) [Hackney, Desouza and Loebbecke, 2005; Kovacs and Spens, 2010]. This concern is of special interest as the number of aid agencies has been increasing, resulting in escalating competition for donations [Thomas and Kopczak, 2007]. Thus, co-opetition [Lee and Panteli, 2010] exists as organizations both collaborate for effectiveness while competing for donor funds [Kovacs and Spens, 2010].

III. THE GAME-THEORETIC APPROACH TO INFORMATION SHARING UNDER CO-OPETITION

Co-opetition describes a situation where organizations simultaneously compete and cooperate [Brandenburger and Nalebuff, 1996; Medlin, 2006]. A continuing issue in the literature is whether organizations should share information: there can be benefits from more information in the cooperative context, but there can also be risks of making a

partner more competitive, or the focal organization less competitive, in other arenas [Hackney et al., 2005]. Both Schrader [1990] and Loebbecke et al. [1999] developed a game-theoretic model and expanded on the ideas of relative changes in competitive advantage due to IT-enabled information sharing in the typical for-profit, co-opetition context.

Schrader's model of information-sharing value highlights the point that in transferring knowledge, a party would lose any monopolistic value held by keeping its knowledge alone. Loebbecke et al. [1999] further provided a model to assess IT-enabled, interorganizational information-sharing benefits under co-opetition, which extended Schrader's [1990] earlier model by adding three dimensions: "synergetic" value, "leveragability of knowledge" value, and value lost from "negative reverse impact." Synergy occurs when pooling of information creates additional value beyond the sum shared. Knowledge leveragability refers to the recipient's ability to exploit shared knowledge for its own advantage, recognizing that the value of information technology depends on its interfaces with other organizational resources [Baraldi and Waluszewski, 2005]. Negative reverse impact occurs when the sender of information loses value due to the loss of monopoly or proprietary advantage in solely holding the information [Loebbecke et al., 1999]. Using these dimensions, Loebbecke et al. [1999] modeled the relative advantages for two partners under the conditions when partners both transfer knowledge, only one transfers knowledge, or neither chooses to share knowledge.

One interesting implication is that only when synergy is high and leveragability is low do the authors suggest a clear positive stance toward information sharing; other combinations leave organizations ambiguous or negative toward sharing. A test of the model with small and medium-sized organizations [Levy, Loebbecke and Powell, 2003] finds consistent results. Not surprisingly then, both clear benefits and trust between organizations have long been asserted as necessary for successful interorganizational information sharing [Meier, 1995].

IV. APPLICATION OF THE GAME-THEORETIC MODEL TO INFORMATION SHARING IN DISASTER RELIEF

Humanitarian relief organizations currently face many challenges; a prominent issue includes the increasing number of aid agencies and the attendant increased competition for donor resources [Thomas and Kopczak, 2007]. The type of activities NGOs undertake must be evaluated in relation to how they are perceived by their donors and the media [Balcik et al., 2010; Wakolbinger and Toyasaki, 2011]. While all aid agencies share the common goal of providing aid, they also compete for resources, and thus must vie for a "competitive advantage" over other NGOs for future resources. In describing the response to the tsunami in the Indian Ocean, Thevenaz and Resodihardjo [2010] provide a sobering description:

"*…the unprecedented media attention which led to enormous funding also hindered response operations because international agencies felt the resulting pressure to spend rapidly and visibly [Telford and Cosgrave, 2006, p. 93]. This pressure led a majority of decision-makers on the ground to deliver assistance without basing it on needs assessments [de Villede Goyet and Moriniere, 2006, p. 38]. They worried more about how their activities would appear back home [Christoplos, 2006, p. 11] than about the usefulness of their actions.*" [2010, p. 15].

Simply, while aid agencies are bound by an overarching altruistic goal, they also need to consider how information sharing could influence their own donors' perceptions of their work. Information gathering and sharing, including taking inventories or mapping emergency sites, are both time- and resource-intensive chores with potentially low payoffs for organizational differentiation [Bharosa et al., 2010]. Humanitarian organizations are likely reluctant to shoulder the costs of these less-visible tasks.

This need to be visible to donors can thus reduce collaboration, coordination, and information exchange among aid agencies, since they want to emphasize their own contribution—to some extent, such emergencies can be seen as marketing opportunities [Fenton, 2003]. Information that is only known to one aid agency can be an important competitive advantage; for instance, allowing an aid agency to be the first one to respond to an urgent need for help. The effects of both negative reverse impact and lost monopoly value, therefore, reduce aid agencies' willingness to share information.

In this article, we expand on the specific demands of the context of ad hoc, temporary interorganizational relationships by developing three noteworthy extensions to the game-theoretic model by Loebbecke et al [1999]. The extended model reflects the unique characteristics of information sharing in the context of disaster response. The initial foundation of the Loebbecke et al. [1999] model is included with the components of basic value of owned knowledge, leveragability, synergy, and negative reverse impacts. From this platform, we expand the model to accommodate the context of ad hoc temporary relationships.

