

# Modelling the Information Sharing Process in Military Coalitions: A work in progress

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## ABSTRACT

Coalition partners must share information to work together. Models of information sharing assume that it is a linear, one-way process. As part of a larger project, we studied information sharing in military coalitions. Interviews of 47 officers in NATO R&D organizations showed that one piece of information was often traded for another. This is characteristic of an information market. Security regulations make information a scarce resource, although trust may allow the regulations to be waived. Our observations have consequences for the military Network Enabled Capabilities community in their desire to migrate to a “need to share” security principle. Failing to find a suitable process model in the literature, we outline requirements and identify two possible starting points for modelling the information sharing process in military coalitions.

## Keywords

Information sharing, coalition, communication, information seeking, process model, security regulations.

## MOTIVATION

Crisis management and military operations have many features in common. In this paper, we focus on the feature that such operations are invariably planned, performed, and controlled by multiple organizations from diverse disciplines and nationalities. At the time of writing (January 2010), we see this in the international response to the Haiti earthquake. In particular, the partners do not form part of a single organizational hierarchy, but wish to retain their own sovereignty. Although they may be willing to form a temporary coalition for the duration of the operation, their long-term goals are not aligned, and their cultures may even be antagonistic. A key issue that coalitions face is how to organize their Command & Control (C2) processes.

A typical example of a coalition is the International Security Assistance Force (ISAF) in Afghanistan. ISAF is a NATO-led security and development mission established by the UN in 2001. More than 40 nations contribute military personnel from all armed services (e.g. army, navy, air force, marines, special forces). Some nations also contribute development personnel from their Ministries of Foreign Affairs and of Overseas Development, as well as police. They cooperate with the Afghan government, the Afghan National Army, and the Afghan Police service. Other partners include several UN agencies, non-governmental organizations (NGOs), commercial suppliers, and even the media. There are some 15 separate C2 systems within ISAF.

To work together – or at least to avoid conflict - coalition partners must share information. For the purposes of this paper, we define information sharing as the process of making information available to other individuals, teams, or organizations in the coalition, where information is a set of explicit data objects that is acquired or generated, identified, protected, stored, retrieved, and/or exchanged by coalition partners. Sharing may be mediated to a greater or lesser extent by Information and Communication Technologies (ICT).

On joining a coalition, a new partner must exchange information with existing partners to find a place suited to its capabilities. During operations, each organization gathers information about events occurring in its environment, makes decisions based on the information available to it, and performs actions based on those decisions. Information is unevenly distributed, but each organization – whatever its size and capabilities – has information that other partners need. A large military force may have access to specialized information-generating assets such as satellites or unmanned aerial vehicles (UAVs). A small NGO may be able to gain the confidence of local residents, giving it access to information that is denied to large military or police forces. Partners share information to prepare plans collaboratively, to synchronize their actions, to evaluate what they have achieved, and to negotiate changes in their relationships.

**Reviewing Statement:** This paper represents work in progress, an issue for discussion, a case study, best practice or other matters of interest and has been reviewed for clarity, relevance and significance.

An engineer tasked with automating the information sharing process is likely to take the Shannon-Weaver (1963) model of communication as his/her starting point. He/she would say that the individual, team, or organization that possesses a piece of information is the *source*. The source *encodes* the information and injects this as a *message* into a transmission *channel*, where it may be mixed with *noise*. At the receiving end, the individual, team, or organizational *recipient decodes* the information, more or less faithfully extracting the original information from the noisy message. The research question is whether such a simple, one-way, linear communication process model adequately represents information sharing in coalition operations. The purpose of this paper is to show that information sharing in military coalitions is more complex.

## CASE STUDY

In 2005 we initiated a research project to study the cultural influences on military C2, defined as “the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission” (US DoD Joint Publication 1-02). A C2 system comprises “the facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing, and controlling operations of assigned and attached forces pursuant to the missions assigned” (ibid). The cultural aspects of the research project are not relevant to this paper.

