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The network centric environment viewed through the lens of Activity Theory

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Abstract

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Introduction

Information and communication technologies (ICT) now pervade virtually all areas of modern society, civil and military. The Internet has connected people and organisations across the world in a way never seen before and the implications for this new connectivity are still being played out and remain to be fully understood. This technology helped companies to make accurate
predictions, minimise risk, and adapt rapidly to dynamic circumstances. In such organisations, knowledge is the most strategically important resource and organisational capabilities are the product of distinctive competencies in integrating and applying this knowledge. Thus, communication is the pervasive, underlying force responsible for maintenance and dissemination of strategic capabilities based in knowledge.

The connectivity achieved thorough technological networks, i.e. network centricity, transformed the ways in which people gather, share, and process information. This Network Centric (NC) environment also impacted on organisational structures, on learning, as well as on the ways people collaborate and form social networks.

In many ways the environment in which the military forces operate does not differ from that of the business environment. The military is characterised by constant change and uncertainty, and exposed to the vagaries of the political and economic climate. Therefore, like other modern organisations, it will require the capacity to deal with complexity and a system that facilitates learning from experiences, continuous learning and innovation in learning. In the military environment, as with that of business, network centricity implies a complexity of interconnected socio-technical systems that defy traditional forms of analysis. Activity Theory may offer a holistic framework and set of concepts appropriate to the analysis of this complex environment.

A team of researchers at the Defence Science and Technology Organisation (DSTO) has been investigating the human factors that need to be considered and supported to make the most of the network centric environment or network centric warfare (NCW) in which military forces are now operating. NCW can be simply described as the style of warfare that is potentially possible when individual combat units are robustly connected by information. The aim of network centric warfare or operations is to obtain common and enhanced battlespace awareness, and with the application of that awareness, deliver maximum combat effect. The fundamental building block of such operations is a comprehensive ‘information network’ that involves not only technology but also human networks. It is therefore essential to understand what motivates people to share data, information,
and knowledge and perhaps more importantly, to gain insights into what motivates them not to share.

Moreover, with regard to the demands on future Australian Defence Forces (ADF) personnel, attention must be drawn to the idea that the NC way of operating is believed to be a key enabler of the ability to conduct a multidimensional manoeuvre (MDM). Hence, a multidimensional manoeuvre will require high-levels of information exchange for decision and sense making not only between different levels of command, but across government agencies and coalition partners (Australian DoD, 2000). As such, a major emphasis is placed on understanding when and why people will collaborate to share information, and when and why they will not. High standards of training, doctrine, and leadership will moderate this willingness. However, attention must also be directed to psychological mediators, particularly the notion of trust, and how it is created, sustained and, in some situations, destroyed (Australian DoD, 2003a).

In this chapter, we will draw on the research data to address these issues and will analyse human activities in the network centric context through the lens of the cultural-historical Activity Theory, where the pragmatic concept of 'Activity' is simply what people do to achieve an outcome, i.e. the activities that are carried out by people in support of their interpretations of their role, the resources and opportunities available, and the purpose for which the activity exists. Following a description of the research and some relevant findings, we will propose that the activity of sense-making is central to common awareness and decision making through information sharing in technology enabled NC environments. The chapter presents an analysis of sense-making activities at individual, group and organisational levels where the Activity Theoretical concept of the Internal Plane of Action is mediated by increasingly sophisticated Information and Communications Technologies (ICT).

**Research methodology**
The research into the Human Dimension of Future Warfare (HDoFW) began with a review of literature and current research, with a particular emphasis on the context of network centric warfare (NCW) for future warfighting. More specifically, the researchers focussed on the commonly accepted characteristics
of traditional and future warfighters and the future information demands, skills, competencies and workforce requirements for NCW.

Thereafter, the research team conducted over thirty interviews with personnel who had returned from deployment to the Middle East. Some interviewees (also referred to as 'participants') had also served in East Timor. In order to obtain as comprehensive a picture as possible a stratified sampling method was used. This chapter is based on thirty-three interviews, totalling over sixty hours, with interviewees drawn from all three Services, both genders, and ranks ranging from Private (and equivalents) to Brigadier (and equivalents). One civilian member of the Australian Defence Organisation (ADO) who had returned from the Middle East was also included in the sample. During the interviews, questions relating to the following issues were asked:

- Pre-deployment training and preparation;
- Duties during deployment;
- Decision-making processes;
- Command and control (C2) arrangements and processes;
- Interdependence between Services, nations (or other agencies);
- Information gathering and sharing;
- Communication flows and channels;
- Important skills and competencies; and
- Lessons learned.