First, transferred knowledge has no absolute value in and of itself, but is valuable only as a function of its leveragability to the transferee. This requires understanding that leveraged information does not have added value until it accommodates the preexisting absorptive capacity and strategic imperatives of the receiving organization. Second, we combine the leveraged and lost monopolistic value of transferred knowledge into one term of "positive and negative leverage value" to the *transferor* to reflect that a sending organization in this context must simultaneously balance altruistic and competitive considerations. Third, we emphasize an often-overlooked issue, that is, that the act of both transferring and receiving knowledge incurs real, often substantial, processing costs to parties. These costs are especially prominent in the humanitarian relief context. Indeed, a sizable literature has long reflected that there are costs and difficulties of merging information across firms [Klein and Rai 2009; Schubert and Legner, 2011] even under conditions of a likely protracted relationship, as noted in the merger literature [McKiernan and Merali, 1995]. The extended model is presented in Table 1.

Table 1: Game-Theoretic Framework [Adapted and Extended from Loebbecke et al., 1999]

		Player A	
	A's Payoff / B's Payoff	Transfers information	Does not transfer information
Player B	Transfers information	$r + s + r*I_a + (\alpha - \beta)*r*I_b - nri - c_s - c_r$ / $r + s + r*I_b + (\alpha - \beta)*r*I_a - nri - c_s - c_r$	$r + r*I_a - c_r$ / $r + (\alpha - \beta)*r*I_a - nri - c_s$
	Does not transfer information	$r + (\alpha - \beta)*r*I_b - nri - c_s$ / $r + r*I_b - c_r$	r / r

Legend:
r = basic value of current information
s = synergetic value gained from mutual information sharing
$r*I_a$; $r*I_b$ = value of leveragability of transferred information for Players A & B
nri = negative reverse impact
c_s and c_r = cost for sending and receiving information
$(\alpha - \beta)$ = term accommodating altruistic versus competitive leverage value

The framework begins with the assumption that two organizations exist with an information resource valued at r, reflected in the condition when neither organization shares information with the other. We first outline why firms in such a context are likely to share information. Here, our first motivator for sharing information is the synergetic possibilities; that is, that mutual information creates additional value beyond the sum of the values obtained by each organization individually. The next motivation for organizations is the added value of receiving useful, or leveragable, information for an organization's own work. Finally, organizations are altruistically interested in sharing information that can aid the overall mission. This last aspect is a prominent ethic in disaster relief and holds considerable weight.

Synergy

Consistent with Loebbecke et al. [1999], the model maintains the added value of synergy for the reciprocal sharing of information that goes beyond the value obtained by each organization. Synergies raise the value of the information an organization currently has by lowering uncertainty or raising overall meaningfulness with added information. Perhaps the most compelling synergies are those in which simply the combining of information with other actors produces new and valuable insights that are unachievable alone. For instance, information sharing concerning the costs of resources can increase actors' negotiation power with service providers by allowing for price comparisons [Howden, 2009]. This sort of efficiency occurred in immediate post-war Afghanistan, when the ensuing confusion and rise in demand by NGOs provided the opportunity for an exploitative, locally run cartel for trucking services to arise. Humanitarian organizations formed an information exchange on logistics which then identified and dissolved the cartel, partly by communicating the potential for bringing in outside trucking resources [Samii and Van Wassenhove, 2003].

Often synergies arise by allowing organizations to evaluate the value of their own abilities and knowledge relative to other actors in the context. During a disaster response situation, organizations need to make tradeoff decisions concerning which activities they will pursue. And, though faced with very strong uncertainty, organizations need to make these decisions quickly and consistently [Zhang et al., 2002]. By sharing data related to their activities, organizations can avoid duplication of effort or, conversely, gaps in service [Oloruntoba and Gray, 2006; Van Wassenhove, 2006]. Information sharing, for instance, can contribute to optimal storage facility use [Mete and Zabinsky, 2010]. The Emergency Preparedness and Response Working Group (EPRWG) in the East Africa and Great Lakes Regions, for instance, is developing initiatives to share procurement services and logistics resources (e.g., personnel, charter flights, and contingency stocks) in emergency situations [Fenton, 2003].

Moreover, organizations can also use such information to determine where they have a strategic or capability advantage, so that their efforts are employed to their best use rather than just their first-known opportunity. Sharing information on equipment, space, and personnel has helped reduce oversupply and stock outs [Howden, 2009]. During the response to the 2001 earthquakes in El Salvador, organizations participated in an inventory tracking system (SUMA) in which all donations and purchases coming into the government warehouses were recorded. With the increased visibility of the needs, resources, and responders' capabilities, activities were better organized to improve collaboration and increase effectiveness [Tomasini and Van Wassenhove, 2003].

Negative Reverse Impact

The model does incorporate the loss in value from negative reverse impact, which occurs when the sharing of information reduces the value of the sending organization's information, without necessarily raising the competitive profile of the competitor [Loebbecke et al., 1999]. For instance, any knowledge of special access routes or suppliers that arises during disaster relief operations would be less valuable to a sending organization once other actors' awareness and use increases congestion on those routes. Sharing information about a resource also tends to lead to an ethic of expectations which naturally progresses to sharing a resource with other actors, leading to possible supply shortages for the sending organization. A third example could be the loss of control by enforced regimes of information sharing—the "Battle of the Samaritans" [Boin, Kelle and Whybark, 2010] leads to more hierarchical interactions in the name of coordination, and can lead to investing time in "coordination for coordination's sake" [Kaaatrud, Samii and Van Wassenhove, 2003, 14]. Our model subsumes the loss in monopolistic knowledge held by the sending organization ("*va"* in Loebbecke et al. [1999]) to this category.

