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CONFIDENCE IN CRISSES: TIME-PRESSED INTER-ORGANIZATIONAL INFORMATION SHARING

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Abstract

In emergencies, collaborators in ad hoc teams often must quickly share information across boundaries. In order for good decisions to be made under severe time pressure, participants must trust one another and feel confident that the data they use will support their decision-making. The data must also be of adequate quality (at a minimum, it must be accurate and timely) to aid the decision-making process. Previous research suggests that both interpersonal and inter-organizational information sharing are affected by trust. However, systematic examination of information sharing under time pressure is understudied, including the relationships between participants’ trust in one another, their confidence in the data that is being shared, the actual quality of that data, and the outcomes of the decisions made. We answer this need by reviewing prior relevant research, offering a set of research propositions, and discussing how these phenomena might be examined in a study of information sharing in emergency telemedicine.

Keywords: Emergency response, inter-organizational information sharing, data quality, trust

Introduction

In time-pressed crises – such as large-scale power outages, extreme weather events, emergency telemedicine consultations, and denial-of-service computer attacks – people from multiple organizations sometimes have trouble sharing information and coordinating their responses. For example, when police, fire, and EMT personnel respond to the scene of an accident, information from various sources are exchanged, which in turn can impact the success of their collaboration (Fedorowicz et al. 2006). Sometimes the problem is that systems or networks are incompatible. In other instances the necessary data may not be available in a useful form or at the right time to be helpful (Gogan, et al., 2006). Alternatively, participants may not be authorized to exchange some data, or participants may not know whether they can rely on the accuracy of the data that are available to them. The poor quality of just a single data element shared across organizational boundaries can have life-or-death consequences. For example, in 1988 the USS Vincennes mistakenly shot down an Iranian Airbus, resulting in the loss of 290 lives. According to Fisher and Kingma (2001), a system flaw reportedly contributed to this tragedy. The commercial Airbus was misidentified as a fighter jet, due to re-use of an identification number. Time pressure apparently affected the decision to shoot down the plane; had more time been available a set of confirmatory procedures could have been enacted that would have improved the opportunity to reveal that the aircraft was not a fighter jet.

This paper examines inter-organizational trust, data quality, and participants’ confidence in data provided by other organizations under time pressure. We briefly review studies of inter-organizational information sharing and trust, data quality, and decision-making under time pressure. We next offer a research model and set of propositions to guide research on this important topic. Lastly, we propose a study of inter-organizational information sharing in emergency telemedicine.

Inter-organizational Information Sharing and Trust

Our research focuses on information sharing and decision making in crises and other time-pressed non-routine situations. Much previous research on inter-organizational information sharing focused on routine information-sharing. For example,
one study reports that supply chain participants’ information sharing is found to be affected by participants’ relationships, which take time to develop: “Formal and informal interaction routines that take time and effort to develop enable integration of informational flows across a firm’s supply chain. Investments in relation-specific assets and long-term orientation in relationships enable the development of these interaction routines.” (Patnayakuni et al. 2006, p. 13).

Participants’ readiness to share information can vary. Lack of senior management support is frequently mentioned as an impediment, and incompatible systems and IT architectures as well as inadequate employee training may also impede inter-organizational information sharing (Fedowowicz et al. 2006). Another barrier is the perceived risk that a business partner will exploit proprietary information (Larsson et al. 1998; Barringer and Harrison 2000; Straub and Watson 2001).

Trust is a necessary element for information sharing to occur between individuals, whether within or across organizational boundaries. A definition, drawn from social exchange theory, is offered by Young-Ibarra and Wiersema (1999): “Trust is the expectation by one trading partner about another, that the other will behave in a predictable and mutually-acceptable manner.” When a partner organization is seen as untrustworthy, participants may decide not to provide data and/or not to use or rely on others’ data. Conversely, trust reduces this perceived risk (Ibrahim 2005; Arino et al. 2001; Nidumolu 1995; Schoorman, et al., 2007). Some research suggests that propensity to trust is an individual trait (Brown, et al., 2004). And, per Nicolaou and McKnight (2006) perceived information quality impacts the user’s trusting beliefs. Further research is required to learn how trust (or distrust) affects participants’ decisions to provide data to others and to use data received from other organizations’ systems or individuals.