All interviews were transcribed and coded prior to the analysis. Qualitative software, NVivo, was used to store and retrieve data.

Emerging issues

Although each of the interviewee's related their own experiences and reflections on the issues covered during interview, several common and often interrelated themes emerged. These include: training and preparation for deployment, military/service culture, command and control, autonomy and empowerment, relationships and trust, information sharing, information overload, uncertainty, morale, and training and education.

The military, like other modern organizations, requires the capacity to deal with complexity and a system that facilitates
learning from experiences, continuous learning and innovation in learning. Specifically, it attempts to exploit the increasing interconnectedness between organisational units to allow better communication, information sharing, cooperation and therefore flexibility, adaptability and effectiveness. NCW might offer a whole range of warfighting advantages, including the ability to focus limited resources using superior knowledge, increased protection for forces through information, and an ability to share information quickly and securely across current boundaries.

However, this wiring together of the force does not guarantee that NCW or its benefits will naturally follow, since network centric warfare, as currently conceived, is inherently a behavioural, tactical, bottom-up phenomenon. It entails more than just the possession of large amounts of information. In fact, simply flooding the network with information will more than likely ensure that shared awareness does not occur. Information must be absorbed and interpreted by the people within the connected and communicating units, within the broader context of a commander’s intent, in order for the desired benefits to materialise.

In this chapter however, we will only expand on issues related to relationship and trust, information sharing, and information overload, as these concepts are integral to knowledge creation and subsequent decision making during operations. Furthermore they are concepts that render themselves to the lens of Activity Theory. Quotes that are representative of these themes are used so as to privilege the voices of the participants themselves, rather than those of the researchers.

**Relationships and trust**
Future warfare will almost certainly involve more collaboration across services, across nations and with civilians and reservists. The Strategic Workforce Planning Review Report (Australian DoD, 2003b) suggests that this workforce mix will be a likely component of future operations. The Review cites the East Timor experience, which, although it was not part of the overall planning, evolved a workforce mix as the operational risk diminished. Therefore, interdependence and effective collaboration is at the core of any future Force. In many locations in the Middle East theatre, interdependence with other
Services and countries in Joint and Coalition units was a fact of everyday life. Some interviewees found this problematic. For example:

All the coalition needed to be educated on the fact that you are a coalition regardless of whether we went there knowing we were a coalition or not. Everyone was very single Service, single country focused.

Others found that collaboration with other units within the Australian contingent and with the Coalition forces was dependent, to a large degree, on building good relationships. Collaboration provided access to information, equipment, parts and general support. Good interpersonal relationships, in turn, enabled the development of trust. Often, this trust was consciously developed through face-to-face contact, and once established, facilitated further collaboration.

Effective and efficient exchange of information underpins the success of all military activities. Without such exchange, the collective action and cooperation necessary for the accomplishment of military goals, particularly in operational contexts, is impossible. However, effective information exchange in a warfighting context is often more difficult than it first appears. Factors can emerge which obstruct an individual's willingness to volunteer information or to provide it to others on request, particularly when the information of concern is highly sensitive and when the potential recipient is largely unknown. Concerns over how others might use valuable information often restricts one's readiness to part with it (Erickson, 1979).

A large amount of research has demonstrated that the extent to which an individual trusts another has a significant impact on their willingness to exchange valuable information with others (e.g., Fine & Holyfield, 1996). Despite this extensive empirical attention however, consensus on a definition of trust has not been forthcoming (Barber, 1983; Kramer, 1999). For present purposes, trust can be defined as the subjective expectation of positive treatment under conditions of vulnerability (Mayer, Davis, & Schoorman, 1995). In other words, we trust another to the extent that we believe they will act beneficially (or at least not detrimentally) towards us if we choose to engage them in some form of cooperation and when cooperating involves some degree of risk (Gambetta, 1988). Thus, trust is especially relevant when
there is uncertainty or ignorance as to the motives and actions of others. When these can be predicted with absolute certainty, trust is not required. When they cannot, as in most 'real world' circumstances, a degree of trust is necessary to make human action and interaction possible.