Leveragability

Organizations may also be willing to invest in information sharing due to expectations of future interactions or relationships and, hence, potential reciprocity [Gouldner, 1962; Kachra and White, 2008]; or because they recognize that other organizations can leverage information for the benefit of a mission to which they are committed. The value of transferred information is of course dependent on the actual ability of the information-receiving organization to leverage the information for its own use. But this same ability to leverage the information to its own advantage can indirectly impact the information-sending organization (transferor) in the context of disaster response. Thus, the model first divides leveragability into two components, l_a and l_b (leveragability by Player A and B, respectively).

First, we examine the condition of reciprocal information transfer for just Player A where both organizations share information. The framework highlights the impact of the different types of leverage ($r*l_a + (\alpha - \beta)*r*l_b$). The first term signifies that Player A benefits only from the value of transferred information "r" to the extent that Player A can leverage that value ($r*l_a$). This multiplicative adjustment to leveragability is a refinement of Loebbecke et al.'s [1999] original model which included leveragability as an additive component. Research indicates that organizations benefit from information differentially based on both absorptive capacity [Drechsler and Natter, 2012] and their own strategic imperatives [Rogers and Bamford, 2002]. Indeed, one recurring issue for organizations in general is "information overload" which can truly make additional information a costly management problem [Edmunds and Morris, 2000]. This multiplicative formulation allows us to represent situations where the value of information for the information-receiving organization is lower or higher than the value for the sending organization.

The second consideration for leveragability is the indirect impact on a sending organization A in aiding the receiving organization B, modeled by the term "$(\alpha - \beta)*r*l_b$". The positive α term acknowledges the considerable humanitarian mission and identity value of aiding other actors, referred to here as the "altruistic effect." Certainly, this effect is usually assumed to be the overriding motivation in disaster relief. While altruism may be substantial, realism demands that the effect should be tempered with the long-term co-opetition counter-effects represented by β.

Specifically, the leveragability of transferred information often enables the receiving organization to become more competitive, that is, lowering the relative competitive position of the sending organization. For instance, a rival humanitarian organization may be able to leverage received information so as to be a first responder to a disaster

situation, providing positive humanitarian effectiveness and also gaining positive press (and donor response) at the expense of a sending organization, even though the sending organization may have invested considerable resources to gain the valuable information. The total term (α – β) thus reflects that, depending on an organization's mission, the competitive environment, and incentives provided by policy makers and donors, the positive or negative effect can dominate in the final value or cost for a sending organization.

Information-Sharing Costs

While the original co-opetition framework includes many key elements, it does not include information-sharing costs. An important contribution of this research is the incorporation of information-sharing costs in accounting for the costs and benefits of information-sharing regimes; this is especially prominent for time-sensitive, ad hoc relationships in the co-opetition framework. By explicitly acknowledging these costs, organizations can develop strategies that avoid, accommodate, or significantly ameliorate such sharing costs.

A prominent issue arising in a review of the disaster response literature is the resistance to adopting time-absorbing processes or costly training procedures in order to participate in information-sharing regimens. Simply, "knowledge transfer is costly…knowledge transfer costs arise because of cognitive limitations" [Heiman and Nickerson, 2002, p. 101]. Case studies highlight this major cost as a critical feature of information sharing in disaster contexts. Whereas effective information system integration in contexts such as mergers and long-term alliances has long been understood to be both difficult and expensive, the salience of this issue in ad hoc, disaster response situations has not been given the prominent treatment that integration difficulties deserve. As explained later in this article, in disruptive conditions, IT integration costs can be prohibitively high and prevent organizations from sharing information.

In some cases, for example, the disaster itself radically changes the functioning of the IT infrastructure [Ives and Junglas, 2006], and thus previous agreements or expectations for information sharing may be unreasonable in the disrupted environment. Specifically, organizations pressured to participate in information sharing must incur the costs of training personnel to assess, input, interpret, and apply the correct information in the correct information system interfaces. However, crisis situations such as those encountered in disaster response are inherently stressful on responders, and communication problems can result from inadequate expertise in an information system [Paton and Flin, 1999]. Even in the best of conditions, people are reluctant to invest time in learning new information system interfaces rather than accomplish work tasks [Mao and Benbasat, 2000]. Indeed, people often resist learning new applications in anticipation of the quick obsolescence of new technologies [London and Diamante, 2002], and this disinclination is likely to only increase in a context of temporary and ad hoc situational demands.

Significantly, the costs of information sharing include not only the time to master how an application is structured, but also in understanding how to communicate information meaningfully, as organizational procedures and culture are embedded in the collecting and recording of information. Fruhling [2006] found that it required multiple interactions and iterations between system analysts and end users to design an effective emergency system that met the users' needs. Consequently, it is commonly recognized that the ability to share information requires organizations to identify and consensually adopt a governance system as well [Williams, 1997], ideal conditions which are not available in disaster relief contexts. When requirements for information sharing lean toward impacting on operations, organizations can experience even greater conflict as they react to imposed constraints [Lee, Gilliland, Bello and Osmonbekov, 2011]. In particular, access and sharing across organizations is considerably less effective without an additional investment in media and forums that create interactions for shared meaning and vision [Hult, Ketchen and Slater, 2004], as well as trust [Lee et al., 2011] across organizations. Emergency responders face extreme limitations in time by definition, and thus individuals in critical situations are averse to the difficulties of cognitively managing information sharing across organizations.

