

Is C2 Research Playing In The Right Ballpark?: A Case for Linking C2 Research to Command Principles

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Abstract

Information systems (IS) provide a revolutionary technology to support, or perhaps fundamentally change, how our military forces are commanded. This paper is motivated by a search for underlying principles of Command and Control (C2) to provide a firmer footing for understanding how computing and communications advances are, or could be more effectively, applied in the C2 process. Command archetypes identified by researchers such as van Creveld, Czerwinski and Builder are described and related to current military C2 doctrine. The role of C2 research is then examined in relation to these command principles. Based on this analysis, the paper concludes that C2 research conducted without explicitly identifying the command principle could in fact be undermining current military command. By adopting a more principled approach, particularly in the application of IS, two streams of C2 research emerge. The first is that intended to enhance the command type used by the military, and the second is research into alternate command archetypes.

Introduction

Current research into command systems is heavily influenced by developments in information and communications technologies. These technologies, driving what many see as a Revolution in Military Affairs (RMA), are being applied in many innovative ways to improve commanders' situational awareness and their ability to communicate with their forces. The focus is on the processes of command, with improvements coming through the development of tools for the staff functions supporting the commander. The implicit assumption seems to be that improvements in process will improve command effectiveness. It is rare in this environment for research to examine explicitly the effect of such process change in terms of a particular command philosophy, even that expressed in military command doctrine.

The ideas discussed in this paper have primarily been informed by research undertaken by the Defence Science and Technology Organisation (DSTO) and the Australian Graduate School of Management (AGSM) at Headquarters Australian Theatre (HQAST). The paper examines fundamental archetypes of command as the basis for a more principled approach to researching the impact of new technologies on the command systems of our military. The implication emerges that a move to align research to the underlying principles of command in the military would be more likely to improve the outcomes in terms of command effectiveness.

Military Command

Levels of command in the Australian Defence Force

Military command is seen as a hierarchy of the three tiers of Strategic, Operational and Tactical Command, shown diagrammatically in Figure 1. It is only recently that the Australian Defence Force (ADF) has explicitly addressed the operational level, with the establishment of Headquarters Australian Theatre (HQAST).

For most of its existence Australia's armed forces have been principally organised on the basis that in times of crisis their role would be to contribute to a wider allied cause. This resulted in the development of a high degree of expertise and experience at the tactical level of war, but the integration with larger allies has meant that the ADF has had little experience at the operational level. Until the recent INTERFET operation in East Timor, only in the occupation of German possessions in New Guinea and South West Pacific in 1914 can Australia claim to have organised and conducted an independent campaign (Australian Defence Force Warfare Centre 1998). The creation of HQAST and development of an Australian operational command capability is a significant challenge for the ADF and for DSTO, the scientific organisation supporting this enterprise.

