Information Sharing during Multi-Agency Major Incidents

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ABSTRACT

Information sharing is vital for the successful completion of a group task. It’s significance is emphasized in situations where group members are drawn from different organizations, where members do not know each other and when they are making complex, time dependent decisions within an uncertain environmental context. In this paper we address information sharing in such a context focusing on multi-agency collaboration when responding to a major incident. The research was informed by the use of third generation Activity Theory. The results are reported here using three dimensions; social, technological and temporal. The paper provides recommendations to system designers and policy makers regarding ways to improve information sharing among members of multi-agency teams.

Keywords

Information Sharing, Trust, Information Practices, Emergency Management, Activity Theory, Multi-Agency

INTRODUCTION

Emergency responders in the UK emergency services are categorized into Category 1 and Category 2 responders (Secretariat, Civil Contingencies Act 2004). Category 1 responders include the first responders from the police, fire and ambulance services, along with members of the relevant local authority, the Environment Agency and other NHS (National Health Services) bodies. Category 2 responders include people from the utility services, humanitarian support and local companies where the incident happens. For example, if there is a fire at a chemical factory then the emergency contact person of that factory will be involved in the tactical meeting and can provide relevant information on the company’s health and safety. Category 1 responders are further divided into operational (bronze), tactical (silver) and strategic (gold) depending on the type of role they perform. In this research, we focused on one of these levels the tactical (aka silver) commanders. These officers are the lynch-pin, middle level managers who need to maintain the aims and objectives set by the strategic commander but also need to control and coordinate the operational commanders.

Whenever a major incident happens, tactical commanders are notified of the incident mostly by their own, service-specific control room. Tactical commander then go to the incident place where they command, control and coordinate their own agency tasks. Once the tactical commander takes control of the situation, s/he needs to attend a tactical meeting (also known as a silver meeting) with members of all other local agencies involved. The main reason for this meeting is to share information (Dennis, 1996). This is required because the information held by each agency is different. For example, the police hold information related to their own tasks, such as road plan, while the fire services may have information related to pipelines and water hoses. The ambulance service often has information relating to patients and the criticality of their condition in any local area. But during a major incident, these agencies may need information from other agencies. For example, if there is a fire or flood in an area, people from the fire services may want to get the information on vulnerable patients, who may need to be evacuated first, which they can obtain only from the ambulance service. Similarly, the police service might need information on pipelines from the fire service. Thus the silver meeting is often a key component of emergency management where information sharing is the key objective.

In this type of multi-agency tactical meeting, the people involved may vary too. Membership of the multi-agency group can depend upon the nature and location of the incident. If for example, the incident happened at the border of three counties (administrative areas); emergency responders from all three areas will be involved. Emergency responders in the tactical meeting may not know the emergency responders from other counties. Thus the people involved in the tactical meeting may not constitute an established team. As stated by Cronin and Weingart (2007), this kind of multi-agency group may generate creative solutions because of the diverse knowledge of its members.

To understand the information sharing among members of such a multi-agency group, it is imperative to understand...
the dynamics of such diverse group. Savolainen (2009) and Engeström (1999) pointed towards the need of multi-dimension analysis to fully understand the underlying issues. Thus in this paper, an analysis in terms of social, technological and temporal dimension will be developed to better understand the overall context of information sharing among multi-agency emergency responders.

This paper proceeds as follows; firstly we discuss related research positioning our work within the field. Secondly we discuss our methodology reviewing our use of Activity Theory. We then present our findings utilizing three dimensions: social, technological and temporal. Finally, we discuss the significance of the research. Research in information practices has the dual objective of informing both the management and technology developers; both these dimensions will be addressed in combination.