This need to establish good working relationships and trust was recognised by many interviewees, as illustrated in the following comments:

...it took a long time for me to build up personal relationships with the ... staff where they trusted us enough to be able to [support us]... It's all about trust.

Without the trust and interaction, on a social level, where they were happy to have a joke with us and establish something like what we would call "mateship", where they were happy to respond to any requests we might make, it would have been much more difficult. We did see examples of people trying to get what they wanted without that, from people they didn't know, especially across the two countries ... the results were varying.

It is still about building a relationship, I think, because to get something out of someone that they do not necessarily want to give up, then it is all about them knowing and trust and liking and thinking there is going to be a mutual benefit out of it.

The majority of comments described successful interactions built on cultivated relationships:

So, if they weren't getting any joy with the Americans - their offsiders, they would come to me and say, "Hey listen, we're trying to shape this collection effort, or we're trying to...We're not getting any joy through this level." I would then take it straight across to the ... and, because I'd built those relationships, but also because he was good guy, he would bend over backwards to make sure that we got what we needed and I guess that sort of became my role in many regards.

It was basically good business as far as we were concerned to keep up good relationships with the Americans. We took it as an opportunity to draw on their mass of knowledge and experience...So, to work with these guys and to take on as much information as you could, was invaluable.
Relationship is very important to the Americans. So, to get one item, be prepared to talk conversation for an hour.

Relationships within the Joint environment were similarly varied, but, in this case, the majority of comments were typically about the Services’ lack of understanding about each other, their training, their skill sets and their Service-specific ways of operating:

...I had an Air Force corporal under me who I found is very different to an Army corporal...One thing I found with Air Force is...you can have two Air Force corporal technicians and their skill sets are totally different, depending on their postings, where they’ve been. Where Army, we do, on our promotion courses and training courses, everyone does the same training.

Navy officers know their stuff...the seaman officers...so, in terms of warfighting ...I had inherent trust... Shocking [however] at all officer kind of stuff, you know, the officer cult ...and...I cringed every time they talked to my soldiers or, you know, said, “Don’t worry, call me mate,” type thing...

Relationship building within work teams on operations was also considered important by the majority of interviewees:

Just sort of say, “You’re a part of this team here. We value you”. You know, and when parcels come in you share the goodies around... These are very small examples, but together they build that jigsaw of trust and responsibility. You get into some screaming barneys ...but you also accept that that’s just part of it...You accept that sometimes somebody is going to fly off the handle. And they will feel bad about that and they will come back later...You know, we all went through that.

Probably the thing I was under-prepared for was the personnel aspects, essentially the man management side of things ...you are living in the same compound...in the same room and area, and there is no escape. You have to take a step back and behave quite differently because you are in a situation where there is a high threat, you are being attacked. ... The management of those interpersonal and command relationships 24-hours a day was very difficult.
It was clear that face-to-face contact was perceived to be the most effective way of establishing rapport and building relationships:

*Sit down and have a brew and talk to them or go to the gym with them...whatever it took, you know, it takes a lot of time out of your schedule so, you know, that was one of my key points when we came back was the time it takes to build those relationships to get information.*

*I don’t do email to anyone ... Everything is face to face because they say for mission command, “We’ve got to know - we’ve got to understand each other”.*

**Information gathering and sharing**

With wider use of technologies to achieve routine or programmed tasks, the dynamic of human productivity in organisations has shifted into a ‘meta-realm’ of shared activity. Daneshar (2003) notes that, in such contexts, it is not only what a person knows that is important but also what they believe should be shared, when, how and with whom. Thus, for most participants in such systems, the notion of awareness needs to be extended to include the emerging new roles that involve attending to the needs of other participants and related communication responsibilities. Other features of this ‘meta-realm’ include advanced strategic cooperation and increased communication aimed at shared applications of a range of knowledge emerging from more complex and often more intense experiences (Crawford, 2003).