Specific Information-Sending Costs

Besides the direct information-sharing costs elaborated upon previously, aid agencies can face indirect information-sharing costs, since sending organizational information makes their choices and behaviors transparent to their partners. While such arrangements may contribute to efficiency, transparency can also lead to behaviors such as hyperscrutiny and bargaining pressure that constrain the range of behaviors the focal sending organization may then pursue [Fabian and Dhillon, 2007]. With hyperscrutiny, managers are pressured to act according to appearances to outsiders. One outcome can be the compromise of a long-term initiative by actions required to maintain short-term accountability appearances [Roberts, Stout and Halpern, 1994]. Under extreme circumstances, managers may hide discrepant information, delay action, or impede information dissemination [Marchand, Kettinger and Rollins, 2002]. Hearns and Deeny [2007], for instance, identified the need to accommodate outside visitors as a significant stressor and workload addition for aid workers during emergencies; information-sharing routines widen that potential audience of outsiders for information-sending organizations.

With bargaining pressure, organizations are compelled to assure their behaviors conform to the expectations of their stakeholders [Fabian and Dhillon, 2007]. Organizations, for instance, could abuse the transparency they gain from information sharing by using their awareness of a focal sending organization's emergency resources to request additional sharing or access. Information-sending organizations may then be forced to choose between frayed relationships or reassigning resources from other initiatives they deign equally, or more, important.

Finally, information-sending costs also include the risk that shared information is improperly protected, which can lead to life-threatening consequences for both humanitarian organizational actors and victims. Under the often violent and chaotic conditions inherent in emergencies, demands for humanitarian organizations to maintain some kind of standard recordkeeping for sharing purposes may make conditions considerably more dangerous. As one United Nations summary report on Darfur [2008] explained: *"Of serious concern was the forceful interference by local and Khartoum-based HAC [Humanitarian Aid Commission] officials who visited several NGO premises in Nyala and Kass (South Darfur) at the end of August, and interrogated, harassed and bullied staff. NGOs were forced to disclose their computer passwords, and sensitive files … were searched, copied and taken away"* [United Nations, 2008, p. 6].

Basically, information in disaster response situations often must be protected from other actors, for example, desperate victims or gangs likely to steal/loot supplies, or those who are enemies of the victims intended for protection. The previous example indicates that the protections humanitarian organizations might expect at a government or military level are regularly compromised; to expose other humanitarian organizations to privileged and sensitive information only heightens concerns.

Specific Information-Receiving Costs

Even when organizations gain the expertise to participate in information sharing, absorbing information so that it can be leveraged usefully is a looming obstacle as it incurs substantial costs. The information processing infrastructure is a key determinant of the ability to respond to flexibility requirements [Chung, Rainer and Lewis, 2003]. Two of the more evident difficulties for receiving organizations concern the potential for experiencing heightened ambiguity and information overload.

In particular, in certain emergency situations additional information may increase ambiguity, conflict, and confusion rather than enable task completion. During the Haiti earthquake disaster, for instance, a helicopter port which had been processing patients to a U.S. hospital ship was closed down due to an order to prioritize a UN operation. Yet, no UN operation was ongoing, and apparently a clear medical exception was in place [Little, 2010]. One piece of wrongly interpreted information was more destructive than if procedures had stayed routine. Such an outcome is not surprising given considerable evidence that electronic communications such as email are frequently misinterpreted—perhaps as much as 50 percent of the time [Kruger, Epley, Parker and Ng, 2005].

Along with the problem of ambiguity is the problem of information overload, which has long been understood to harm decision-making [Hult et al., 2004]. Not only does overload negatively impact individual information processing, but similar problems are found for groups [Paul and Nazareth, 2010]. The problems of overload are especially pronounced in emergency management situations [Turoff, Chumer, Van De Walle and Yao, 2004].

V. CONCLUSIONS, LIMITATIONS, AND IMPLICATIONS FOR RESEARCH AND PRACTICE

Precarious world events indicate that stable forms of interorganizational information sharing are likely to be continuously jeopardized to an ever-greater degree by depressed economic conditions, currency wars, national indebtedness, and political instability. Organizations are likely to face sudden disruptions in their supply chains that require them to reconsider how and to whom they communicate on short notice. Therefore, for-profit organizations are likely to increasingly face analogous situations to humanitarian organizations providing disaster relief.

Richey [2009] argued that further theoretical grounding in the quickly expanding literature on IT-enabled supply chain management in disaster response situations is necessary, and suggested the co-opetition resource perspective as a possible avenue for future research. Following these suggestions, we substantially developed the co-opetition framework by Loebbecke et al. [1999] to capture information sharing in disaster response, employing direct examples from the research literature to illustrate pertinent applications. We model leveragability as multiplicative to existing absorptive capacity and strategic imperatives, arguing that it cannot be understood in isolation from these preexisting organizational characteristics. We also add the new dimension of the information-sharing costs associated with transfer that are prominent in time- and resource-constrained environments. This research thereby provides a theoretical basis for future empirical, case-based, and modeling research.