Related Research

Our interpretation of the literature in emergency and crisis management suggested that the research in this field is in its infancy stage (Robert & Lajtha, 2002). Furthermore, Roux-Dufort (2007) indicated researches are mostly restricted to case studies and storytelling about what went wrong. Green and Kolesar (2004) showed that in recent years there is shortage of research in this field. A few models were developed in the 70's and 80's for the ambulance service (Fitzsimmons, 1973; Savas, 1969), fire service (Kolesar & Blum, 1973) and police forces (Chaiken & Dormont, 1978). However, it was identified that even during the 9/11 incident; those models developed in the early 80’s were still used and deployed (Green & Kolesar, 2004, p.1012). This could be an indicator of the lack of new models or resistance to change. With frequent and repeated disasters (man-made, natural) happening around the world, there is an essential need to research in the emergency management.

For multi-agency emergency management, one of the major problems is the coordination among responders (McEntire, 2002; Quarantelli, 1988). Chua et al. (2007) emphasizing on coordination mentioned that during Hurricane Katrina, agencies were not able to coordinate due to lack of trust. Heide (1989) emphasized the need of inter-organizational coordination with an inclination towards the communication problem, typifying communication difficulties as coordination difficulties. It is thus imperative to understand the communication process and information sharing among responders in emergency management.

To resolve the coordination problem, Haddow et al. (2008) suggested the use of open communication systems. Several other researches has indicated the advantage of using technology in sharing information to improve coordination (Adam, Kozanoglu, Paliwal, & Shafiq, 2007; Dantas & Seville, 2006). Quarantelli (2001) too, envisaged that the use of technology will have substantial improvement in crisis management. Sagun et al. (2009) added further that technology is indispensable for information sharing in disaster management. However, Chua et al. (2007) noted that communication system nearly collapsed with only satellite phones and few hand radios available during Hurricane Katrina implying lack of reliability towards the use of technology during major incidents.

In the information practices/behavior research, information sharing has been looked at from different perspectives such as motivation (Davenport & Hall, 2002), issues within a team (Sonnenwald, 2006), technology (Dantas & Seville, 2006), serendipitous information sharing (Fisher, Durrance, & Hinton, 2004; Marshall & Bly, 2004) and information seeking (Su & Contractor, 2011). However, very little research has looked at information sharing in time-critical environments (Sonnenwald, 2006; Sonnenwald & Pierce, 2000) or multi-agency environments such as emergencies (Adam et al., 2007; Dantas & Seville, 2006; Liu & Chetal, 2005). The research by Sonnenwald (Sonnenwald, 2006; Sonnenwald & Pierce, 2000) looked at information sharing among the members within command and control; however, it can be argued that people within the command and control function are essentially from the same agency, in Sonnenwald’s work, the army.

From emergency management research perspective information sharing is a potentially fruitful area of research where there is a clear gap in the literature and a significant need for research. Equally, in the information practice research, the context of information sharing among multi-agency emergency responders has not been focused on. Thus there is a gap between the research in emergency management and information practices. The aim of this research is to fill this gap by addressing questions such as why information sharing is necessary in multi-agency major incidents, is it easier to share information in an ad-hoc group, what factors affect information sharing.

METHODOLOGY

A qualitative stance has been taken in this research; to achieve in-depth analysis and hence to understand more deeply the information sharing issues. 20 semi-structured interviews ranging from 40 minutes to 99 minutes (averaging 70 minutes) were conducted along with 35 hours of observation of multi-agency training and exercises. The interview structure was designed using Activity Theory as a framework (for details see (Mishra, Allen, & Pearman, 2011)). As stated by Devitt and Borodzicz (2008), real time observation is rarely practicable in the research setting of emergencies for ethical and other reasons. Critical Incident Technique method (Flanagan, 1954) was used to formulate the specific interview questions which involved asking interviewees to go through a recent emergency that they had handled. To assure generalizability of data, different incidents ranging from major floods, major fires, terrorist attacks, local riots, chemical incidents, major events were looked at. During the interview, handwritten notes were taken along with voice-recording. These notes were also analyzed from which initial broad themes were identified.
Voice files were transcribed by the first author and main comments, while transcribing, were noted. After an initial round of interviews the data was analyzed and theory developed. The interviews questions were then amended to explore the new themes that emerged. Due to the need of anonymity of data, after the transcription, names of people and places were replaced by Name1, Name 2 and Area1, Area2 and so on. Similarly, interviewees name were also replaced by Interview1 (I1), I2 and so on based on the chronological order of interviews conducted. However, the name of agencies such as Police, Fire, and Ambulance were not anonymised because it emphasizes the underlying issue within different agencies. Coding was undertaken using N-Vivo (a qualitative data analysis software package). Memo and annotation in NVivo were used extensively. Memo was used for noting down the links of emerging themes with the extant literature. Only the most highly referenced codes such as information sharing, technology were explored for this paper.