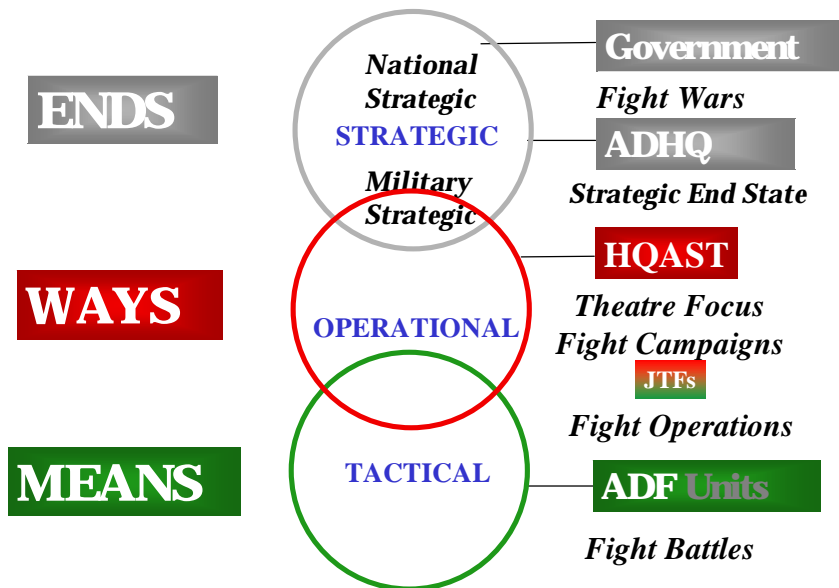


Figure 1: Australian Defence Force - Levels of Military Command

The Command Function

With the focus on the processes of command, most of the available official definitions of command and control tend to be descriptive rather than point to any underpinning generalised theory. The definitions characteristically concentrate on the personal nature of command and:

“especially the fact that it is vested in an individual who being responsible for the ‘direction, coordination and control of military forces’ is then legally and professionally responsible for every thing those forces do or fail to.”(Allard 1996).

NATO separately defines command and control as:

Command. In the general sense command is defined as:

“The authority which a commander in the Military Service lawfully exercises over subordinates by virtue of rank or assignment. Command includes the authority and responsibility for effectively using available resources and for planning the employment of, organising, directing, coordinating and controlling military forces for the accomplishment of assigned missions. It also includes responsibility for health, welfare, morale and discipline of assigned personnel.” (NATO)

Control. In the general sense control is defined as:

“The authority exercised by a commander over part of the activities of subordinate organisations, or other organisations not normally under his command, which encompasses the responsibility for implementing orders or directives. All or part of this authority may be transferred or delegated.” (NATO)

These definitions describe what a commander is expected to do, and what is involved in the roles and responsibilities of the position. They do not give much indication of the underlying philosophy of command, or the principles on which it is based.

Van Creveld (1985) in his book “Command in War” closely examines the evolution of military command through the ages and draws conclusions about underlying command archetypes. He sees uncertainty as the central fact with which all command systems have to cope.

“In general the more important the human element as opposed to the technical element in any given situation, and the more important the enemy’s action in shaping that situation, the greater the uncertainty involved.” (van Creveld 1985, p 268).

Thus the structure and method of operation of command must adapt to manage the level of uncertainty involved in carrying out the task assigned.

Van Creveld’s assessment is that when confronted with a task and having less information than is needed, an organisation may react by either increasing its information processing capacity or else designing the organisation, and indeed the task, to enable it to operate on the basis of

insufficient information. These approaches, he contends, are exhaustive, and failure to adopt one or the other will result in a drop in performance.

Approaches to improvement in performance are also limited to these approaches. The first leads to a multiplication of communication channels and an increase in the size and complexity of the central directing organ. The second approach can be subdivided into two options, giving a total of three possible approaches to command. Either drastic simplification so as to enable it to operate with less information (e.g. Greek phalanx, or Frederick the Great's robots), or else the division of the task into parts and the establishment of forces to deal with each part on a semi-independent basis.

Command Archetypes

Thomas Czerwinski (1996) identifies these three approaches to command as:

- Command-by-**direction** (centralised awareness and direct control),
- Command-by-**plan** (drastic simplification of sub-tasks) and;
- Command-by-**influence** (division of task into semi-independent parts).

Whilst these approaches are not mutually exclusive and often employed in combination he, like van Creveld contends that these methods or command archetypes are dominant. Each offers a response to the underlying commander's quandary arising from uncertainty and lack of information. This insufficiency of information does not mean lack of quantity, but information that is not of the right form at the right place and at the right time; what van Creveld calls 'information pathology'. A 1989 RAND study (Kahan, Worley et al. 1989) found that "Commanders' information needs are rarely specific pieces of data, but are instead highly variable and human-intensive elements". C2 requirements are not information-intensive, but information-sensitive.

It is worth looking at the three command archetypes, to better understand how they attempt to handle the uncertainty and 'information-pathology' of command.

Command-by-Direction

This is the oldest method of command, and was virtually the only method until the 18th century. In this form of C2, the commander seeks a vantage point from which to observe and control the battle. The aim is to have full awareness of everything of relevance to the operation, and to be able to direct personally forces to meet the unfolding situation. This form of command attempts to manage the complexity by prioritising on the basis of full situational awareness and then dynamically directing all of the forces, all of the time.

