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Title:
Formal and Informal Networks during Emergency Situations: The Impact for Information Strategy

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Abstract:

This paper is based on research studies and simulations of information flows used for decision making in emergency situations. The initial research, based on wild fire emergencies, that involve inter-organizational information flows between civil organizations. The further study involved 18 interviews with the military personnel who were deployed in operation Sumatra Assist (SA) post Dec 26th 2004 tsunami. The paper also relates to other emergencies in which a mix of civil and defence organizations are deployed. In addition to the tsunami disaster, these emergencies include the Afghan earthquake and Hurricane Katrina, in which defence elements were directly involved from the outset.

The combined operations in these emergencies emphasise the crucial support given by the defence elements for both transportation and communication. The studies and simulations of the information flows in these emergencies illustrate the essential nature of informal information flows in an effective response to the emergency. The paper discusses the outcomes from the studies and simulations in terms of an information strategy for such combined emergency operations.

1. Introduction

In the recent years we all have heard numerous media reports about natural disasters, terrorist attacks, wars and accidents. Most of these incidents happen without any prior warning causing immense infrastructure damage, suffering, disruption, and grief. Whatever the case may be, natural or human cause, national or international level, all of these situations require a rapid response in terms of people and equipment, and multi-agency co-operation and co-ordination. These invariably include military, police, government and non-government organisations/agencies, fire brigades, and medical personnel supported by local/national authorities. While every catastrophe may be unique in its response requirements and the emergency personnel are trained for such eventualities, the past experiences seem to indicate that the contingencies in place can be heavily challenged. Following a major emergency there are enquiries, analyses and lessons learned and what appears to emerge is that communication and co-ordination efforts are often compromised, decisions are made on incomplete and/or conflicting information and there is increased significance of informal networks in management of crisis situations. Furthermore, in situations where problems are continually changing, cutting through formal communication lines is a prudent and practical way of achieving a faster response[1,2,3,4,5].

This paper examines the use and growth of informal communication channels for command and control purposes during different classes of emergency situations. The objective has been to establish a strategic approach to such channels that augments the formal channels in a predictable manner.

The initial studies for the paper have been based on actual wild fire emergencies, and they have concentrated on the way in which information flows change as a wildfire situation escalates. A feature of these flows has been the range of inter-organizational flows between civil organizations, and the general public communications infrastructure.

The current studies are related to emergencies in which a mix of defence and civil assets are involved, as well as the general public, emergencies such as operation Sumatra Assist (SA), the Afghan earthquake, and Hurricane Katrina.

For the purposes of clarity the emergencies are grouped under three classes, fire, flood and drought. In Australia in January 2006, all three emergency classes were underway in different parts of the continent.

The key elements of these classes have been similarly grouped under the critical resources of power, transportation and communication. In addition the effects of complexity, uncertainty and size or scope over time are also considered.

2. Emergency Classes

2.1 Fires

A fire is a natural phenomenon, governed by physical laws such as wind shifts, and the presence of lightning strikes, but interacting with a largely man-made environment. In Mellegard and Persson analysed and then simulated the flow of information for command and control of the fire fighting activities using a purpose built simulator[6].

The specific characteristics of information flow modelling in this environment lead to a purpose built set of tools for the simulator which included:

- The basic decision making unit is an agent with internal state, implemented as an expert system
- The decision making and rule handling within the expert system is based on a production system. An open source application, drools, was selected for this task.
- The choice of handling knowledge in a distributed manner resulted in a local blackboard model for the information containers.
- The simulation is time driven by clock ticks generated by a centralized communications manager module.

Since a requirement on the simulation toolset was to permit general usage, all of the software selected, such as drools had to be compatible with an overall Java environment.

The strategy employed for containing the fires rendered fire crews downwind of a wind direction change at risk, so receiving timely and accurate information and then alerting the relevant crews was of high priority.

The simulation studies showed that the formal communications structure could provide accurate information, but not in a timely manner. In contrast the informal channels between crews and other volunteers did provide accurate information in a timely manner.

The ability to convey such information was a result of the mobile telephone networks, with individuals' telephones acting as the informal channels. A key to this usage was the 'community of interest' as everyone involved was a volunteer within the fire fighting system. This meant that critical and timely information was coming from these known and expert sources.

Following the simulations an investigation was made into the reaction to such informality at the formal or head office level[7]. The primary issue at head office was that of loss of control of the overall strategy, as it was perceived that the front line teams were making tactical decisions by default that were not known by the head office strategists.

The nature of this issue, loss of control versus the necessity for local C2 decision-making was recognised by head office but no satisfactory resolution has been forthcoming. This fundamental problem is considered later in the paper.

2.2 Flood

This class of emergency covers a number of situations in which the effect of water is the primary concern for emergency services. In Australia floods come from the monsoon in the northern parts and from what are termed rain events in the south that occur when major high-pressure systems stall for a number of days. Within this class come disasters such as Hurricane Katrina (Aug/Sep 05), the recent cyclone Larry in Queensland (Mar 06), and the Asian Tsunami (Dec 04).