The line separating interpersonal trust and inter-organizational trust is not sharply drawn. Trust affects companies’ willingness to produce or use information (Moorman, et al., 1992 and 1993), and affects individuals’ willingness to share personal information (McKnight, et al., 2002). Herein, “participants’ trust,” refers to the trust of those individuals (from different organizations) who actually participate in a crisis incident. Trust in an inter-organizational context is “the mutual confidence among the members of two or more organizations in the forbearance of opportunistic exploitation by another based on both calculation and good intentions.” (Larsson, et al. 1998, p. 292).

Trust is seen as comprised of three interrelated aspects: calculative, competence and relational trust (Paul and McDaniel, 2004). We see these as similar to three aspects of perceived trustworthiness of a trading partner that have been examined in numerous business studies (Mayer et al. 1995; McKnight et al. 1998; McKnight and Chervany 2001; McKnight et al. 2002): benevolence (acting in the customer or partner’s best interests), competence (ability to effectively carry out transactions necessary to the trading partnership), and integrity (honesty).

Prior research also confirms that the nature and impact of trust can change over time (Moorman et al. 1992). For example virtual team members’ levels of trust in one another differ under varying conditions and during different stages in a project (Jarvenpaa et al. 2004; Larsson et al. 1998; Nidumolu et al. 2001). For this reason, some researchers contend that longitudinal research is needed, in order to gain a better understanding of how interpersonal and inter-organizational trust and related behaviors and structures evolve (or in some cases, co-evolve) over time (Elgarah et al., 2005).

Little is known about the factors that influence trust and information sharing when people from different, loosely-coupled organizations must quickly share information, make decisions and perform tasks under time pressure (Schumaker, 2002). From the above studies of inter-organizational information sharing and trust, much has been learned, yet there is still a need to investigate questions such as:

- In a non-routine crisis, is trust as important as (or more important than) in routine situations?
- In crises, is trust as important for participants’ decisions to provide information as it is for participants’ decisions to obtain and use others’ information?
- Does trust in a provider of data improve users’ confidence in the data? What else affects their confidence in data?

Data Quality

Herein we use the terms “data quality” and “information quality” interchangeably, while recognizing the oft-cited continuum in which “data” represent discrete events/measures and “information” involves some meaningful aggregation of data. Most information quality studies have examined transaction processing data, which support routine information sharing. Fewer studies have examined information quality in inter-organizational decision-making, and very few have examined non-routine, time constrained inter-organizational decision-making. Data quality problems exist in relationships, dependencies and
connectivity between units within an organization and become compounded as units interface between organizations (Orr, 1998). Quality problems within a single domain or functional area are more routine and easier to address, as compared with situations in which information sharing extends to multiple units or into other organizations (Lee 2003). Even when participating organizations have compatible IT architectures (such as integrated ERP systems) the data they share will not necessarily be consistent along all quality dimensions (Strong and Volkoff, 2005).

Information quality is multi-dimensional (Wand and Wang, 1996). Kahn, et al. (2002) identified four main categories of information quality: soundness, usefulness, relevance, and completeness. These categories are further classified into sixteen dimensions. Of these, accuracy has been the most extensively studied (Parssian et al. 1999). In non-routine time-pressed situations, another important quality dimension is data timeliness, defined as “the extent to which the information is sufficiently up-to-date for the task at hand” (Lee and Strong 2003). The balance between using current but inaccurate information or accurate but outdated information -- i.e., the accuracy-timeliness tradeoff -- was studied by Ballou and Pazer (1995). When similar data are provided from multiple databases, timeliness becomes even more critical (Cappiello et al. 2003). For instance, if systems have different update criteria, ambiguities will exist in the data. Specific data provided by each system may be accurate as of a specified time, yet information based on combining the data may be inaccurate and result in erroneous decisions. Data timeliness has not been studied extensively, and few studies have examined data quality issues in non-routine, time-pressed situations that require sharing of data across organizational boundaries.