This form of command has largely fallen out of favour because of its failings as the scale and speed of conflict increased from the 18th century on. Early commanders learnt that even if they could find a vantage point from which they could see the whole battle, distance prevented them from playing any role other than observer. On the other hand, they could choose to stay to

command directly what was expected to be a critical unit, and thereby direct some of the force all of the time. But then they lost the overall perspective and control of other units. Alternatively, they could move from unit to unit, thereby directing all of the force some of the time. Until the information age, the commander's dream of being able to direct dynamically all of the force all of the time has been almost impossible.

This form of command embodies van Creveld's first method of coping with having less information than is needed to perform the task: increase the information processing capability. Modern concepts of digitising the battlefield, information superiority, and full situation awareness seem to be an implicit and unstated attempt to support this type of command. Van Creveld's study of command convinces him that this approach is inadequate and in danger of being self defeating because of the increasing size and complexity of the centralised sensing and directing organ.

Command-by-Plan

With command-by-plan, the commander attempts to plan every move in advance, relying on highly trained troops and strict discipline to carry out the scheme as ordered. In this way, the plan and discipline is used to control all of the troops all of the time. It was the primary method in World War 1, building on the successful experience of industrialisation and mass production.

Czerwinski (Czerwinski 1996) contends that "highly centralised command-by-plan has become the norm for command of modern forces". Particularly during the Cold War, this form was subject to much experimentation and adaptation to drive the training, equipping, and organising the force to be able to operate according to plan.

Command-by-plan attempts to control complexity by centralisation and careful attention to detail. In the modern context, the uncertainty is managed by increasingly complex analysis, simulation and precision. Implicitly, it attempts to control the disorderly nature of war as much as the adversary. Essentially, the organisation and the tasks within the operation are designed to operate with less information, all the complexities having been investigated and analysed in the formulation of the plan. This method is characterised by trading flexibility for focus, as indicated by terms like, centre of gravity, target sets and critical lines of communication.

The modern concepts that implicitly support this form of command include the various forms of precision warfare, and the concept of "system of systems". With dominant battlespace awareness the target planners aim to predetermine and control the flow of the conflict. By honing the target list, and organising synchronised and parallel operations, the plan focuses on overcoming the enemy's "centre of gravity".

In van Creveld's terms, this command archetype embodies the second method of managing uncertainty by drastic simplification of the organisation and the tasks. The planners have considered, and controlled for, the likely complexities and simplified the options down to a manageable number of tasks, which can then be rehearsed for execution according to plan. His analysis also finds command-by-plan inadequate and in danger of being self defeating. He contends that command forms that centralise uncertainty do not lend themselves to success".

This is not to imply that planning is not essential. Czerwinski (Czerwinski 1996) quotes Eisenhower to draw the distinction between planning and command-by-plan:

“In preparing for battle I have always found that plans are useless, but planning is indispensable”.

Planning is essential for the basically linear elements of warfare and preparation for combat support activities, but has dangers if used as the predominant means of controlling the operation.

Command-by-Influence

Command-by-influence is characterised by *auftragstaktik* or “mission type orders” as developed by the Germans late in World War I and refined in World War II. In this method of command, the outline and minimum goals of an effort are established in advance, effectively *influencing* all of the forces all of the time. This form relies on self-contained, joint or combined arms units capable of semi-autonomous action. All this activity occurs within bounds established by the concept of operations derived from the commander’s intent.

This form of command attempts to manage complexity by distributing the uncertainty, in effect, placing reliance on the initiative of subordinates to adapt to the situation as it evolves. Unlike the other two forms of command this method accepts that disorder is inevitable and distributes the decision making closer to where the situation is evolving. Great reliance is placed on the initiative of subordinates using local situational awareness, on clear understanding of the commander’s intent and most importantly on a high level of trust. The reliance on human characteristics of shared understanding and trust, contrasts with the other two forms which attempt to *control* the complexity of war either through prioritised direction from a central commander, or through careful centralised prior planning and rigid discipline.