The co-opetition framework is especially useful in that it highlights those variables that detract from the value of information sharing. First, the receiving firm may be able to leverage the shared information such that the sending organization is relatively less competitive than when the sending firm held the information proprietarily. Second, the mere fact that information becomes widely known may make the information less valuable. Finally, in these ad hoc relationships, the processes of information sharing can be especially costly.

This model provides some clear imperatives for further research. The development of the game-theoretic framework is based on a study of examples from the literature. While this approach allows for the development of a general classification of benefits and drawbacks of information sharing in ad hoc situations, it does not allow for an in-depth analysis of the tradeoffs between the individual elements. Case-based field studies could further draw out barriers and benefits of information sharing in ad hoc situations under co-opetition and their changing role throughout the disaster response phases.

The model draws attention to the benefits and barriers of information sharing. However, it does not provide specific insights on how aid agencies can facilitate information sharing. Analytical models might analyze how donors and funding agencies can create incentives to increase aid agencies' willingness to share information. Furthermore, analytical models could derive the conditions that ensure that these initiatives are successful. In addition, empirical research should analyze the impact of administrative and technological innovations that may substantially address the costs of information sharing. For instance, one extension for this research would be to consider how governance regimes for information sharing are likely to be differentially beneficial [Boin et al., 2010) based on the modeled conditions and demands of the context. Secondly, the rise in mobile technologies and the ability to build "ad hoc" "apps" are significant changes in the information-sharing environment, providing added capabilities in resiliency, accessibility, and scalability [Huang, Chan and Hyder, 2010]. While inroads have been made in identifying mobile apps that have been used in disaster response [Fajardo and Oppus, 2010], their vulnerability to misuse based on the costs outlined here has not yet been explored.

This model's delineation of the costs and benefits of information sharing in emergency contexts provides a base for proactive planning to ameliorate costs and improve benefits. A practical contribution is that the framework provides funding agencies and donors with a better understanding of the factors that hinder information sharing among aid agencies. Specifically, the additional variables draw special attention to the important role that both the competitive effect and information sharing and receiving costs play. Practical implementation of the framework as a decision-support tool for aid agencies necessitates measuring all model elements and integrating quantitative and qualitative elements into one measurement system. The current framework does not provide indications of how the different elements can be combined. Hence, this important question is a topic that should be addressed by future research.

The refined framework contributes not only to the area of IT-enabled humanitarian supply chain management, but also to information sharing in ad hoc relationships under co-opetition in general. Supply chain disruption management is an important issue for many companies [Tang, 2006]. As the Aisin Seiki/Toyota example shows, information sharing among suppliers can contribute to quick disruption recovery. The refined framework emphasizes that although companies want to encourage their suppliers to share information in disruption situations, they will likely face resistance from suppliers that focus on the negative implications of this strategy. While the current model is specifically tailored to information sharing in the context of disaster response, future research could adapt the model so that it reflects ad hoc information sharing in co-opetitive environments in a for-profit supply chain context.

The derived model suggests that companies may be able to "rehearse" procedures [Kendall, Kendall and Lee, 2005] for collecting, protecting, and sharing information resources by identifying in advance their most likely vulnerabilities and potential needs. Indeed, if such sharing initiatives are to be successful under co-opetition, practice should make firms more sensitive to the need to overcome both suppliers' competitive considerations and their sometimes sizable information-processing costs. Optimistically, such practice could strengthen suppliers' commitment to the overall supply chain success as well [Medlin, 2006], akin to the altruistic component of disaster response.

REFERENCES

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Balcik, B., B.M. Beamon, C.C. Krejci, K.M. Muramatsu and M. Ramirez (2010) "Coordination in Humanitarian Relief Chains: Practices, Challenges and Opportunities", *International Journal of Production Economics*, (126)1, pp. 22–34.

Baraldi, E. and A. Waluszewski (2005) "Information Technology at IKEA: An "Open Sesame" Solution or Just Another Type of Facility?", *Journal of Business Research*, (58)9, pp. 1251–1260.

Bates, J. (2011) "From Icebergs to Autos, Effects of the Japan Earthquake Are Long Lasting", *The Huffington Post*, August 9, http://www.huffingtonpost.com/john-bates/japan-supply-chain_b_922056.html (current Feb. 10, 2012).

Bharosa, N., J. Lee and M. Janssen (2010) "Challenges and Obstacles in Sharing and Coordinating Information during Multi-agency Disaster Response: Propositions from Field Exercises", *Information Systems Frontiers*, (12)1, pp. 49–65.

Boin, A., P. Kelle and D.C. Whybark (2010) "Resilient Supply Chains for Extreme Situations: Outlining a New Field of Study", *International Journal of Production Economics*, (126)1, pp. 1–6.

Brandenburger, A.M. and B.J. Nalebuff (1996) *Coopetition*. New York, NY: Doubleday.

Busquets, J. (2010) "Orchestrating Smart Business Network Dynamics for Innovation", *European Journal of Information Systems*, (19)4, pp. 481–493.

Cela Diaz, F. (2005) "An Integrative Framework for Architecting Supply Chains", MS thesis, Boston, MA: Massachusetts Institute of Technology.