The concept of NC is based on the connecting together of the elements of a military or mixed force so they can readily communicate needed information in real time, or close to it, using software applications built for that purpose. The vision is to use that information to make better decisions, faster, and to communicate those decisions to the executors of them more quickly and precisely than one’s adversary. But to achieve this requires not only an effective underlying technological capability but also a highly proficient, well-organised and trained force that is able to take advantage of the resources that the technological capability makes available to it. Most particularly, it requires the ability and willingness to discern and focus on what is of importance in the volume of available information, and to trust
and share it with others who may need or be able to make use of it.

Information sharing is clearly and inextricably linked to relationship building. Several themes relating to information gathering and sharing emerged from the interviews. Arguably the most important one is that information gathering and sharing cannot be assumed to be a natural and direct consequence of the existence of network or other technological communication links between different parties. Face-to-face or voice interaction was often preferred to electronic means of communication, even when these were available, and frequently pre-establishment of at least some level of relationship was mentioned as an important enabler or precursor of information gathering and sharing activity. As examples:

How did I get the information? Word of mouth. Walking around, talking to a lot of people ... You would - you would find out who's the person you need, who's got that piece of information, or may have that piece of information, or knows who knows somebody who has that piece of information. And you would just start ringing, walking, phoning. ... it was all personality based. ... the networks, in a sense, were person to person, personality based networks.

... they did not build the relationships they needed. Again, a lot of people - I learnt a lot of stuff ...that a lot of other people did not know because I would spend two or three hours saying "Hi, this is who I am." You know, I would give them stuff or get back from them ... [they] were cagey about giving out information but if you made the right contacts you got the information you needed.

I had to consult ... as to whether they were happy with the designs that we had for the new structure and whether they had the resources to supply those. I would get in the car and go and see them (rather than send them an email).

Information is also evidently not only preferentially gathered from sources, but also shared with other individuals or groups with whom a typically personal or socially-based link has already been established. For instance:

Sometimes I was really nervous about [sharing information] and I was generally quite cagey, I suppose. But again, my
idea was firstly to get to know them. But, I did not have much time. They would ask me questions and I would often defer to a senior officer. “Sorry, I can’t answer that, you know”. Shunt it off to someone else who can make the decision.

Informal, non-technological-based means of information gathering and sharing also continue to be very important, even given technological connectivity and means of communication. For example:

Largely it was all informal, “Did you hear that last night?” “Yes, where did it come from?” “We think somewhere over there.” So, you would give them very general hints, but you could not tell them the recommended flight paths or anything like that. You could not tell them what was going on. So, I suppose, what we decided on, and what was decided on as a group, was that you cannot tell them specific events, because you just were not allowed ... but you would tell them general things to keep them safe. You did not want them to die.

and:

... because once it is on paper everyone can say that you have said. So, while the e-mail is supposed to be informal, that is a load of hogs wallop, I know it gets stored. So, if I was ever worried about something I was going to say, then I would ring someone up and say in a caged way, talk to them.

Information overload
Information technologies have advanced to the point where it is now possible to “produce, manipulate and disseminate information ... much faster than we can process it” and “instead of better enabling a person to do their job [this] threatens to engulf his or her control over the situation” (Edmunds & Morris, 2000). This phenomenon is now well known as “information overload”. Other terms referring to the same thing are “infoglut” and “data smog” (Shenk, 1997), and the effect on those exposed and affected by it has been called “analysis paralysis” (Stanley & Clipsham, 1997) and “information fatigue syndrome” (Oppenheim, 1997). Four major factors have been found to contribute to information overload: the sheer volume of information, the difficulty or impossibility of successfully managing it due to time constraints, the irrelevance or
unimportance of most of it, and the multiple sources from which it arrives. However, it appears that the volume of information (Farhoodmand & Drury, 2002) and the time pressure aspect (Kock, 2000) are the most important.

Indeed, while information sharing was sometimes difficult for some personnel, the large amount of information coming in and the variety of sources for that information, was a frequently mentioned problem.

As a staff officer you deal with a lot more information than you did in the past because you have accessibility through computers. So you're inundated with knowledge, with information. And also people are always asking you questions and everything else. And we've actually got to the stage now where we command through email. Right? I'm appalled by this. If I'm a commander, I command face-to-face with the soldiers. I tell you.