Command-by-Influence represents van Creveld’s third response to uncertainty; namely the division of the task into parts and the establishment of forces to deal with each part on a semi-independent basis. Here the “information pathology” is handled by distributing the assessment and decision making. Van Creveld (1985, p 269) is clear in assessing this form of command as superior to the other two forms:

“It is the central theme of this book that through every change that has taken place and given any one level of technological development, the first two of these approaches are inadequate and stand in danger of becoming self-defeating, and that, the likelihood of further change notwithstanding, the third one will remain superior to them in virtually every case.”

Command Archetype	Description	Command Structure	Coordination	Strategy for dealing with uncertainty
Command-by-Direction	Centralised situation awareness and direct control all of the forces	Centralised	Centralised	Control
Command-by-Plan	Careful analysis of situation, reduction of operation into specific tasks, training and discipline used to execute tasks according to plan.	Centralised	Plan	Control
Command-by-Influence	Operation divided into missions allocated to semi autonomous units which operate within commander's intent	Distributed	Shared intent and trust	Decentralised decision making and Low level initiative

Table 1 – Command Archetypes

Military Doctrine

Western military doctrine writers have generally come to the same conclusion as van Creveld, but few state this as clearly as the US Marine Corps:

“Our view of the nature of war leads us to one of two responses to dealing with the fundamental problem of command: either pursuing certainty or coping with uncertainty. These responses lead to two distinctly different theories of command and control ... The Marine Corps’ concept of command and control is based on accepting uncertainty as an undeniable fact and being able to operate effectively despite it. The Marine Corps’ command and control system is thus built around mission command and control which allows us to create tempo, flexibility, and the ability to decentralize and rely on low-level initiative.” (U.S. Marine Corps 1996, p. 104)

Australian C2 Doctrine – Directive Control

Decisive Manoeuvre: Australian warfighting concepts to guide campaign planning (Australian Defence Force Warfare Centre 1998), the Australian Operational Level command doctrine, is built around nine underpinning concepts that support its overarching warfighting concept of Decisive Manoeuvre. However, the detail of the concepts tends to bury the underlying principle of command on which it relies.

This is the doctrine of “Directive Control”, which is an alternative name for command-by-influence. It is not as explicitly stated as in the US Marine Corps doctrine, but the extracts from *Decisive Manoeuvre* below make it clear that Australian doctrine is aligned with command-by-influence concepts:

“4.4 However capable the C3I system is made, the Australian circumstance dictates that the campaign will operate most effectively when the subordinate commanders have become imbued with the commander's intent and are able to act on opportunities on their own initiative confident that they are contributing to the achievement of the end state. This is the essence of Directive Control and requires not only trust and confidence between commanders and their subordinates, but mutually between units, formations and services. To achieve this we must develop within the ADF the ethos of a 'band of brothers', with a shared vision of the Australian way of warfighting.

4.5 Commanders must recognise that subordinates operating within Directive Control may have to renounce notions of rigid grouping and logistical support arrangements. Improvised reactions to events in the battlespace, within the commander's intent, are a particular feature of ensuring momentum is maintained in manoeuvre warfare.” (Australian Defence Force Warfare Centre 1998, Chpt 4)

Scientific Support to Military Command Systems

Each of the three levels of command has particular characteristics, but all command has the fundamental problem of managing uncertainty. At each level the commander has to make decisions in the face of conflicting, ambiguous, uncertain, and perhaps false, information. Each level of command has its unique problems, and modern military organisations rely on scientific research to help to understand and manage the complexities.

In Australia, the DSTO has a strong record in research and development in areas of the physical sciences, contributing particularly to the tactical military capability. This work involves conducting research to understand the unique environment in which the ADF operates and then using this knowledge to develop innovative solutions to improve performance of military hardware in the Australian conditions.