Chen, R., H.R. Rao, R. Sharman, S.J. Upadhyaya and J. Kim (2010) "An Empirical Examination of IT-enabled Emergency Response: The Cases of Hurricane Katrina and Hurricane Rita", *Communications of the Association for Information Systems*, (26) Article 8, pp. 141–156.

Christoplos, I. (2006) *Links Between Relief, Rehabilitation and Development in the Tsunami Response: A Synthesis of Initial Findings*, London, England: Tsunami Evaluation Coalition.

Chung, S.H., R.K. Rainer Jr. and B.R. Lewis (2003) "The Impact of Information Technology Infrastructure Flexibility on Strategic Alignment and Applications Implementation", *Communications of the Association for Information Systems*, (11) Article 11, pp. 191–206.

Day, J.M., I. Junglas and L. Silva (2009) "Information Flow Impediments in Disaster Relief Supply Chains", *Journal of the Association for Information Systems*, (10)8, pp. 637–660.

de Ville, C. de Goyet and L.C. Moriniere (2006) *The Role of Needs Assessment in the Tsunami Response*, London, England: Tsunami Evaluation Coalition.

Drechsler, W. and M. Natter (2012) "Understanding a Firm's Openness Decisions in Innovation", *Journal of Business Research*, 65(3), pp. 438-445

Edmunds, A. and A. Morris (2000) "The Problem of Information Overload in Business Organisations: A Review of the Literature", *International Journal of Information Management*, (20)1, pp. 17–28.

Fabian, F.H. and G. Dhillon (2007) "Losing Managerial Discretion: The Unexplored Risk of Collaborative Information Sharing", *Journal of Information Science and Technology*, (4)1, pp. 50–62.

Fajardo, J.T.B. and C.M. Oppus (2010) "A Mobile Disaster Management System Using the Android Technology", *WSEAS Transactions on Communications*, (6)9, pp. 343–353.

Fenton, G. (2003) "Coordination in the Great Lakes", *Forced Migration Review*, (40)8/9, pp. 23–24.

Fruhling, A. (2006) "Information Systems and Health Care XIII: Examining the Critical Requirements, Design Approaches and Evaluation Methods for a Public Health Emergency Response System", *Communications of the Association for Information Systems*, (18) Article 20, pp. 431–450.

Gao, Y. (2011) "Philanthropic Disaster Relief Giving as a Response to Institutional Pressure from China", *Journal of Business Research*, (64)12, pp. 1377–1382.

Gouldner, A.W. (1962) "The Norm of Reciprocity: A Preliminary Statement", *American Sociological Review*, (25)2, pp. 161–181.

Hackney, R., K. Desouza and C. Loebbecke (2005) "Cooperation or Competition: Knowledge Sharing Processes in Inter-organizational Networks" in S. Hawamdeh (ed.) *Knowledge Management: Nurturing Culture, Innovation and Technology*, Singapore: World Scientific Press.

Hearns, A. and P. Deeny (2007) “The Value of Support for Aid Workers in Complex Emergencies: A Phenomenological Study”, *Journal of Emergency Nursing*, (5)2, pp. 28–35.

Heiman, B. and J.A. Nickerson (2002) “Towards Reconciling Transaction Cost Economics and the Knowledge-Based View of the Firm: The Context of Interfirm Collaborations”, *International Journal of the Economics of Business,* (9)1, pp. 97–116.

Howden, M. (2009) “How Humanitarian Logistics Information Systems Can Improve Humanitarian Supply Chains: A View from the Field” in Landgren, J. and S. Jul (eds.) *Proceedings of the 6th International ISCRAM Conference,* Gothenburg, Sweden.

Huang, C.M., E. Chan and A. Hyder (2010) “Web 2.0 and Internet Social Networking: A New Tool for Disaster Management? Lessons from Taiwan”, *BMC Medical Informatics and Decision Making*, (10)1, p. 57.

Hult, G.T.M., D.J. Ketchen and S.F. Slater (2004) “Information Processing, Knowledge Development and Strategic Supply Chain Performance”, *Academy of Management Journal*, (47)2, pp. 241–253.

Ives, B. and I. Junglas (2006) “Information Systems at Northrup Grumman Ship Systems Sector: The Hurricane Katrina Recovery”, *Communications of the Association for Information Systems*, (18) Article 27, pp. 557–577.

Kaatrud, D.B., R. Samii and L.N. Van Wassenhove (2003) "UN Joint Logistics Centre: A Coordinated Response to Common Humanitarian Logistics Concerns." *Forced Migration Review*, (18), pp.11-14.

Kachra, A. and R.E. White (2008) “Know-how Transfer: The Role of Social, Economic/Competitive, and Firm Boundary Factors”, *Strategic Management Journal*, (29)4, pp. 425–445.

Kendall, K.E., J.E. Kendall and K.C. Lee (2005) "Understanding Disaster Recovery Planning through a Theatre Metaphor: Rehearsing for a Show that Might Never Open”, *Communications of the Association for Information Systems*, (16) Article 51, pp. 1001-1012.

Klein, R. and A. Rai (2009) “Interfirm Strategic Information Flows in Logistics Supply Chain Relationships”, *MIS Quarterly*, (33)4, pp. 735–762.