My day-to-day routine would be get up, go into the office - they would have conferences for targeting, they'd have conferences for hearing about the conferences. They tell them the briefs and then the commander's update. So, if I went to every conference that I went to ... I'd spend my whole day at conferences so what I would need to do is pick particular conferences which I thought were important.

On more than one occasion, I would get involved in multiple chats and ... one night there I was in six chat rooms at once holding six simultaneous conversations. ... Now, while I was able to keep everybody sort of satisfied and still pass information, what I did notice was that it was like a set of blinkers being put on me. Because I wasn't able to stand back and look at the bigger picture about what's actually happening. I was, you know, dealing with snippets of information all over the screen, my peripheral vision just came right down to the screen and I literally blacked out what was going on around me until [an officer] came and grabbed me by the shoulders and dragged me out of the seat, and said, "Go and have a look at the chart, go and have a look outside and then come back and answer these questions", so yes, information overload at that point.
I think we’re going to have to come up with a better way of filtering information. I think we’re going to start suffering from information overload, if we’re not suffering from it already...

In their study of information overload, Farhoomand and Drury (2002) find that filtering is the most commonly suggested solution to the problem. But the obvious question is ‘how’? Any kind of automated filtering assumes that it is possible to identify what would be interesting, relevant or important in the information beforehand but in a typically unstructured, confused and chaotic military environment this is unlikely to be possible in general.

Some interviewees developed successful strategies to deal with information overload.

Timor and Iraq were interesting, at the start of each operation, I would religiously sit down, read all the message traffic, read all the emails, surf to whatever websites I could find that would have information for me and I would spend hours and hours and hours doing that. But as the days went by, I would realise, well, at this time of day, I don’t need to go looking in that place because I know there’s no new information there, so I can leave that till later in the day, or I really need to get to this source of information now because it’s just been updated. So, it’s not something that I think you can brief or train, or whatever, it’s something that you just need to experience.

I’ve got a watch-keeper, two watch-keepers working 24 a day, 24 hours a day, day shift and night shift and their job is to go through and pull out electronic items which identifies anything pertinent to us which we need to know. Otherwise, you just skip ... because if you try and read everything, I mean there’s not enough hours in the day.

The data indicates that our warfighters perceive that certain issues are problematical and may impact on the ADF’s ability to develop and sustain the ideal of the Force operating in the NC environment. Therefore, more effort needs to be invested in fostering inter-unit and inter-Service linkages and relationships within the ADF. Furthermore, more research needs to be
undertaken into the potential application of electronic techniques for supporting relationship building and social interaction (e.g. virtual communities) as a means of encouraging the development of informal links and relationships between personnel from across the ADF and possibly appropriate international forces as well. Underpinning all this is, however, the understanding of how individuals behave when faced with a multiplicity of activities and an uncertain environment.

**The Activity Theory Analysis**

As Activity Theory was developed in Russia during the first half of the 20th century the language of Activity Theory used here are approximate English translations from the much richer terminology of the Russian language. This is particularly true of the basic concept of ‘activity’ where this analysis begins. Activity Theory places the focus of analysis on the activities that are carried out by people in support of their interpretations of their role, the opportunities and resources available to them, and their purpose for which the activity exists. This is both subjective, in the sense that it is a matter for individual interpretation, and objective, in the sense that the motives, purpose and context are a vital part of the reality of human work. From this perspective, an activity is the only complete meaningful unit of analysis when studying the way people work. An activity is defined by the dialectic relationship between a subject (i.e. a person or small group of people) and the object of their work, which includes purpose, motive and context. An activity both mediates, and is mediated by, the tools used and the social context of the work activity. This two-way concept of mediation implies that the capability and availability of tools mediates what can be done and the tool, in turn, evolves to hold the historical knowledge of how a society works and is organised. Activity Theory is therefore appropriate for the network centric environment where sophisticated ICT tools mediate work in a complex work and social context.

