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C2 That! Command and Control over Post-Industrial Armed Forces

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Abstract

There is a rich and growing C2 literature on the implications of 'complex endeavours' for the way in which our armed forces are managed. The authors of this paper argue that this literature still underestimates some of the profound transformational effects of epochal change on armed forces in general and on C2 in specific. The paper starts out by going back to the roots (etymological and historical) of command and control over 'armed forces'. It highlights some of the revolutionary changes that epochal transitions (e.g. from pre-industrial to industrial) have historically triggered in both the concept and the practice of 'armed force' and 'command and control'. It then zooms in on the current transition (from industrial to post-industrial) and speculates on what it might mean to command and control over future complex endeavours. The authors anticipate a return to the original, 'softer' (as opposed to the 'harder' industrial-age) concept of command and control; the decoupling of command from control; a shift from 'early tight' coupling to 'late loose' coupling; and a shift to a portfolio of capabilities and relationships.

1 Introduction

Most analysts and practitioners alike still associate the concept of 'armed force' with one particular historical instantiation of the application of armed force: the one anchored in the industrial age. The analytical C2 community – much more than the actual C2 community, let alone the defence community as a whole – has been on the forefront of the attempt to break the defence community out of its industrial-age mental and physical shackles. This attempt has met with limited success in most National Defence Organizations (NDOs), and is currently even subject to somewhat of a backlash.

The authors of this paper are of the opinion that epochal change is starting to occur before our very eyes and that it will have fundamental – and underappreciated – implications for our armed forces. Although the C2 community has been at the forefront of the thinking of these issues, we still feel some implications are underappreciated even in this community. Much of the literature on C2 in a post-industrial age has been mostly about what we would still call 'Armed Forces 1.0' – how the new PHYSICAL technologies of the information age can be used to improve existing ways of working (and thinking) within an essentially unchanged concept of 'armed force'. 'Armed Forces 2.0' – in analogy to other forms of 2.0 in the civilian sector (Web 2.0, Enterprise 2.0 and even Government 2.0) – would entail different 'Armed Forces' actors doing novel things using new ways of working (based on new SOCIAL technologies).

This paper will focus on the command and control aspects of this shift towards Armed Forces 2.0 and will attempt to make a number of points:

- It will try to challenge the industrial age mindset by delving a bit deeper in the more profound origins of the concepts of 'armed force' and 'command and control'. The paper will take a closer look at both the etymological origins of these two concepts (which will prove to be far more 'modern' than generally surmised) and at the historical variations in the way they were implemented across different ages;
- It will attempt to identify some of the main SOCIAL technologies that the physical Information and Communication Technology (ICT) changes are starting to spawn (in non-defence areas) and what they might mean for C2 over 'Armed Forces; and
- It will also question whether command and control would not better be decoupled, as they are in most other walks of life.

2 Going Back to the Roots

2.1 'Armed Force'

The wordsmiths who 'invented' words for the various concepts they saw and experienced around themselves often showed remarkable skill. Some of them welded words that stood the test of time¹ for centuries. The longevity of some of their inventions suggests they were able to capture something very fundamental about the concepts they described. These words sometimes saw their initial meaning subsequently adjusted to changing circumstances – but yet people held on to the word itself. We do not often stand still to think about these 'fundamental', original meanings of words. And we can really only venture an approximate guess about what they truly had on their mind. But the very exercise of figuring that out – captured in the linguistic discipline of 'etymology' (the science of the origins and development of words) – remains a fascinating one. A brief etymological excursion into the historical roots of the concept of 'armed force' may therefore prove quite illuminating for the purpose of breaking loose from the mental shackles of the industrial age.

The English word 'army' is derived from the word *arm*², which was in turn directly borrowed (around 1300) from the Old French word *armes*, from the Latin *arma* "weapons," literally "tools, implements (of war)". So far, so unsurprising. The more interesting part of this story is that when we go back further in time, the original root of the words 'arm' is thought to derive from the Proto-Indo-European³ base **ar-*, meaning 'to fit, to join'⁴. The notion thus seems to be that 'arms' implied 'that which is fitted together'. This suggests that 'armed force' merely represents what we today would call 'capability packages' (that what could be fitted together) for the purpose of imposing one's will on others ('force'). And the precise instantiation of these capability packages typically reflects the Age in which they are used. In pre-historical times, 'what was fitted together' was essentially wood, a few primitive ropes and some stones (for clubs, spears, bows, slings). In the Bronze Age, bronze was added to the mix to yield edged metal weapons; the Iron Age added the much more commonly available iron to the mix – and so on until we reach the current industrial-age 'armed force' that we now take as the standard.