**Analysis**

Activity theory can also be used as an analytical tool as well as a structuring framework (Barab, Schatz, & Scheckler, 2004; Y Engeström, 1987) was used to analyze the data from the interviews. It also aids in understanding the context within which the information behavior research is being conducted (Allen, Karanasos, & Slavova, 2011). In activity theory, the unit of analysis is always an activity. The subject (in this case the tactical commander) acts upon the object/problem space (incident) to achieve the desired outcome. Rules and social norms and division of labor dictate the subject towards achieving the desired outcome. Similarly, tools are used as mediating factors to act upon the object. These tools can be physical (radio, face to face interaction) or intangible (experience, conversation, questions to be asked). An activity results due to motivation. Activity can further be decomposed into a set of actions which are oriented towards short term goals. When a certain action becomes routinized, it is called an operation which depends on condition. When condition is changed operation becomes action. For illustration, an example of driving a car can be considered. For a person who is driving the same car for a long period time, driving is an operation as the condition (car) remains same. But when that person changes his/her car, s/he needs to drive consciously to understand how that new car works. Thus with the change in the condition, the operation becomes action as driving that particular new car is not something that the person is used to. This decomposition of activities into actions and operations provides the basis for a micro level analysis (Mishra et al., 2011).

According to Engeström (2001), third generation activity theory is suitable to study inter-organization where activity system of two or more agencies are interacting. Because multi-agency group interaction needs to be analyzed in this research, third generation activity theory will be used. Thus for police, fire and ambulance, the activity system of each individual agency needs to be modeled. As shown in Figure 1, the tactical commander from each agency has his/her own agency’s objectives to fulfill but the common goals for all agencies are to save life and property. For example, the main objective of the police tactical commander may be road management, whilst the fire tactical commander may be concerned with rescue of someone if it is floods, or putting out the fire if the incident is a major fire. Similarly, the ambulance tactical commander may be more concerned about vulnerable people. Thus, each agency has its own objectives. Due to this, there might be a conflict in the task structure of each agency. As noted by one of the interviewees, fire commanders are good at destroying evidence. This shows that the objective of fire commander is to put off fire if there is one. Fire commander may not realize that there might be an evidence for the police commander to find out the root cause of the incident. Thus, it is necessary for all the involved agencies to come together to set a common (shared) aim and objectives as shown in Figure 1 which is set by the strategic commander (if there is one) and also includes saving life and property.

![Figure 1. Activity Model of the Tactical Meeting based on Engeström (2001) 3rd Generation Activity Theory](image-url)
FINDINGS
Several issues directly linked to information sharing were found while using this Activity Theory framework to explore the activities of silver commanders during the tactical meeting. These will be explained in the following sections.

Need for sharing information
As mentioned in the introduction, different agencies hold different information due to which tactical commanders need to meet in order to get a full picture of what is happening. As pointed by one of the interviewees (I4):

I1: So, the incident commander part of the process is to liaise with the police about what is happening, what is your information, the company or whoever it may be where the incident is.

Information needs to be shared among the tactical commanders during the tactical meeting also to ensure that agencies are not doing the same tasks and are not interfering with each other’s allocated tasks. This can be done by sharing information on what each agency is doing or will do and also by setting common objectives.

Information sharing is also necessary to share expertise. As delineated by interviewee I3, the expertise of each agency is required too.