The success in technological support relies on the traditional scientific method that has been so effective in the physical or natural sciences. Research is conducted to gain a basic understanding of the causal relationships involved and the physical parameters of the environment. From this scientific understanding, new or improved equipment can be engineered with high confidence that the expected performance will be achieved. It is also possible to compute how close a particular outcome comes to the theoretical optimal solution. DSTO, like similar military R&D organisations, continues to use this approach to achieve ever higher levels of performance and precision in weapons systems. This reduces uncertainty in the tactical use of such weapons.

R&D support for C2 systems is carried out in what seems superficially to be the same methodology. However, as indicated in Figure 2 below, there is a change in the composition of the systems as we move to higher levels of command. At the operational and strategic level of command, issues of people and organisations make up a more significant proportion of the systems. In this realm there are no immutable “laws of nature” from which to make reliable performance predictions, or to engineer new systems with specified performance characteristics.

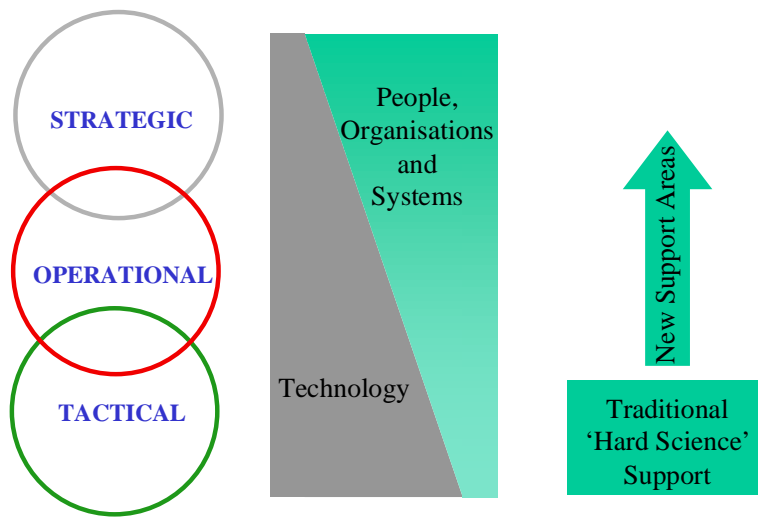


Figure 2: Scientific Support to the Levels of Command

The same methodology is used in scientific support for command and control, but the causal relationships determined in this realm are not the fixed “laws” operating in the physical sciences. Instead, we are working with general principles derived from observation and historical analysis. Not only is it usually impossible to rigorously test these principles in repeatable experiments, but they are generally dependent on the particular situation. The sheer number of variables and non-linearities in command systems means that it is meaningless to undertake the traditional approach of searching for the optimal solution.

There appears to be two approaches for future research to support the practice of military command. The first is to accept that technology will certainly play a major role in future command, and work hard to find ways of using it. In particular, considerable resources are being directed to applying advanced communications and information technologies to improve the processes of command. By concentrating on the sub-systems it is possible to be predictive about the performance outcomes for changes made to them. The risk is that optimising parts of a system does not necessarily improve the overall outcome, and can often precipitate unexpected and adverse results. In effect, this process concentrates on areas where available scientific skills are in place and where the relationship between input and output is clear and can be measured.

The DSTO EXC3ITE program falls into this paradigm. It is dedicated to the development of applications targeted to improving command processes by applying developments in information technology in new ways to enhance information flow, availability and presentation of information to the commander. To improve the speed of uptake of the new technology, parts of the system are located in operational headquarters, so that new tools and capabilities can be assessed in the working environment before they are committed into the live ADF command system.

A second approach to this scientific support problem is to look for a more general theory of C2 that can be used to underpin the design of C2 systems. Such an approach would encourage those developing command support systems to consider in more depth how their system might contribute to overall command effectiveness. Builder (Builder, Bankes et al. 1999, p. 4) notes:

“there is little in the theoretical literature that does not have the commander boxed up in a wiring diagram..... Defining the C2 process as a function of how the communications system is wired together is analogous to considering a particular tank gun as being essential to the fundamental laws of ballistics, which drive the design of the weapon.”