Herein, we distinguish between data quality, which we define as the extent to which a unit of data is faithful to the state or event on which it is based, and confidence in the data, which we define as a user’s perception of its value. In a routine transaction processing example, data quality is good if a valid sale occurred and the recorded data accurately reflect the number of units sold and the price at which they were sold. A user’s confidence in the sales data is probably not an issue (unless the user is an auditor intent on uncovering fraudulent accounting, or a new system has not yet been well tested and users believe it is not processing the information properly). Now consider non-routine, time-pressed medical care: a diabetic patient has been in an accident and is in shock. His blood type may be accurately reported as A positive and at noon his blood sugar level may have been accurately recorded. However, the first responder might lack confidence that these numbers are correct, especially if they are provided to him or her by an unknown individual or unfamiliar system from another organization and/or in a form that differs from how they are typically provided in the clinician’s home organization. The clinician’s confidence in the accuracy of the information may be colored by his or her trust in the individual or system providing it (i.e., his/her perceptions of the benevolence, competence, and/or integrity of the data provider). Furthermore, if it is now 2 pm, the clinician is more interested in the patient’s blood sugar level now, not the level at noon. If the clinician is not confident in the data regarding the patient’s blood type and blood sugar level, s/he may experience difficulty assessing the patient’s condition and deciding on an appropriate course of treatment. With this in mind, we turn to a proposed new dimension that is likely to play an important role in inter-organizational information sharing: Confidence in Data.

**Confidence in Data**

One likely facilitator or impediment to information sharing is the degree to which participants believe the data provided by other organizations is of sufficient quality to aid in the decisions that they must make. We define confidence in data as the user’s perception of the value of data that are being used or shared. When individuals do not feel confident in the quality of data they receive from external parties, they are less likely to rely upon it when making decisions. It should be noted that prior experience will influence confidence in data but will not influence its accuracy (Fisher and Kingma, 2001).

What affects users’ confidence in data quality? We propose that a user’s judgment of the trustworthiness of the provider of the data (i.e., the recipient’s beliefs about the provider’s benevolence, competence, and integrity) will affect his or her confidence in the data. Supply chain studies, for example, report that participants adjust their demand forecasts based partly on their beliefs about the potentially exploitive behavior of others. A user’s prior experience also plays a likely role in determining their level of confidence. Confidence may be reduced through repeated use of systems (or people) that provide low-quality data. For instance, it has been reported that tsunami warning buoys give a high number of false-positive readings (in which a wave swell is not followed by a tsunami). So, ongoing users of this data may, over time, develop a response similar to the Peter and the Wolf fable; when a true positive reading appears, it may not be acted upon because – having experienced many times when the data, in effect, “cried wolf” – it is believed to be a false-positive. Thus, we propose that problems in the quality of information provided in prior situations will reduce users’ confidence in similar data that are evaluated for subsequent decisions. Conversely, we propose that experiences with high-quality data exchanged in prior crises will increase users’ confidence in similar data for subsequent crisis decision-making.

Thus, it seems likely that a high level of confidence in data received from external parties is required for people to make fast decisions. Users’ expertise and previous experiences in other contexts are also likely to affect their confidence in the data.
received from other organizations, which in turn will impact the extent to which they choose to rely on the data to make decisions. Just as a highly skilled professional may focus on somewhat different data than a novice (Fisher, et al., 2003), potential data users may focus on somewhat different data received from sources they have experience with, as compared with data received from sources that are unknown or perceived as untrustworthy.

**Decision Making Under Time Pressure**

According to the theory of recognition primed decision making (RPD), individuals confronted with a new situation will quickly assess the situation, then recall a previous situation that appears similar, and then choose to take similar actions as in that previous situation (Lipshitz, et al., 2001). Under time pressure, most people focus on a single comparative situation and course of action (Kaempf, et al., 1996), even though a better outcome might be attained by altering the course of action to better meet the needs of the current situation (Flin, et al., 1996; Klein, 1993). Clearly, the impact of time pressure on decision processes and outcomes is an important topic of further study.