In other words, the historical incarnation(s) of this concept of "capability packages' to impose one's (political) will on others' has varied enormously across the epochs. When most of us today think about the concept of 'armed force', we conjure up highly hierarchically organized mobile formations of uniformed soldiers equipped with a wide range of physical technologies based (mostly) on steel, engines and firepower that are employed by national political leaders to advance or defend their national goals. While this particular image is by now deeply ingrained in our consciousness, 'armed forces' have not always looked like this. *Before the nation-state* became the primary actor in the international system (a point in history often traced back by political scientists to the Treaties of Westphalia of 1649), 'armed force' was exercised by a far more heterogeneous set of actors than just the nation-states (tribes, clans, religious or ethnic groupings, etc.). And *prior to the industrial revolution*⁵, the physical incarnation of this force looked quite different from what we observe

¹ And the competition of other words – both in the same language but often also from other languages.

² Harper, *Online etymology dictionary.*, <http://www.etymonline.com>.

³ The hypothetical reconstructed ancestral language of the Indo-European language family whose time scale is much debated, but thought to be about 5,500 years ago

⁴ Harper, *Online etymology dictionary.*

⁵ We want to point out here that we use the term 'industrial-age' fairly loosely here – metals had been used since the Bronze Age, and even firearms go back to at least the Renaissance period and became quite common already in the 18th century. For those interested, see Chase, Firearms. and Buchanan, Gunpowder, explosives and the state. But the argument here is that Industrial warfare saw nation-states creating and equipping large armies and navies (and in the 20th century also air forces) based on mass conscription, rapid transportation (first on railroads, then by sea and air) and unprecedented communication (from telegraph to wireless communications). In terms of physical technology, this era saw the rise of rifled breech-loading infantry weapons capable of massive amounts of fire, high-velocity breech-loading artillery, metal warships, submarines, aircraft, rockets and missiles,

today – not only in terms of physical (weapons) technologies, but also in terms of the accompanying ‘social technologies’⁶ – including organizational principles, doctrines, etc. As with most other aspects of public and private life, the industrial age revolutionized the very essence of ‘armed force’⁷.

We have to acknowledge that the two key defining features of our current image of armed forces – their state-centred (‘Westphalian’) and industrial quintessence – are under increasing pressure. Both may very well stay with us for some time to come, but we can already detect the patchy outlines of a different era with (again) a much more heterogeneous cast of actors and with (and much of this is new) post-industrial socio-technical features (‘arms’, doctrines, organizational structures, etc.). If we assume that humans will continue to avail themselves of whatever they find and can create around themselves to attempt to impose their will (in our opinion one of the very few fairly safe assumptions in defence planning⁸), we have to accept that post-industrial capability packages may look as different from industrial ones, as paleo- or neolithic warriors did from Bronze-age ones; or as armies of medieval knights from the current industrial ones that we are so familiar with.

More and more defence organizations are starting to recognize that the future security environment within which ‘armed forces’ will operate is becoming ever more volatile. Many recent defence foresight efforts (JOE⁹ in the US, Strategic Trends¹⁰ the recent UK Green Paper¹¹ in the UK, the French Livre Blanc¹², NATO ACT’s Multiple Futures¹³, etc.) have acknowledged this profound contextual uncertainty with more candour than ever before. But none of those exercises explicitly embrace this new, potentially much more fundamental (and unsettling) element of what we might call ‘epochal uncertainty’. There are various classification schemes for these epochs (sometimes also called ‘ages’ – as in the ‘industrial age’), but one of the most frequently used ones is based on the dominant human economic activity at any given moment in time. Figure 1 clearly shows these ‘ages’ – from hunting and gathering, to agricultural, to the industrial age which peaks from the late 19th century until after World War II. Since then, we have seen the service sector become the most dominant area of human economic activity – with the information sector starting to take the lead towards the end of the second millennium.

armoured warfare, and nuclear weapons. See Archer, *World history of warfare*. See also Dupuy, *A preliminary, interpretive survey of the history of command and control*.