In any Activity Theory analysis it is important to establish what the main activity of interest is and then to identify the mediating role of the tools that are used by particular subjects (i.e. those performing the activity). Since the dawn of the
"Information Age" the military have invested copious resources on computer-based systems to enable the collection and storage of data in order to facilitate the creation and dissemination of information. There appears to be a widespread assumption that the provision of quality information results in improvements to overall sense-making and subsequent decision-making. Candidates for the activity of interest in this study could be "information gathering/sharing", "knowledge management", "decision-making" and no doubt many others. The work of Hasan and Gould (2001) suggests that the activity of sense-making plays a pivotal role in linking organisational information to decision-making and hence to action. They provide an explanation of how processes of knowledge management support organisational sense-making leading to strategic decision-making. Following their lead, the analysis here will focus on the activity of sense-making in NC environments.

The sense-making view of organisations stems from the work of Weick (1995) and Wiley (1994) followed by others who see knowledge as both a subject and a product of sense-making by individuals, groups and organisations (Cecez-Kecmanovic & Jerram 2002). Linger and Warne (2001) also distinguish three significant levels of sense-making: individual, organisation, and an intermediate level which is the seat of most innovation and creativity in organisations. The sense-making activity and shared understanding is of particular importance to the military. When units know what is going on in the battlespace, and are confident that others do as well, they may be said to have shared awareness. This shared awareness may mean they can also give each other mutual support without higher-echelon coordination, fixed physical proximity or prior relationships with each other, or restrictive doctrine.

The origins of Activity Theory are with the sense-making processes of individuals where the underlying mechanism for the origin of mental processes is the concept of internalisation. As described by Vygotsky (1978), human activity is initially carried out on the external plane mediated by cultural signs: words and tools, and is then internalised through cognitive functions such as attention, memory, and thinking. Internal mental processes are then derived from external actions through the course of internalisation, in contrast to conventional cognitive psychology,
which emphasises the mind as the source of action. It is through activity that we learn and internalise concepts that then become a psychological tool that is manipulation in the Internal Plane of Action (IPA). The IPA is a concept developed within Activity Theory that refers to the human ability to perform manipulation with an internal representation of external objects before starting actions with these objects in reality (Kaptelinin 1996).

Kaptelinin (1996) viewed computer-based tools as an adjunct of the IPA being within an individual's personal space, as shown in Figure 1. This view inspired the application of Activity Theory to the field of Human-Computer Interaction in the early 1990s. It did not however take into account the rapid development of computer-based technologies into the kind of support that is needed for NC organisations.

![Diagram](image)

**Figure 1**: Kaptelinin's (1996) view of the computer as an extension of the IPA.

As computer-based artefacts have become increasingly sophisticated and ubiquitous, they are taking over more of the routine tasks that previously hindered higher-level knowledge work. They support creative thinking and doing, allowing rapid re-organisation of objects and ideas. Moreover, as the same processes are now occurring in the field of communications in a
globally connected world, ICT tools are now situated in the collective as well as the personal space, making activity, with a collective subject and common object, a more useful concept. These group activities or activity systems are now supported by modern groupware and enabling the formation of new virtual communities unbounded by time and space. In this analysis we extend the concepts of Kaptelinin in light of the issues raised by our research.

We contend that the involvement of ICT tools extends across the individual's personal space into the IPA on the one hand and out into the world of the rest of the organisation as shown in Figure 2, on the other. The interactive nature of direct-manipulation interfaces, and the functionality behind them, enhance the capacity of an individual's IPA, for example: the 'what if' nature of spreadsheets, the ideas manipulation function of a word-processor, the design support of a CAD package and so on. On the other hand, individuals communicate ubiquitously via the Internet, Email, text-messaging and so on. Research data clearly indicates that during recent operations in the Middle East, virtual chat rooms, emails and mobile telephones replaced traditional 'Signals' and other formal ways of communicating. As younger generations (sometimes referred to as Gen-Y) that have grown up with this technology join the military forces, electronic ways of communicating forms an integral part of all their activities. Furthermore, when this generation makes up a significant proportion of the ADF much of the current reliance on face-to-face contact in relationship building and trust that is associated with fostering face-to-face relationships may diminish. As stated earlier, the extent to which an individual trusts another has a significant impact on their willingness to exchange valuable information with others. At the same time, there is widespread consensus that the future activities of the ADF (and, indeed all 'modernised' defence organisations) will be characterised by greater levels of interdependence and cooperation between previously disparate individuals, groups, and organisations (Hinge, 1996) and the need to foster good relationships will be paramount.
Figure 2. For an individual, ICT tools extend into the IPA and out into the common organizational space.