I3: (a major fire) where, the fire service and the police had agreed that it was going to put out (the fire) by putting water on it and it wasn’t until the environmental agency turned round and said, if you do that all the runoff goes into the area that actually feeds the drinking water in Area X and will contaminate it for next 10 years.

Another major purpose of the silver meeting is for the resource sharing. Depending on the size of the incident, each agency may not always be capable of handling the situation. In such situations, resources can be sought from other agencies. During observation of one of the multi-agency exercises, it was found that because of major floods, local people were to be evacuated. But the fire services didn’t have information on where to establish the recovery centre. The tactical commander from the fire service then asked the tactical commander from the local authority for a suitable place which was ultimately provided by the local authority. Thus, sharing information aids in resource sharing too.

Issues from a Social Dimension
Using activity theory, contradictions among different components of the activity system can be identified which can be used to inform policy makers and system designers. According to Engeström (1995), contradiction is one of the important properties of activity theory. He further stated that contradiction keeps the system unstable but it is also a source of innovation. Engeström proposed four different types of contradiction within an activity system. Applying the 3rd generation activity model here, resulted in identification of several contradictions within and between nodes of the same system and also between other activity systems. Because of the focus of this research on information sharing, only those contradictions related to information sharing will be delineated here.

Primacy of one agency
During the analysis it became clear that there is a contradiction between the subject (tactical commander) and the shared objective (outcome). When tactical commanders meet for a tactical meeting, they are supposed to share information such that all the group members will have a common understanding of the situation. However, the analysis found that if one particular agency has more information compared to another and this information is sufficient to perform the relevant task, then information is not shared, as a result of which other agencies are not updated on the ongoing situation. This can be reflected in the following excerpt from interviewee I15. Here the interviewee stated that the tactical commander who was in charge of the situation did not share information with other tactical commanders due to which others were not updated on what was happening, causing the tactical commander from one of the other agencies to have to demand the information. It can be seen that the incident is police service primed where the coordinator for the tactical team is the Police Inspector who has primacy of information. The Inspector thus did not feel necessary to contact and share information with the tactical commanders from other services due to which the latter were not able to make sense of what was happening.

I15: And, so the sergeant tried to find out what is going on, but this silver inspector was in charge and had all the facts because he was forward... and we didn’t know quite what was going on. Certainly, we were demanding to speak to this guy for about an hour. You know, we eventually, we did actually demand- in fact it was the fire who demanded the return so we could have proper discussion with them. It was a sergeant who was left at the RVP (Rendezvous Point) at JESCC (Joint Emergency Services Control Centre) and if she was aware of it- she didn’t share with us because we only felt that subsequent to the incident that’s what could have happened.

Classify Information
Classification of information was also found to be an underlying issue in information sharing. During an emergency, information that is made available to the tactical commanders is graded based on importance and confidentiality. As stated by interviewee (I11), commanders sometimes misclassify information.

I11: ...people who are trying to hold back information for whatever reason. We tend to over classify. So sometimes in the case of the police and the military, they classify information so strongly... that is not helpful for the combined response.
Thus if a tactical commander classifies information as grade very confidential, it is not shared with other agencies. This restricts other agencies from getting information from each other.

**Terminology/Language**

Each emergency organization has its own set of reserved terms which form an organizational discourse and often organizational shorthand for communicating. While this may facilitate efficient communication within an organization it can cause problems when communication between organizations needs to occur. One of the interviewees illustrated this by noting that on maps, H stands for hydrant for fire but it is Hospital for health services. Thus, the difference in terminologies used and language spoken can hinder information sharing. As stated by I2 below, there is a clear need for shared ontologies and the reduction of the use of reserved terms when natural language would suffice:

I2: Well I think within any service, you develop your own language - that may be sounds too grand but you have your own ways of codifying things….. I suppose minimise jargon, that’s the other very common one, you have got to speak in plain terms.