⁶ The differentiation between these two types of technologies comes from the evolutionary economist Richard Nelson of Columbia University (Nelson, *Technology, institutions, and economic growth*.) His main focus is economic growth, but the concept is equally useful in other areas. The first one he labels *physical technologies*, which is what most of us typically think of when we think of technology: things such as tanks, or radars, or communications. *Social technologies*, on the other hand, are ways of organizing people to do things. Examples in the defence realm would include doctrine, the laws of war, echelons, etc. Eric Beinhocker, in his monumental ‘The Origin of Wealth’ (Beinhocker, *The origin of wealth*.), gives the following example: “During the Industrial Revolution, for example, Richard Arkwright’s invention of the spinning frame (a Physical Technology) in the eighteenth century made it economical to organize cloth-making in large factories (a Social Technology), which in turn helped spur numerous innovations in the application of water power, steam, and electricity to manufacturing (back to Physical Technologies). The stories of the agricultural, industrial, and information revolutions are all largely stories of the reciprocal dance between Physical and Social Technologies.” It is interesting to point out that this broader definition of ‘technology’ is increasingly being recognized in the defence ‘science and technology’ community, as various ‘social scientific’ fields are increasingly acknowledged as containing some possible ‘technological solutions’ to real-life problems our defence organizations encounter in operations like Iraq and Afghanistan.

⁷ One anonymous reviewer of this paper also pointed out that similar ‘epochal’ changes in social technologies occurred in previous eras as well – as in the pyramid-style of hierarchy attributed to Charlemagne and visible in both state and church structures. On this, also see Zanden, *The long road to the Industrial Revolution*.

⁸ One could refer here to Clausewitz’ original formulation of his ‘wunderliche Dreifaltigkeit’ (amazing trinity) consisting of primordial drives in people (which he framed negatively as violence, hatred, and enmity, but which could also merely be seen in a more neutral sense as an individual’s drive to obtain one’s will); the interplay between chance and volition in the application of armed force; and the political aims to which this armed force is subordinated. Whereas the first can be seen as universal, the second and third elements of the trinity clearly depend on the particular juncture in time. Howard, *Carl von Clausewitz*.

⁹ United States Joint Forces Command Norfolk Va., *The Joint Operating Environment (JOE)*.

¹⁰ Great Britain., *The DCDC strategic trends programme, 2007-2036*.

¹¹ Secretary of State for Defence, Ministry of Defence, United Kingdom, *Adaptability and partnership issues for the strategic defence review*.