However, the model through which individuals communicate even in the NC environments, and hence have access to information to help them make sense of their situation is often quite ego-centric as shown in Figure 3. Unfortunately, the design of many organisational information systems re-enforce this structure where individuals sit at their workstations to complete their allotted tasks. This is far from the situation in the field for many workers and is particularly unsuited to operations of the military.
In real-time uncertain environments, e.g. deployment or military exercises, the most effective operators are often small, highly skilled cohesive groups who have grown as a team into a self-managing unit. In Activity Theory this is called an Activity System which has a collective subject, the team, and a common object. Through common experiences over time in an Activity System, a common group space emerges which may have something akin to a communal IPA as shown in Figure 4. There have been many attempts to develop ICT groupware systems to support the sense-making of Activity Systems with mixed success. One issue appears to be that such systems have a wide variety of needs so that such systems must be flexible, adaptable and so on making the creation of a single all-purpose product
highly problematic. The recent growth of mobile devices may accelerate their development.

Figure 4. For a group, ICT tools link a common IPA space to the organisation.

A network centric way of operating will consist of many activity systems that must be able to carry out their own sense-making to decide when and how to act. They must however have an awareness of the activities of other systems and of the governing organisation structures forming a loosely-coupled multi-dimensional matrix as shown in Figure 5. There must be some form of sense-making at the macro level that give purpose to the whole network without compromising the ability of the activity systems to perform effectively within their own sphere of operations.

This network-centric configuration falls outside the realm of traditional bureaucratic management approaches and is not
well-understood by traditional ICT developers. It is better understood from the perspective of complexity theory where outcomes cannot be planned or predicted. Rather, procedures, systems, reward, guidelines etc, must be put in place to facilitate the sense-making of self-organising units acting as activity systems which must be trusted to share information and form common objects to act to further the cause of the organisation as a whole.

Figure 6. Loosely coupled, self-directed groups in a NC environment.

Conclusions
The views of the warfighters expressed in this chapter strongly suggest that the way in which humans organise themselves, share information, work together and cooperate in a network-centric environment is multi-layered and a complex mix of people and technologies. Activities at the individual and small group level can be usefully adopted as the unit of analysis for network-centric environments. Despite the mediation of sophisticated
ICT, the way people coordinate activities has much more in common with the way they manage in less technologically sophisticated situations than might be expected. More specifically, it is evident that the establishment of relationships at a personal level through face-to-face and often socially mediated means can not only be of assistance but even be crucial in enabling more effective cooperation to occur between different organisational entities than would otherwise be the case. It is the knowledge and understanding gained of the other party, and the trust created as a result of this type of informal interaction and relationship building, that form the basis of successful working links between the different parties concerned.

Computer networks and sophisticated communication capabilities may form an important and even major part of the actual mechanism by which information sharing and other cooperative activities occur and are managed. However, much of this technology is developed with an ego-centric world view where individuals are linked into a central organisational infrastructure and information system. The potential of ICT to support structures where there is distributed activity and decision-making is often thwarted by traditional command and control structures.

There is also insufficient appreciation of the role of the IPA of individuals in the way they process information and communicate within their individual sense-making activities let alone situations involving collective activity. Innovative work has been undertaken in the development of groupware systems. However, these tend to be over designed, thus constraining flexibility of use, or being excessively influenced by the needs of a particular context, often that of the developers. The data presented in this chapter indicated that the initial decision to share and cooperate does not happen just because the technological means or even the situational imperative exists to do so, but rather because the relevant relationships pre-exist or the necessary effort has been invested in creating them. Ubiquitous technological systems need to be in place that can support whatever form these emergent relationships take.

There is little evidence to suggest that technology is the driver of network-centricity but it is an essential tool to mediate its development. This is closely aligned with the Activity Theory
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notions of work as tool-mediated activity and human development through socially-mediated internalisation and externalisation.

References