**The Research Model**

As discussed above, many obstacles can impede effective inter-organizational decision making in time pressed situations. We propose to look at three specific obstacles: trust, data quality and participants’ confidence in data.

Prior research has established that members of an organization must judge members of another organization to be trustworthy before they will provide them with data. Our study focuses on the recipients of the data. The trust the recipients from different organizations have in the individuals or organizations that provide data will impact their confidence in the other party’s data and their propensity to use it. This leads to our first proposition: Given that data are provided by individuals and/or systems from one organization to recipients from one or more other organizations:

P1: Higher levels of perceived overall trustworthiness of the data provider will lead recipients to have higher confidence in the provider’s data:

P1a: Higher perceived levels of provider benevolence will lead to higher recipient confidence in the data.

P1b: Higher perceived levels of provider competence will lead to higher recipient confidence in the data.

P1c: Higher perceived levels of provider integrity will lead to higher recipient confidence in the data.

A recipient’s level of confidence in data provided by others will influence his/her choice to use or not use the data. Thus, our next proposition:

P2: Higher levels of confidence in data provided by another organization will influence the recipient’s use of the provider’s data.

P2a. Higher levels of confidence in data provided by another organization will influence the amount/number of times the data will be used.

P2b. Higher levels of confidence in data provided by another organization will influence the variety of types of data that will be used.

Use of data does not guarantee appropriate decision outcomes. As discussed above, an important mediating variable is the actual quality of the data that are used. Low quality data will lead to poorer decisions and high quality data to better decisions. We have chosen to focus on two data quality attributes from the list of sixteen identified by Kahn, et al. (2002). We chose “accuracy” because it appears on every list. We chose “timeliness” because of its obvious relevance to time-pressed decision making. Future studies could fruitfully examine additional data quality attributes. Thus proposition 3 is:

P3: The overall quality of the data will impact the quality of decision outcomes.

P3a. Data that are accurate will lead to better decision outcomes.

P3b. Data that are timely will lead to better decision outcomes.
Previous studies have shown that trust builds (or degrades) over time, based on participants’ experiences with each other. In order for companies to share data they must trust one another, and when organizations do share data their trust in one another increases, provided the data was of appropriately high quality and led to good outcomes. Therefore proposition 4:

**P4:** Decision outcomes impact the recipients’ subsequent views of the perceived trustworthiness of a provider.

**P4a.** Decision outcomes impact the perceived benevolence of the provider.

**P4b.** Decision outcomes impact the perceived competence of the provider.

**P4c.** Decision outcomes impact the perceived integrity of the provider.

We further propose that confidence in data provided by others is affected both by the perceived trustworthiness of the provider and by the recipients’ direct experiences of decision outcomes from previous use of that provider’s data. So, as recipients make use of others’ shared data, and see the impact of that data on their decision outcomes, their confidence in that provider’s data will also rise or fall (depending on the outcomes). Thus:

**P5:** Decision outcomes impact recipients’ subsequent confidence in data provided by the other party.

To summarize the model below, which describes these phenomena from the point of view of the parties who receive information from others: In those time-pressed situations in which data are provided by individuals or systems from one (or more) organization(s) to recipients in one (or more) organization(s), the recipients must have a high enough level of trust in the potential providers’ trustworthiness (benevolence, competence, and integrity), to be confident in the data they provide to in turn use that data in decision making. The actual data provided must be of a sufficient level of quality (herein, accurate and timely) to aid in the decision that must be made. Decision outcomes will, in turn have a subsequent impact on recipients’ confidence in data coming from each provider, as well as their trust in each provider. Figure 1 depicts our model.

![Figure 1: Research framework and propositions](image)

Note that our proposed model does not fully reflect the collaboration process. In the literature review, we noted that individuals and organizations will not provide information to others unless they first trust the recipient parties. Since the provider’s point of view has already been well studied, our model focuses on the recipient’s point of view. Furthermore, for the sake of simplicity this model does not describe the collaboration process itself. In other words, many factors that can affect decision outcomes, besides the use of data and quality of that data, are not yet described in this simplified model.