The latter emergency was examined through a DSTO research studying the Human Dimension of Future Warfighting (HDoFW). Although the research project mostly involved interviewing personnel who were deployed in the Middle Eastern Area of Operations (MEAO), the military is increasingly deployed in the humanitarian and relief operations, so the research project also included personnel who took part in operation the SA. In total 18 interviews were carried out and covered issues such as: duties whilst deployed, decision-making processes, C2 arrangements and processes, cooperation between Services, nations, or other agencies, information gathering and sharing, formal and informal communication flows, important skills and competencies, and lessons learned. All interviews were recorded and transcribed and software for qualitative data analysis, NVivo, was used to study the data.

The Indian Ocean earthquake and the resulted tsunami of 26 December 2004 was one of the deadliest disasters in modern history. Countries affected were Indonesia, Sri Lanka, India, and Thailand. The most affected was Indonesia with more than 200 000 people dead or missing in the province of Aceh, and 70 000 in the capital Banda Aceh, (population 450000). Most essential services were affected, with water reticulation destroyed or contaminated, loss of waste disposal programs, and vector control brought to a standstill through loss of staff and equipment. Relief effort involved the largest humanitarian deployment of the Australian Defence Forces (ADF) personnel. The international relief response was immense with more than 400 organisations registered in Aceh alone[8]. The ADF together with the New Zealand Defence Force established the ANZAC Field Hospital (AFH) which included an Environmental Health Section (EHS). The EHS liaised with counterparts in civilian and military agencies, both Indonesian and international. These liaisons facilitated exchange of information, sharing of equipment and access to laboratory results, and greatly assisted the disease control efforts.

Similarly as in the case of fire emergencies (section 2.1), during the operation SA the liaisons established with the other counterparts were crucial for an effective response and although many of them were formal liaisons, the need for speedy decision making, resource sharing, and ever unpredictable problems and situations necessitated and created a robust informal network. Due to political and cultural sensitivities, the Australian contingent was particularly cautious that these informal communication channels were not seen as 'sabotaging' the formal lines of doing business. However, what clearly transpired from the interview data is the fact that the bureaucratic processes were often too rigid and did not have the in–built flexibility and agility to expedite the standard operating procedures to meet immediate operational needs. A classic example given was the need to replenish oxygen supply which was used at an enormous rate in Aceh. Informal cross-Service networks were used to speed up the process to achieve the needed result. Similarly, informal interagency and international networks were quickly operationalised to find out who had a surplus and of what resources/equipment to move them around as the need arose.

As in the case described in section 2.1, mobile phones were the primary means of communicating and served as individual nodes in the web of informal channels. In addition, building up a new network through social contacts, particularly with people from other agencies through face-to-face discussion and establishing rapport were the preferred means of trust building which subsequently led to speedy information and resource exchange.

2.3 Drought

In contrast to the previous two categories this third category represents an absence or extreme scarcity of an active agent, and covers situations such as food aid in Africa and the Pakistan earthquake as well as the conditions regularly experience in Australia over major parts of the continent that are related to the El Nino or Southern Ocean Oscillation effect.

A primary determinant as to the effectiveness of the emergency services response to drought is that of access to the affected region, particularly with a view to establishing reliable communications. This problem has been clearly demonstrated in Pakistan as a consequence of the terrain and of the weather. This situation was the subject of an ABC TV report three days after the earthquake.

As with the fire situations, having reliable and timely information is critical, working on a timescale of a very few days, as opposed to minutes in the fire situation. Such a rapid response has proven difficult if not impossible to achieve without the effective support of the defence assets.

On the more general access, as in Africa, the breakdown of law and order in west and central Africa make access for viable civil communications for critical relief efforts essentially untenable.

One consequence in both Africa and Pakistan is the need to make full use of what informal communication channels exist, such as aid agencies and on-ground groups such as Church based and other medical teams. The use of such informal channels is already of major benefit. The real time tracking outbreaks of potential epidemics, such as caused by the Ebola virus, is one example. This has been the subject of an investigation by the Australian Surgeon General, seeking to minimise the risk for relief groups.

The longer-term approach, as in Darfor, is to re-establish law and order to the extent that effective communications can be maintained through formal channels, whilst still using the informal channels. As in Pakistan, this is essentially a defence operation, which then highlights the needs for a consistent communication strategy within a multi-national defence response, and the existing informal channels.

3. Key Elements

3.1 Power

A major consideration in establishing both formal and informal channels of communication is the availability of power. The deployment of handheld radios plus GPS capability for individuals gives a range of command and control options, but assumes that two factors can be dealt with.

The first is power for the individual, and the use of disposable batteries has become an environmental hazard for the US Forestry Service. However the ready availability of devices such as wind up torches that are equipped with mobile phone charger interfaces makes for a viable solution to the handheld problem.