¹² Sarkozy, *Dé fense et sécurité nationale*

¹³ See <http://www.act.nato.int/MultipleFutures/>

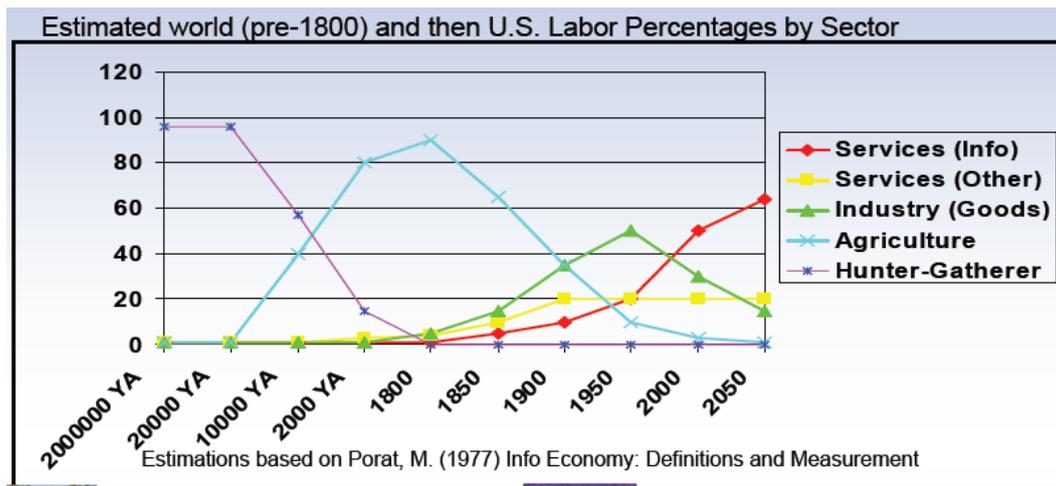


Figure 1 Epochs based on dominant economic activities

‘Epochs’ have had an enormous impact on all areas of human life – as current generations can clearly attest. All we have to do is to compare the life of our grandparents with our own lives in terms of technology, comfort, jobs, recreational opportunities, mobility, and even personal traits (physical appearance, life expectancy, self-identity, etc.). There is no reason to think that the military domain will be spared from this trend. This means that not only the future security environment might change more than we think today, but possibly even the very essence of ‘armed force’ in the post-Industrial Age itself. That the ‘armed forces’ of the future may very well look radically (even unrecognizably) different from the image we carry in our heads today. A pre-historic (or even Medieval) warrior could not possibly have anticipated the form ‘armed force’ would take in the industrial age. When transported by a time machine to the industrial age he¹⁴ would certainly recognize eternal abstract elements in the conduct of warfare such as violence, guile, camaraderie, etc.; or even more concrete ones such as strike, force protection, manoeuvre, etc. – but he would feel totally overwhelmed by the massive application of new industrial-age physical and social technologies that were fully unfathomable in his age. So too do we have to remain open to the likelihood that the physical and social technologies that will be embodied in post-industrial armed forces may transcend our current notions of ‘armed force’. Societies that will prove able to adapt more quickly adapt to these changes are likely to have a significant ‘evolutionary’ advantage over those that adapt slowly or not at all.

The following table provides an overview of some of the important differences between the ages¹⁵

Table 1 Some military differences across the epochs

	Pre-industrial	Industrial	Post-industrial
Actors	Chieftains	‘Princes’ (link with nation states)	States + non-states
Armed Forces	Ad-hoc forces (no permanent larger than 3000 – see v Creveld)	Permanent (industrial) armed forces	?
Weapons (‘arms’ ¹⁶)	Bare-handed/Cold	Industrial platforms/Hot	much more diverse (DIME+) / knowledge-

¹⁴ It does appear that throughout history (even in antiquity), warfare has been a predominantly male occupation.

¹⁵ This is part of ongoing work at TNO/HCSS and is only presented here as a preliminary illustration of a number of key differences between the eras.

¹⁶ In the etymological sense as a capability package used to obtain one’s will.

			based/cyber?
Organization	Clan	Linear	Network
Structure	Vertical simple hierarchy	Vertical multi-layered hierarchy	Heterarchy?
Connectedness	Singular force (all-in-one)	Connected (e.g. Combat support & Combat Service Support)	Distributed?
Weather	'Fair-weather'	Year-round 24/7	Pervasive
Environment	Mostly land, some sea	Land-Air-Sea	Multi-environment (space, cyber)
Effects obtained through	Concentration	Mass (economies of scale)	Network (network economies)
Level	Tactical	Operational(/strategic)	Fused
Projection	Local	Line-of-sight	Global
Mode	Hit-and-run / Siege	Linear Attrition & Manoeuvre	Network ?
Specialization	All-in-one	Advanced role specialization	Network
Time of 'battle'	Punctuated	Punctuated	Pervasive
Leadership	Heroic leadership	Increasingly sophisticated C2	Network
Planning	Basic planning	Deliberate purposive planning	Adaptive planning
Model	Small 'star' model	National 'star' model	Galaxy-model

In the current period of deep uncertainty¹⁷, it is therefore important to remind ourselves of the fact that the concrete embodiment of the concept of 'armed force' (in the sense of a combination of tools that enable policymakers to use extra-ordinary coercive power to impose their will on others¹⁸) has historically not always been like it is today. And it may not necessarily always remain like this. This paper will explore a few implications of this possible shift to a new post-industrial 'armed force' gestalt for the area of 'command and control'.

2.2 'Command and Control'

Just as we have done for the concept of 'armed force', we will also provide a brief etymological excursion into the original meaning of the words 'command' and 'control' – which in some sense can be seen as the 'glue' that keeps the 'capability packages' together in the pursuit of the political goals.

Both historical semantic components of the word '*com-mand*' deserve attention¹⁹. The familiar Latin 'cum'-prefix (meaning: 'together with') evokes a 'softer', more collegial, consensual association of

¹⁷ See De Spiegeleire and Bekkers, "Deep Uncertainty – Implications for Defence Planning."