The project goals were to:

- Establish whether national, organizational, and professional cultures have an impact on network-enabled C2 processes in the context of large-scale security operations involving multinational, multi-service, multi-disciplinary, and civil-military coalitions; and
- Identify the implications of these impacts for the specification, design, development, and use of network-enabled C2 systems.

We are currently working on the first of these goals. As the definitions indicate, C2 involves several processes. Within a military command team, this involves planning an operation, issuing appropriate commands to subordinate units, and monitoring (“control”) the subordinates’ execution of those commands. In this context, a command team may vary from an individual military officer to a multinational (“combined”) and/or multi-service (“joint”) headquarters (HQ) with several hundred staff. In coalitions, the command teams from different organizations – civil as well as military – must share information to achieve the overall goal. We have chosen to focus on this information sharing process. Moreover, the PhD student working on the first goal – the second author of this paper - has chosen to narrow his scope to the influences on the source only, i.e. a monadic approach. His research has been divided into three stages using qualitative methods:

- Stage (1) is a pilot study combining a literature survey and two case studies aimed at verifying the influence models found in the literature under the complexity of real-world dynamic coalitions. The case study setting was two NATO Response Force (NRF) exercises (NRF increments 10 and 11). The NRF is a military coalition that exists for a period of six months, known as an increment. The NRF exercise qualifies a particular increment for operational duty, and involves approximately 600 personnel. The force composition changes from one increment to the next, but always consists of a combined joint HQ and land, air, sea and special forces components, each with their own command teams. These are geographically dispersed to different locations within Europe. Information sharing within and between the HQ and the component command teams occurs via a large variety of ICT, around half of which is national- and service-specific.
- Stage (2) is a detailed multiple case study aimed at developing a new model describing the influences on coalition information sharing. Semi-structured interviews were taken from 47 military officers (from major to general in rank), drawn from some 15 nations and all military services. The setting was four NATO R&D organizations: the Allied Command Transformation Command Control Communication Computers and Intelligence, the Command and Control Center of Excellence, the Combined Joint Operations from the Sea Center of Excellence, and the Joint Air Power Competence Center. This paper draws on the second author’s analysis of these interviews; more details may be found in Van den Heuvel (2010).
- Stage (3) focuses on C2 information sharing in a further set of case studies. The settings to date include a single-nation joint exercise in the Netherlands (Purple Nectar 2009), two more NRF exercises (increments 12 and 13), and ISAF operations in Afghanistan. This stage is ongoing.

Citations specifically selected for the purpose from the Stage (2) interviews demonstrate two points about the information sharing process in military coalitions:

- The information process resembles a market:

*“So information has a value. And if I give information, I want to get something back. Because I paid, I invested a lot of money to get the information” (R12).*

*“Information is the same as money. It gives me power, it gives you power. So I want to share it, but I do not want to share it for free. ... So in a lot of cases ... information was used to pay [for] information you got from someone else. It was trade, it is trade... The currency of a military is not money but is power. So information is money, or information is power, that is the same” (R16).*

*“We trade information, information sharing is a trade. I give you something, if you give me something. ... Technology is a very powerful solution if you don’t want to share information” (R34).*

These citations show that information sharing in military coalitions is not simply a linear, one-way flow of information from sender to recipient. Instead, it is a trade between two parties acting independently up until the moment that they interact. They may be two sender-recipients, each of whom has both information to offer and a need for the other’s information. Alternatively, they may be a recipient seeking information and a sender who has the information that the recipient seeks. In either case, trading information involves a combination of information sharing and information seeking. This combination is many-to-many, because the two parties to a trade must first discover one another out of the larger collection of potential senders and recipients.

A second point that the citations from R16 and R34 illustrate is that trading information can take the form of barter: my information in exchange for yours. Alternatively, when the recipient has no valuable information to trade, he/she may have to “pay” in the form of loss of power (R16). Thus, a coalition partner that has invested in remote-sensing satellites and a large fleet of UAVs is potentially in a powerful position.