**Additional work**

The tactical meeting is often considered to be the best practice in terms of sharing information among multi-agency emergency responders. However as stated by interviewee 115, tactical commanders may feel that tactical meetings are simply an extra job.

I15: I am not doing my job then (during tactical meetings)- I am not focusing on what’s going on in the incident and making sure that my bronzes and operational staff are being supported with better equipment and supplies and everything else they need

**Technical Issues**

Tactical commander may decide to locate at different places depending upon the task to be managed during the incident. This depends on the nature of the task handled by each agency and also depends on the availability of information. Fire and ambulance services may prefer to be located near the scene because of the nature of the task they need to perform whilst police might prefer to be located at headquarters. This may result in tactical commanders not being collocated. For the tactical meeting, no mandatory rule is provided by the emergency services regarding location of a tactical commander. It was also found that while some agencies prefer all the tactical commanders to be located together in a headquarter, as stated by interviewee 117, there is a move by the police to actually take us away from scene and put us into police control rooms which from my side of health, it is going to cause us a lot more problems because we need to be at the scene because that is where we manage, even though there’s a bronze, tactical commanders from the fire and ambulance services are unwilling to be located there. In such circumstances, the only way for communication and information sharing among the tactical commanders is via use of technology. When the activity model of the tactical meeting was analyzed with different types of technologies as tools for the information sharing among tactical commanders, several underlying issues were identified as outlined below.

**Availability**

It was found that different agencies use different types of technology. As stated by one of the interviewees, all the blue light services and the local authority had the Airwave radio system to communicate with each other but a person from the Environment Agency did not, as a result of which s/he was hindered from participating in the information sharing.

I13: So, we could set up a silver command channel so we could talk to each other. But the problem then is, environmental agencies don’t have it (radios) and other agencies don’t have it. People on the scene may never have used it but we’ve got radios we can bring out.

**Familiarity**

Similarly familiarity was identified to be another technological problem which affects information sharing. When tactical commanders are not collocated, they need different technologies to communicate with each other so as to share relevant information. However, if a commander is not familiar with the available equipment or technology then s/he may not be able to use it or may take a long time in understanding the way to use it. As was pointed by interviewe 112, in the UK Airwave radios have been recently introduced to make information sharing easier. However, because there are several channels, tactical commanders may find it difficult to know which channel to go to, which emphasizes the underlying problem of familiarity with the technology in use.

I12: The radios can be difficult if you are not familiar with them. So, for other staff who are not familiar with them - sometimes different radios, put a lot of channel and say well this is how to contact us - and they struggle with this

**Simplicity**

Related to the above issue of familiarity is the issue of simplicity. As stated by interviewee 114, there are several logs as a result of which tactical commanders may get confused about which log to look at for a particular event.

1 The Emergency Services mobile radio system
2 Commanders in emergency services need to fill the log book which consists of steps taken by the commander to act towards the effective management of emergency. This will be looked by Judges during debriefing
114: So there may be more than one log, usually they try and consolidate them quite quickly because if they don’t you get confusion with different entries or different logs

Reliability
The most important factor identified in relation to technological issues is that of reliability. Tactical commanders find technology less reliable though its importance cannot be underestimated as pointed by the excerpt below.

118: It (technology) does when it works...

Interoperability
In a multi-agency environment, agencies might be using different technologies which are designed to their own needs. As stated by interviewees (as shown in the excerpts), lack of interoperable systems causes hindrances in developing a common operating picture.

15: that was the principle source of confusion because information was going into one police force and was needed by another. We didn’t have compatible radio channels

115: … if you can’t actually take a picture and share it with your partners then you have not got a good system and certainly not a common operating picture.

Time Factor
The environment in which multi-agency emergency responders work is time critical. As pointed by I2, information sharing in such context needs to be undertaken rapidly with concise communication of relevant information. As indicated by I16, obtaining timely information is vital too.

12: It’s about the rules of the game really…recognizing sometimes that concise information can be a little bit bare and sometimes you do need to have a little bit more background or something but there again in a tight time frame you haven’t got time for everybody to give you a full story about everything or the decision time has passed.