Pigeau and McCann (Pigeau and McCann 1995; McCann and Pigeau 1996; Pigeau and McCann 1998) are among the few researching the fundamentals of command with the aim of developing a conceptual framework for command and control. They start from the observation that the human component of C2 has been neglected and by separating the concept of command from that of control they have been able to move closer to the essence of command

Military doctrine offers another starting point for the search for a general theory of command and control. In Australia, the doctrine writing process brings together the collective experience of our military and of allied forces into a body of coherent underpinning principles. The doctrine development process involves extensive research into historical evidence, and of the lessons learned from experience in real world and simulated operations. In effect, it is analogous to the scientific research process. Evidence is collected and analysed and from that generalisations (“Laws”) are inferred. These generalisations can then be used as the underpinning principles for developing command doctrine. As with the scientific method in the physical sciences, this approach leads to a more consistent and cohesive description of the system. However, the analogy breaks down when considering the immutability and repeatable predictive power of these generalisations in the complex, uncertain and fundamentally human aspects of command in war.

RMA and Command

We are now into the information age, so it is constructive to examine the potential impact of IT on the military command archetypes. Much is made of the RMA (Revolution in Military Affairs), which is driven largely by the rapid development in information and communication technologies. These technologies have the potential to improve the chances of getting commanders’ information of the right form, to the right place and at the right time, thereby overcoming van Creveld’s ‘information pathology’.

For command-by-direction, the command form that attempts to cope with uncertainty by increasing information processing, IT would seem to offer significant benefits. The impact of the World Wide Web, data mining and many other expanding IT applications is transforming civilian society, and it is having, and is anticipated to continue to have similar “revolutionary” effects on military command. A great deal of work is proceeding to support command at all levels with improved communications, better situational awareness and many innovative decision making tools. However, fundamental human cognitive limits remain, and it is unlikely that IT could so transform military command that a commander could have full awareness of all the nuances of the conflict and be able to command all of the forces all of the time. The information processing and communications systems currently available process explicit information according to predetermined algorithms. Few IT systems can yet address the problem that “Commanders’ information needs are rarely specific pieces of data, but are instead highly variable and human-intensive elements”(Kahan, Worley et al. 1989).

Military planning has benefited enormously from modern information technology, and in many cases would be difficult or impossible without such systems. This is still unlikely to make command-by-plan any more effective as a winning command archetype, because along with the inherent complexity and non-linearities in military conflict there will always be an unpredictable human adversary whose moves and motives cannot be predicted with accuracy.

In contrast, it is more difficult to see how command-by-influence has been linked into the RMA at this stage. As Czerwinski (1996) notes: “despite the promise of this form of command, the dim outline of its information system equivalent are only now starting to take shape, and then largely on a theoretical plane”. The tools to support this form of command have to deal with concepts that are more difficult to measure or even define. Measuring the degree to which the commanders intent is shared across the force, or the level of trust existing between command levels or between coalition units are significant challenges, let alone designing support systems to enhance such factors.

Implications and the Way Ahead

Implications

This paper set out to develop a more principled approach to the provision of scientific support to military command and control. Work done by others (notably van Creveld) has derived enduring command archetypes from the evidence of past military conflicts even in the face of dramatic technological change. These archetypes are command-by-direction, command-by-plan and command-by-influence. They each address the underlying commander’s quandary of uncertainty and insufficiency (or ‘pathology’) of information in different ways.

The evidence put forward by van Creveld, backed up by the experience based doctrine of Western military, is that command-by-influence, or directive control in Australian Doctrine terms, is superior to other command types. It seems, therefore, that scientific support to command and control should be explicitly referenced back to the form of command it is intending to enhance. Many of the information technology based systems being introduced into command systems offer the promise of “improved situational awareness” or “structured access to more information” or some other “Good Thing” without regard to the underlying command archetype the client commander and his staff are trained for and working to. If the technologist is implicitly working to enhance a different command archetype to that which underpins the military’s doctrine, then there is risk of undermining the existing command system.