Kovacs, G. and K.M. Spens (2007) “Humanitarian Logistics in Disaster Relief Operations”, *International Journal of Physical Distribution & Logistics Management*, (37)2, pp. 99–114.

Kovacs, G. and K.M. Spens (2010) “Knowledge Sharing in Relief Supply Chains*”, International Journal of Networking and Virtual Organisations*, (7)2/3, pp. 222–239.

Kruger, J., N. Epley, J. Parker and Z.-W. Ng (2005) “Egocentrism over E-mail: Can We Communicate as Well as We Think?” *Journal of Personality and Social Psychology*, (89)6, pp. 925–936.

Lee, J.Y. and N. Panteli (2010) “Business Strategic Conflict in Computer-Mediated Communication”, *European Journal of Information Systems*, (19)2, pp. 196–208.

Lee, N., D.I. Gilliland, D.C. Bello and T. Osmonbekov (2011) “When Electronic Management Tools Work—and Don’t Work—in Social Distribution Channels: A Study of IT Manufacturers and Resellers”, *Journal of Business Research*, (64)10, pp. 1017–1024.

Leidner, D.E., G. Pan and S.L. Pan (2009) “The Role of IT in Crisis Response: Lessons from the SARS and Asian Tsunami Disasters”, *Journal of Strategic Information Systems*, (18)2, pp. 80–99.

Levy, M., C. Loebbecke and P. Powell (2003) “SMEs, Co-opetition and Knowledge Sharing: The Role of Information Systems”, *European Journal of Information Systems*, (12)1, pp. 3–17.

Little, R. (2010) “Closed Copter Zone Was Supposed to Allow Medical Flights: 'Miscommunication' Stalls Comfort's Pickup of Quake Victims”, *The Baltimore Sun*, January 25, 2010. http://articles.baltimoresun.com/2010-01-25/news/bal-md.haiti25jan25_1_palace-grounds-flights-helicopters (current Jan. 15, 2012).

Loebbecke, C., P.C. Van Fenema and P. Powell (1999) “Co-opetition and Knowledge Transfer”, *The Data Base for Advances in Information Systems*, (30)2, pp. 14–25.

London, M. and T. Diamonte (2002) “Technology-focused Expansive Professionals: Developing Continuous Learning in the High-Tech Sector”, *Human Resource Development Review*, (1)4, pp. 500–524.

Luo, Y. (2007) “Are Joint Venture Partners More Opportunistic in More Volatile Environments?”, *Strategic Management Journal*, (28)1, pp. 39–60.

Maitland, C., L.-M.N. Tchouakeu and A.H. Tapia (2009) “Information Management and Technology Issues Addressed by Humanitarian Relief Coordination Bodies” in J. Landgren and S. Jul. (eds.) *Proceedings of the 6th International ISCRAM Conference,* Gothenburg, Sweden.

Majchrzak, A., S. Jarvenpaa and A. Hollingshead (2007) "Coordinating Expertise among Emergent Groups Responding to Disasters", *Organization Science*, (18)1, pp. 147–161.

Mao, J.-Y. and I. Benbasat (2000) "The Use of Explanations in Knowledge-based Systems: Cognitive Perspective and a Process-tracing Analysis", *Journal of Management Information Systems*, (17)2, pp. 153–179.

Marchand, D., W.J. Kettinger and J. Rollins (2002) *Information Orientation: The Link to Business Performance*, Oxford, England: Oxford University Press.

Marino, L.D., F.T. Lohrke, J.S. Hill, K.M. Weaver and T. Tambunan (2008) "Environmental Shocks and SME Alliance Formation Intentions in an Emerging Economy: Evidence from the Asian Financial Crisis in Indonesia", *Entrepreneurship: Theory & Practice*, (32)1, pp. 157–183.

McKiernan, P. and Y. Merali (1995) "Integrating Information Systems after a Merger", *Long Range Planning*, (28)4, pp. 54–62.

Medlin, C.J. (2006) "Self and Collective Interest in Business Relationships", *Journal of Business Research*, (59)7, pp. 858–865.

Meier, J. (1995) "The Importance of Relationship Management in Establishing Successful Interorganizational Systems", *The Journal of Strategic Information Systems*, (4)2, pp. 135–148.

Mete, H.O. and Z.B. Zabinsky (2010) "Stochastic Optimization of Medical Supply Location and Distribution in Disaster Management", *International Journal of Production Economics*, (126)1, pp. 76–84.

Oloruntoba, R. and R. Gray (2006) "Humanitarian Aid: An Agile Supply Chain?", *Supply Chain Management*, (11)2, pp. 115–120.

Paton, D. and R. Flin (1999) "Disaster Stress: An Emergency Management Perspective", *Disaster Prevention and Management*, (8)4, pp. 261–267.

Paul, S. and D.L. Nazareth (2010) "Input Information Complexity, Perceived Time Pressure, and Information Processing in GSS-based Work Groups: An Experimental Investigation Using a Decision Schema to Alleviate Information Overload Conditions", *Decision Support Systems*, (49)1, pp. 31–40.

Peterburgsky, S. (2012) "In Search of Responsible CEOs: The Case of CEOs with Non-profit Experience", *Journal of Business Research*, (65)9, pp. 1374–1383.