116: … who’s got that information and how quickly can I get it.

DISCUSSION
In multi-agency group tasks, members of the group may have their own objectives related to the agency they belong to. These people need to come together to perform a common task as input from different agencies is required. During the major incident, the members of multi-agency teams may not necessarily be same every time. The group is formed on an ad-hoc basis depending on nature of the incident and different situational factors. Information sharing, amongst the multi-agency members, is thus imperative so that people can pursue effectively common goals and objectives. Though information sharing is an important factor in ensuring a productive outcome, several factors hindering information sharing have been identified.

If one agency has sufficient information to obtain its agency’s objectives, then it is easier for the agency members to make sense of the situation and hence to decide on the next action. In such a scenario, these agencies may not engage in information sharing with members of other agencies. This can be particularly so in a time critical work environment. Emergencies are very critical; the main aim for any agency is to save life and property. In such circumstances, where no further information is required for making sense of the situation, tactical commanders may not feel it necessary to engage in tactical meetings. This however, does not fulfill the overall aim of the multi-agency task as when one agency is not sharing information; other agencies lack the common understanding which leads to conflicts in the work task. To overcome this issue, it is necessary that common information pool is established (Gigone & Hastie, 1993). The literature has, however, not focused much on this issue of primacy of information with one agency. Stasser and his colleagues (Stasser & Titus, 1987; Stewart, Billings, & Stasser, 1998) researched on the unshared information within a group; however, their research did not cover primacy of information with one particular agency.

It was also identified that members of the multi-agency team classify information which limits information sharing. According to the Civil Contingencies Act 2004 (Anon, 2010, p. 284), information needs to be shared by Category 1 responders with other local responders to enhance coordination. Some responders, however, note the need to share information clashes with the need to restrict sharing of information that was classified as highly confidential. This issue was overcome in situations where group members trust each other. One of the interviewees noted: I usually don’t have to ask to them because we are all so used to working together so much. This finding is supported by literature which states that if people in a group trust each other then there is a higher degree of information sharing among them (T. Y. Chen, Chen, & Chu, 2008; Wilson, Salas, Priest, & Andrews, 2007). Thus to encourage commanders to share information in a multi-agency environment, trust needs to be established. This can be achieved by providing frequent multi-agency training and exercises (Crichton & Flin, 2001; Crichton & Flin, 2005) as by frequent interaction, people start understanding each other and hence they will be able to acknowledge the culture of each other’s agency which leads to familiarity and ultimately results in trust (Patricia, Joseph, & Michael, 1998). In the literature of information sharing, issue of language is persistent (Sonnenwald, 2006). Frequent interaction among multi-agency responders also diminishes the issue of language. As was stated by I2, again it (language) is not so much of a problem because the more we are doing today working together as you learn the main jargon of the other services as well. But that then tell you that you have got to put effort into doing that in advance and do exercises in advance. Thus, frequent interaction also
helps in understanding language of other agencies. This finding is in line with Clark (1996).