The more serious aspect is that of power for the communications base station, or the equivalent. Both fire and flood tend to destroy such facilities, as was most apparent in New Orleans. In the drought case the power supplies are notable for their absence in the Pakistan and African cases, but are readily available in the Australian environment.

A requirement from the defence sector has been the enabling of a GSM mobile phone network in a dynamic manner to address both the power element, and the communications element.

This was explored in a Tandem Thrust exercise (Australia's major biennial training exercise with United States forces) where an AXE GSM base station was converted into a self contained and self powered unit. The user registration component of the civil GSM network was subsequently replaced by a patented pop-up user implementation, which allowed both defence and civil users to use the GSM net[6].

This exploration served two puposes, one was to determine is off the shelf communications equipment could be used at a personal level, the second was to determine the level of security obtained with a civil form of network

Another option is that provided by satellite phones that could also be interfaced to the range of devices in common use such as the wind-up radios and torches.

3.2 Transportation

The second element that has a major bearing on the formal and informal communication strategies is that of transportation, the issues of time and space. An example was the response to the Asian Tsunami in the Aceh province of Indonesia, the closest province to the epicentre of the earthquake.

The walls of water literally flattened the province so no infrastructure remained, no port access, no road access, and barely enough land on which to land helicopters, the only effective mode of transportation.

In this example there was very little that the local civil organizations could do, so a rapid response by the combined defence forces was needed. As a result all communications in the initial stages were formal defence channels, with the enabling of the civil and informal channels coming later. The experience in East Timor of using a civil telecommunications organization to expedite the build up of communications was invaluable, post the defence operation.

Similarly the situations in Darfor, Pakistan and even New Orleans needed the formal defence-enabled infrastructure in place before significant relief progress could be made.

From a strategic viewpoint these examples show the need for a very rapid response defence configuration that can deploy a number force protected communications groups within hours of an emergency, and with the pre-agreement of the sovereign nations involved.

3.3 Communications

The various examples noted of emergencies of different classes and different political and environmental characteristics have shown a need to use both formal and informal communications for a variety of reasons.

In the case of wildfires the reason is the lack of timeliness provided by the formal networks, together with the issue of a central office communication overload as a fire intensifies[9].

In the case of Pakistan the destruction of access roads, and bad weather placed a premium on the informal networks in the first critical hours before a coordinated defence approach can be initiated. Similarly in places such as Dafor the issue of law and order places an emphasis on informal channels until such time as a force protected defence communications infrastructure can be deployed.

For the Asian tsunami the situation in Aceh province meant that even the informal channels were absent, whereas in Thailand there was enough infrastructure left for tourists to communicate by mobile phones, the informal network that enabled the start of a properly planned emergency response.

The implication from these example is that a strategy designed to handle equivalent emergenciy situations must take advantage of both formal and informal channels from the outset, an outcome discussed in the next section.

4. The Communications Strategy

An old management adage is that it is always better to ask forgiveness than ask permission, and defence personnel and their opposite numbers in the volunteer fire brigades are experts at getting a job done by whatever means are necessary, including the extensive use of informal communication channels.

The challenge for the C2 planners is to try and reap the benefits of rapid operational responses with maintenance of a strong strategic situational awareness.

The examples of incorporating GSM into the defence communication fabric, as was done in Tandem Thrust, and illustrated in the fire brigade simulations, are pointers to a potential strategy. AXE style GSM base stations are now available in backpack formats, so that a GSM enabled network can be fully mobile, and deployable in a very short timeframe.

This form of strategy solves the technical integration of the formal and informal channels to a significant degree, but it does not address the organizational issues, such a s head office overload. In principle it actually makes the situation worse due to the rapid increase in message traffic from what was an informal network.

This is not a new problem, as was noted in Vietnam with the controller in the sky concept, a concept that rapidly fell out of favour. The ability to layer and classify traffic

from operational to strategic is a well known art, somewhat countered by the inevitable tendency of some senior staff to wish to micro-manage. The developments in the acquistion of information without overload are discussed in the context of UAVs in Croft J Send in the Global Hawk[10].

5. Summary

Disaster or emergency management requires that critical and timely information is coming from known, trusted and expert sources and is quickly reaching those at the operational front. This is not always what the reality allows for. The communication strategy must, therefore, optimise the process of transferring critical data to enable local decisions to be made based upon local data, which may change from minute to minute. In such cases the only information available may come from informal channels some of which may be non-expert. The examples of a relief operations in Pakistan, Aceh, New Orleans and Darfor illustrate that defence forces are in the best position to enable basic infrastructure before any significant relief work could be done.

Because of unique capabilities of the defence, the decision making process, i.e. C2 processes needs to be enhanced with a degree of empowerment and autonomy embedded into the system to better recognise the role of informal networks. In many cases a difficult political situation in a given place, the lack of law and order and any infrastructure to support formal and informal communication channels further highlights the needs for a consistent communication strategy within a national and/or multi-national defence response. .

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