Richey, R.G. Jr. (2009) "The Supply Chain Crisis and Disaster Pyramid: A Theoretical Framework for Understanding Preparedness and Recovery", *International Journal of Physical Distribution & Logistics Management*, (39)7, pp. 619–628.

Roberts, K.H., S.K. Stout and J.J. Halpern (1994) "Decision Dynamics in Two High Reliability Military Organizations", *Management Science*, (40)5, pp. 614–624.

Rogers, P.R. and C.E. Bamford (2002) "Information Planning Process and Strategic Orientation: The Importance of Fit in High-Performing Organizations", *Journal of Business Research*, (55)3, pp. 205–215.

Romano, N.C. Jr., J.B. Pick and N. Roztocki (2010) "A Motivational Model for Technology-Supported Cross-organizational and Cross-border Collaboration", *European Journal of Information Systems*, (19)2, pp. 117–133.

Samii, R. and L.N. Van Wassenhove (2003) "UNJLC Afghanistan Operations First Year", INSEAD Case 05/2003-5092, Fontainebleau, France: INSEAD.

Schrader, S. (1990) *Zwischenbetrieblicher Informationstransfer, Eine Empirische Analyse Kooperativen Verhaltens*. Berlin, Germany: Drucker and Humboldt.

Schubert, P. and C. Legner (2011) "B2B Integration in Global Supply Chains: An Identification of Technical Integration Scenarios", *Journal of Strategic Information Systems*, (20)3, pp. 250–267.

Schulz, S.F. and A. Blecken (2010) "Horizontal Cooperation in Disaster Relief Logistics: Benefits and Impediments", *International Journal of Physical Distribution & Logistics Management*, (40)8/9, pp. 636–656.

Simchi-Levi, D., P. Kaminsky and E. Simchi-Levi (2008) *Designing and Managing the Supply Chain. Concepts, Strategies and Case Studies, 3rd edition,* New York, NY: McGraw-Hill.

Stephenson, M. Jr. and M.H. Schnitzer (2006) "Interorganizational Trust, Boundary Spanning, and Humanitarian Relief Coordination", *Nonprofit Management and Leadership*, (17)2, pp. 211–233.

Tang, C.S. (2006) "Perspectives in Supply Chain Risk Management", *International Journal of Production Economics*, 103(2), pp. 451–488.

Telford, J., and J. Cosgrave (2006) *Joint Evaluation of the International Response to the Indian Ocean Tsunami: Synthesis Report*. London, England: Tsunami Evaluation Coalition.

Thevenaz, C. and S.L. Resodihardjo (2010) "All the Best Laid Plans…Conditions Impeding Proper Emergency Response", *International Journal of Production Economics*, (126)1, pp. 7–21.

Thomas, A.S. and L.R. Kopczak (2007) "Life-saving Supply Chains—Challenges and the Path Forward" in H. L. Lee and C. Y. Lee (eds.) *Building Supply Chain Excellence in Emerging Economies,* New York, NY: Springer.

Tomasini, R. and L.N. Van Wassenhove (2003) "Coordinating Disaster Logistics after El Salvador's Earthquakes Using SUMA's Humanitarian Supply Management System", INSEAD Case 10/2003-5145, Fontainebleau, France: INSEAD.

Turoff, M., M. Chumer, B. Van De Walle and X. Yao (2004) "The Design of a Dynamic Emergency Response Management Information System (DERMIS)", *Journal of Information Technology Theory and Application*, (5)4, pp. 1–35.

United Nations (2008) "Darfur Humanitarian Profile No. 33. Situation as of 01 October 2008", Office of UN Deputy Special Representative of the UN Secretary-General for Sudan UN Resident and Humanitarian Coordinator, http://www.unsudanig.org/docs/DHP33_narrative_1%20October%202008.pdf (current Jan. 8, 2012).

Van Wassenhove, L.N. (2006) "Humanitarian Aid Logistics: Supply Chain Management in High Gear", *The Journal of the Operational Research Society*, (57)5, pp. 475–489.

Wakolbinger, T. and F. Toyasaki (2011) "Impacts of Funding Systems on Humanitarian Operations" in M. Christopher and P. Tatham (eds.) *Humanitarian Logistics: Meeting the Challenge of Preparing for and Responding to Disasters*, London, England: Kogan Page, pp. 33–46.

Wilkinson, I. and L. Young (2002) "On Cooperating Firms Relations and Networks", *Journal of Business Research*, (55)2, pp. 123–132.

Williams, T. (1997) "Interorganisational Information Systems: Issues Affecting Interorganisational Cooperation", *The Journal of Strategic Information Systems*, (6)3, pp. 231–250.

Wu, Z. and T.Y. Choi (2005) "Supplier–Supplier Relationships in the Buyer-Supplier Triad: Building Theories from Eight Case Studies", *Journal of Operations Management*, (24)1, pp. 27–52.

Yin, R.K. (1994) *Case Study Research: Design and Methods*, Thousand Oaks, CA: Sage Publications.

Zhang, D., L. Zhou and J.F. Nunamaker (2002) "A Knowledge Management Framework for the Support of Decision Making in Humanitarian Assistance/Disaster Relief", *Knowledge and Information Systems*, (4)3, pp. 370–385.

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