It was also identified that tactical commanders consider the tactical meeting to be an additional job. As Crichton and Flin (2001) stated, when team needs to work, an additional task in terms of communication is created to ensure there is no conflict. In addition to this, the reason can be explained based on the motivation and incentives too. At present, the commanders are evaluated based upon the task they perform within their own agency and not based on multi-agency criteria. Multi-agency achievements are not looked at due to the nature of the agencies. This leads to the commanders thinking more about themselves than about the group. Thus commanders might not be motivated to work in a multi-agency environment; rather they will be more oriented towards their individual agency. Liu and Chetal (2005) stated that incentives can be a factor that hinders information sharing. Thus to overcome this persistent issue and to establish the platform for information sharing, the system of incentive needs to be revisited and redesigned to highlight multi-agency achievements. In addition to sociological factors, technological factors were also identified to affect information sharing. In such circumstances, for information sharing different technologies such as mobile, VHF/UHF radios, Airwave radio, internet systems may be used by the commanders. However, it emerged that these technologies, though useful in several instances, are still not considered as a reliable source. According to Dawes et al. (2004), during the September 11 World Trade Centre attack, communication and other computational infrastructure was damaged which makes technology even more doubtful. Only if people find it reliable will they use it to its full capacity. It is thus necessary to establish trust among commanders towards the use of technology. Backup communication system can be one way to ensure reliability. In this research, availability was identified as an important factor that affects information sharing among users. This finding is in line with Su and Contractor (2011) who stated that accessibility of technology is required for information seeking and sharing. It was identified that simplicity is also an issue in information sharing. Responders often struggle to use different support systems and technologies in place within certain agency. It is necessary that users are familiar with the technology in use. At present, different agencies use different types of technologies. It was identified that even within one agency for different forces; technology used for the same task varies. Due to this reason, during a major incident when responders from different agencies need to work collaboratively or also when responders from the same agency but different forces need to work collaboratively, they struggle with operating tools and technologies as they are not familiar with that particular technology thus impacting information sharing. The issue of interoperability has also been raised from time to time by different researchers (Chen, Sharman, Chakravarti, Rao, & Upadhyaya, 2008; Jenkins, 2006; Rhodes & Jenkins Jr, 2007). It is necessary to ensure that technologies used by different agencies are interoperable with each other such that information sharing is possible. As mentioned above, different types of technologies are used by different agencies. Thus whenever information needs to be shared, due to the incompatibility of systems, information sharing is hindered. Thus technology which fits user requirement and which is interoperable with other agencies within the multi-agency team must be used.

Time is also an important factor that impacts information sharing. This finding is in line with Rietjens et al. (2009) who stated that there was a lack of time for staff of civil and military to share information during a response. It is thus necessary for the responders to balance the information being shared. Information should not be too long or too short (for others to find it difficult to interpret).

Based upon the findings and the discussion, it can be concluded that information sharing is influenced by several elements of social, technological and temporal factors. These are illustrated below in Figure 2.

**Figure 2. Factors impacting information sharing**

**CONCLUSION**

In this paper, information sharing as an example of an ad-hoc multi-agency team, the emergency services, was investigated. To enrich the research, the issue of information sharing was analyzed from social, technological and temporal dimensions. Several issues were identified using these dimensions. Trust was identified as a major social factor that affects information sharing. If people trust each other then confidential information is shared within a group too. Primacy of information was identified to hinder information sharing. When one agency has primacy of information, that agency may be unwilling to share information with others. This factor is under-researched in the literature and opens a new area of research in information sharing in a multi-agency environment. Activity theory has also been shown as a useful tool to analyze the information sharing within a multi-agency group. Third generation activity theory provided a robust analytical framework to analyze multi-agency issues.

Several recommendations are made to improve the information sharing among ad-hoc multi-agency teams.
Frequent interaction, training and exercise encourage understanding each other and hence build trust which is necessary for sharing information. Also policy makers need to revisit information distribution. For a better outcome towards information sharing, a common information pool must be designed so that one agency may not have the primacy of information. Similarly, for system designers it can be recommended that above all, technology must be made reliable. At present, the emergency services are spending huge amounts of money in buying new technologies but until and unless users/commanders feel that the technology is reliable, the use of such technology is still doubtful. Interoperability was also found to be very important for information sharing, which needs to be considered by system designers. Policy makers and management of different agencies within the emergency services need to use technology that is compatible with each other. Moreover, information should be shared among responders within shorter time frame for which concise and brief language should be used. As suggested by one of the interviewees, common plans and policies for multi-agency might aid in addressing language issue.

In this paper, information sharing is analyzed from social, technical and temporal perspectives. Future work might involve finding out the relation between these dimensions to see how it impacts information sharing. Also, the Knotworking concept (Y. Engeström, Engeström, & Vahako, 1999), which fits appropriately to such ad-hoc multi-agency team context, may be useful to analyze different information practices issues within a team.

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