- Security regulations form barriers to information sharing:

*“And if we are willing to share that information, do we have the opportunity or do we have the possibility to share? Not from the technical side but ... do policies allow us to do it. So even if there is willingness to share information, there may be cases where it is not possible to share because policies don’t allow us to do so. And most of the times when you see effective information sharing that is because of people [who], I would say, are violating those policies to make it happen because they believe it is required” (R24).*

*“Trust is paramount because trust will get you over the policy and politics hurdles. Personal trust is essential” (R23).*

*“You have to know that the information you share is in good hands” (R34).*

These citations show that information sharing in military coalitions is subject to an additional barrier beyond the usual ones of time and space, namely security regulations (R24 and R34). These security barriers are permeable, because they may be waived when personal trust exists between sender and recipient (R23 and R34). There is a large literature on trust, which is outside the scope of this paper.

## RELATED LITERATURE

Faithful to the project title, literature study to date has focused on the influences on information or knowledge sharing, as reported in the information systems and knowledge management literatures. All the models surveyed to date have been ones in which determinants, possibly grouped into dimensions, influence the information sharing process, perhaps with moderators. We term these *influence models*. An example is Jarvenpaa and Staples’ (2000) investigation of factors underlying the use of collaborative electronic media for information sharing. Their determinants included the individual’s and organizational values and attitudes towards the information to be shared, whether the information was owned by the organization, the individual’s propensity to share, whether the individual’s task was interdependent on others’ work, how comfortable the individual was with computers, and the characteristics of the computer-based information.

By contrast, we are interested in process models. The second part of our project concerns the development and use of network-enabled C2 systems. Information systems – of which C2 systems are a specialisation – are implemented as collections of dynamic processes, with each process transforming inputs into outputs. Essens, Vogelaar, Mylle, Blendell, Paris, Halpin, and Baranski (2005) distinguish task- and team-oriented C2 processes. Task-oriented C2 processes include ingesting sensor data and information received from subordinate forces, parsing, filtering, and making sense of the ingested information, identifying gaps in the available information, assessing the current situation, generating plans, making decisions, issuing orders, monitoring progress in executing the orders, and managing resources. Team-oriented C2 processes include maintaining the overall

vision, setting common goals, motivating team members, adjusting team members' responsibilities, collaborating, synchronizing plans and actions, and sharing information.

We require that the process model should match the observed characteristics of information sharing processes found in military coalitions. It should support the network structure of coalitions, with many-to-many, two-way relations between individuals, teams, and organizations. In network-enabled C2 systems, sources will "push" information onto the network, from where recipients can access it by "smart pull". The model should be equally applicable to human-human, human-artefact, artefact-human, and artefact-artefact communication, whether this be "face-to-face" or mediated by ICT.

We were unable to find a communication process model exactly matching these requirements. Two papers in the information sharing literature presented a process model. Hendriks (1999, Figure 2) presents a Shannon-Weaver variant in which noise transforms into barriers of space, time, social distance, culture, language, and differences in mental or conceptual frames. Szulanski (2000) offers a four-step model: initiation, implementation, ramp-up, integration. However, both are linear, one-way, one-to-one models.

In the communications science literature, McQuail and Windahl's (1981) survey of communication models covers basic models, such as Shannon-Weaver and its elaborations, models of personal influence, diffusion, and the effects of mass communication on individuals, models of the effects of mass communication on culture and society, audience-centred models, and models of mass media systems and the production, selection, and flow of news. In broad terms, their survey covers models of one-to-one and one-to-many communications, but not many-to-many. Most of the models surveyed are monadic, with the communication process being initiated on the sending side. A few models are dyadic, with the communicating agent combining sending and receiving functionalities. The audience-centred models view communications from the receiving side. Only Donahew and Tipton's (1973) model of information seeking assumes that the recipient takes the initiative.