**Proposed Research Project**

In order to examine the interplay of data provider trustworthiness, recipient confidence in the data, data quality, and data usage on time-pressed inter-organizational collaboration, we plan to study telemedicine for urgent care. Telemedicine systems are used to share information and provide medical care over distances using telecommunication networks (Kyriacou et al. 2003; Shumaker, 2002). Telemedicine is useful for diagnosing and treating patients who -- due to physical, financial, or time constraints -- cannot travel to a specialist or appropriate medical facility. For example, when a meteorologist located in Antarctica injured a tendon in his knee and required surgery, telemedicine was used to enhance the medical care provided. Telemedicine is especially useful in time-pressed situations. For example, when a patient is having a heart attack or a car
accident occurs far from an emergency room, time is a critical element and telemedicine can play an important role in patient survival. Typical emergency telemedicine systems will bring together various medical providers (i.e. testing labs, radiologist, point of contact facility, consulting facility, and other medical data providers). In some cases, the facility or caregivers at the point of contact (the EMTs, the rural hospital, or other medical establishment) may have limited history with the consulting physician. They may not trust each other and may lack confidence in the information that is exchanged.

Previous pilot studies of remote trauma management suggest that telemedicine systems can yield high quality of care (Tachakra et al. 2001; McGee 2004). In a survey of telemedicine markets (Dakins 1997), approximately 40% of respondents felt that emergency telemedicine was their most needed telemedicine system. However, these studies did not examine the interrelationships among perceived data provider trustworthiness, recipient confidence, data quality, usage and outcomes.

We propose that for telemedicine systems to aid in decision making for urgent patient care, clinicians must trust those who provide data via the telemedicine system. Specifically, we propose that they must trust the data provider’s benevolence, competence, and integrity. High levels of trust in the provider will lead the clinician to feel confident that the data will be useful. And, the data provided over a telemedicine system must in fact be reasonably accurate and timely. If a clinician feels confident in the data, yet the telemedicine system does not actually provide high-quality data, critical mistakes can occur. Conversely, if a clinician is not confident that the data provided by the telemedicine system is useful, the clinician may not accurately access the patient’s condition, resulting in additional medical complications or death.

We propose to conduct research on the use of emergency telemedicine systems, basing our work on the above research model. We propose to employ a mixed-methods study, combining qualitative and quantitative measures. Some elements of our model are based on existing theories of trust and data quality, and thus can be fruitfully investigated using instruments adapted from others’ previous research. We plan to conduct a large-scale survey of users of emergency telemedicine systems (physicians, nurses, EMT’s and other clinicians) to assess their judgments of the trustworthiness of the organizations involved in the telemedicine encounters (benevolence, competence, and integrity), their level of confidence in the data received from other parties and their actual use of the data provided via the system during emergency telemedicine events.

We also plan to interview key informants in two or more telemedicine case studies, to explore caregivers’ views of these and other aspects of inter-organizational information sharing in recent emergency telemedicine encounters. Semi-structured interviews will allow us to delve deeper into the interactions among data quality, trust, confidence, and decision outcomes, as well as to identify other factors which influence collaboration in time-pressed situations, as seen by the participating caregivers. All interviews will be taped and professionally transcribed, then analyzed, using a combination of structured coding and inductive theming. Within-case and cross-case analysis will be conducted to identify aspects of organizational and inter-organizational contexts that can affect data sharing and collaboration. To ensure that a full range of perspectives are captured, we will also employ the snowball sampling technique to identify additional informants to include in the interview process. We expect that this methodology will provide confirmatory evidence for our model, reveal patterns of interaction among the specified variables, and help identify other influential variables.

We call on other researchers to join this effort by examining other forms of non-routine time-pressed collaboration. Research is needed to investigate the proposed model in different settings, as well as to investigate other questions. For example, given that reputation, prior relationships, and other factors have been shown to be important antecedents for inter-organizational trust in routine situations, are these factors also important precursors for trust in time-pressed situations? This important area of investigation has been under-studied, and IS researchers can make a crucial contribution by untangling the relationships among data quality, trust, confidence, usage, and outcomes.

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