The rationale for much of the present IT support appears implicitly based on enhancing command-by-direction. There is an argument that IT is such a significant development in military conflict that it could enable a change from the historically “best practice” of command-by-influence, to some form of command-by-direction. The implication is that IT really can cause an RMA in command and control. Such a dramatic change would need to be very well researched and clear evidence collected before such a high risk change could be contemplated. Importantly at this stage, those conducting such research into C2 tools should be explicit as to the command type that these support.

Technological support intended to enhance C2 should be very clear about the underlying command archetype it is supporting. In the Australian context, research intended to enhance

current C2 systems should be explicitly linked to the principle of Directive Control that underpins Australian military command doctrine.

Way Ahead

This paper has outlined generally accepted underlying principles of command in the military with the aim of providing a more principled framework within which to conduct scientific research into command support. It proposes that research into military command and control would be more effective if it were explicitly linked back to underlying principles of command. This implies two main research streams in command support. The first is work intended to support C2 based on the principles espoused in current military command doctrine. The second is research into the effects new technologies might have on enhancing the relative effectiveness of another command archetype.

Support for Command-by-Influence

Research into tools to support existing Command-by-Influence doctrine is, in effect, what is implicitly intended at present. A more principled approach would make explicit the connection between the research work and the underlying command principle. Thinking about and describing the linkage would focus the research on enhancing the underlying command type, not just at improving performance of part of the command process. The research outcome would be coherent with military command doctrine and the benefits would be more apparent to the customer.

Research into Command Principles

This line of research may be unwittingly being conducted at present. Those striving to improve parts of the command system, without consciously considering the underlying principles of command, may in fact be working to improve a command principle different to that underlying the customer's command system. If more carefully considered, this work could be the embryo of research into alternate command types. The information revolution may be so fundamental as to give command-by-direction or command-by-plan ascendancy. Van Creveld sees this as unlikely, but an explicitly identified research into command paradigms in the information age might just yield results that would provide a significant military advantage. In van Creveld's terms this new technology may be the catalyst that introduces a more effective paradigm for handling the uncertainty and "information pathology" of command.

Conclusion

Research into the command of military forces has identified underlying command archetypes, with command-by-influence being identified as generally the most likely to prevail. Most western military forces explicitly base their command and control doctrine primarily on command-by-influence. In the Australian context this is called Directive Control.

The paper concludes that research into command and control support systems would benefit by explicitly taking account of the underlying command principles that it purports to support. This principled approach would improve outcomes of research into systems supporting the accepted command archetype and give focus to research into alternate command types that may be more effective in the information age.

Bibliography

- Allard, C. K. (1996). Command, control, and the common defense. New Haven [Conn.], Yale University Press.
- Australian Defence Force Warfare Centre (1998). Decisive Manoeuvre: Australian warfighting concepts to guide campaign planning. Canberra, Defence Publishing and Visual Communications.
- Builder, C. H., S. C. Bankes, et al. (1999). Command concepts: a theory derived from practice of command and control. Santa Monica, Rand National Defense Institute.
- Czerwinski, T. J. (1996). "Command and Control at the Crossroads." Parameters(Autumn 1996): pp. 121-132.
- Kahan, J. P., D. R. Worley, et al. (1989). Understanding Commanders' Information Needs, RAND.
- McCann, C. and R. Pigeau (1996). Taking Command of C2. Second International Command and Control Research and Technology Symposium, Market Bosworth, UK.
- Pigeau, R. and C. McCann (1995). Putting Command Back into Command and Control: The Human Perspective. Command and Control Conference, Congress Centre, Ottawa. Canada, Canadian Defence Preparedness Association 26 September 1995.
- Pigeau, R. and C. McCann (1998). Re-defining Command and Control. Toronto, Defence and Civil Institute of Environmental Medicine.
- U.S. Marine Corps (1996). MCDP 6 : Command and Control. Washington D.C., United States Government.
- van Creveld, M. (1985). Command in War. Cambridge, Mass., Harvard University Press.