Since McQuail and Windahl's (1981) survey was published almost thirty years ago, there has been substantial research into information seeking and information retrieval. Inspired by the Internet and World Wide Web, there has also been research into *information navigation* (e.g. Miller & Remington (2004)), into the *contribution of information* to websites, fora, blogs, and wikis (e.g. Olivera, Goodman & Tan (2008)), and into *information foraging* inspired by the parallels between searching for information and for food (e.g. Pirolli (2009)).

Most usefully, we found an emerging literature on *information and knowledge markets*. An information market is a mechanism for distributing information resources (Stewart, 1996). This assumes that information is available for distribution, that someone wants it, and that the market's purpose is to connect the two. There are two views on how such a mechanism can function: in one, legal constructs make information a scarce resource, and, in the other, information is treated as a public good and should be freely shared. There is no consensus among researchers on the relative merits of the two views. In military coalitions, security regulations function as a legal construct that makes information a scarce resource; see the citation from R24. Trust makes it possible to waive these regulations; see citations from R23 and R34. McGee and Prusak (1993) noted that people barter for information, trading it for information of greater value or using it as an instrument of power. This is exactly what we observed; see the citations from R12, R16, and R34.

Simard (2006) has proposed a cyclic process model for information markets consisting of Generate, Transform, Enable, Use internally, Transfer, Add value, Use professionally, Use personally, and Evaluate stages. He concludes that knowledge markets are more complex than described by provider-user models, that knowledge markets have neither beginning nor end, and that agents embed, advance, or extract value in a continuous cycle of interactions. A simpler alternative to Simard's model could be to represent the "information push and smart pull" in network-enabled C2 systems by combining information sharing and information seeking models.

## CONCLUSIONS AND FURTHER WORK

Crisis management and military operations such as ISAF involve coalitions. To work together, coalition partners must share information. We have shown from case study interviews that information sharing in military coalitions is more complex than a simple, one-way, linear process. One piece of information may be bartered for another, or the recipient may "pay" for it in terms of (loss of) power. Security regulations give information a scarcity value, although trust may enable the regulations to be waived. We conclude that information sharing in military coalitions often has the characteristics of an information market (McGee & Prusak, 1993).

Our research has been limited to military coalitions and the use of semi-structured interviews. Similar investigation is needed of information sharing in civil and civil-military coalitions and in rescue, crisis response, and humanitarian operations. Other research methods, such as the critical incident technique or longitudinal observation of a coalition or individual information sources and recipients, could yield additional insights.

Our observations could potentially have major consequences. There is an ongoing debate in the military Network Enabled Capabilities community over migrating from the current “need to know” security principle on which regulations are based to “need to share”, i.e. from information-as-scarce-resource to information-as-a-public-good. Knowledge of existing information sharing practices could aid this transformation. From a scientific viewpoint, we speculate that the information sharing process in coalitions may exhibit two phase transitions. When a coalition forms (or a new partner joins an existing coalition), the participants do not know one another, let alone each other’s capabilities. A partner with information to share and another with a corresponding need for that information must first discover that the other exists. This is a time-consuming process. The first phase transition comes when, having discovered one another, a source and recipient add each other to their list of acquaintances. Discovery time is eliminated for subsequent exchanges. The second transition occurs when a particular source-recipient pair frequently trade information. When each has gained an understanding of what the other does with the information, they can build trust. In effect, they become friends, instead of just acquaintances. Trust enables them to waive the security regulations, enriching and further speeding up the information sharing process. It should be possible to test this speculation by simulation and by longitudinal study of an emerging coalition.

A better information-sharing process model is needed. One possibility is Simard’s (2006) nine-stage, cyclic model of information markets. Another would be to combine information sharing and information seeking models. To suit information sharing in military coalitions, the desired model must support the network structure of coalitions, with many-to-many, two-way relations between senders and recipients. The model must apply to human-human, human-artefact, artefact-human, and artefact-artefact communications, whether “face-to-face” or mediated by ICT. The next step in our research will focus on candidate models.

The effect of security regulations in military coalitions, the role of trust in waiving them, and whether this leads to two phase transitions deserve a whole research project in its own right.

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