¹⁸ See Harper, *Online etymology dictionary*, <http://www.etymonline.com/index.php?term=army>.

¹⁹ "command" - c.1300, from Old French *comander* "to order, enjoin," from Vulgar Latin **commandare*, from Latin *commendare* "to recommend" (see *commend*), alt. by influence of classical Latin *mandare* "to commit, entrust" (see *mandate*). Replaced Old English *bebeodan*. The noun is attested from 1552. *Commandant* is 1687, from French *Commandment* is c.1280; pronounced as four syllables until 17c. "Of þe x commandements ... þe first comondement is þis, O God we ssul honuri" (c.1280)." Ibid. See also Étymol. et Hist. A. x^e s. « confier (qqn, qqc. à qqn) » (*St Léger*, éd. J. Linskill, 20) – xvi^e s. ds Hug. B. 1. x^e s. *commander* + inf. « ordonner de + inf. » (*St Léger, ibid.*, 220); xi^e s. « ordonner (qqc. à qqn) » (*Alexis*, éd. C. Storey, 170); 2. 1564 « commander à ses passions, à soi-même » (Thierry); 3. 1573 « diriger en chef, p. ex. un corps d'armée » (J. Dupuis, *Dict. français-lat.*); 4. 1653 « dominer un lieu par sa position » (Vaugelas, *Quinte-Curce*, 1. 3, c. 4 ds Rich. 1680); 5. 1671 « donner le signal d'une manœuvre (à l'armée) » (Pomey). C. 1675 comm. (Savary, *Parfait Négociant d'apr. Kuhn*, p. 49). Du lat.

providing direction than the current interpretation of command as a top-down instruction along the 'chain of command' with significant elements of compulsion. Also the second semantic element, 'mandare' (to commit, entrust) apparently had a weaker connotation in its original meaning than its current cognates *mandate*, *mandatory*, etc. suggest. What then emerges here is that the historical roots of the word 'command' suggest a shared²⁰ (the Latin 'cum') form of mandating based more on elements of 'commitment' and 'trust' ('shared intent') than on 'top-down' orders.

The etymological root of the word *control* is equally interesting²¹. Its meaning appears to have changed much less over time than the verb 'to command' and is closer to our current understanding of the word. But its roots nicely show the tension (and symbiotic complementarity) with the verb 'to command'. Whereas command is based on the Latin prefix 'cum' (together with), control is based on the opposite Latin prefix 'contra' (against). In nice contrast to the historical roots of 'command', which suggests being with others and setting a course of action in motion by 'enjoining' others to do things based on trust and commitment (i.e. more in line with the (aligned) wills of the subordinates than against them); the etymological roots of 'control' suggest monitoring the natural course of events that unwind after a course of action has been decided and – where necessary – steering 'against' (contra) it on the basis of a perceived discrepancy between what ought to be and what is.

The second interesting observation on the term 'control' is the historical practice that seems to have given birth to the concept in this sense: the 'contrarotulus' or contre-rolle used for duplicate copies of accounting rolls (i.e. accounting records)²². The famous English poet Geoffrey Chaucer (c.1340-1400), for instance was one of these early 'controllers' and he used some of this practical knowledge in his *Canterbury Tales*²³. The idea that the control function requires a separate (duplicate) reporting

**commandare* réfection d'apr. *mandare* « charger, confier » du lat. class. *commendare* « confier » et « commander » Centre national de ressources textuelles et lexicales, "Commander: Etymologie de commander."

²⁰ Recent emphasis on these aspects in new thinking on operational planning in both Shimon Naveh's work and in the new US emphasis on 'designing' operational plans suggests a possible return to these historical roots. See Naveh, *Interview with BG (Ret.) Shimon Naveh.*; Groen, *Systemic Operational Design*. and the latest US Army publication incorporating some of Naveh's ideas: United States Army, *The United States Army Commander's Appreciation and Campaign Design*..

²¹ "control"  c.1310, "to check, verify, regulate," from Anglo-Norm. *contreroller* "exert authority," from M.L. *contrarotulus* "a counter, register," from L. *contra-* "against" (see [contra](#)) + *rotulus*, dim. of *rota* "wheel" (see [roll](#)). From a medieval method of checking accounts by a duplicate register. Sense of "dominate, direct" is c.1450." Harper, *Online etymology dictionary*. See also Étymol. et Hist. A. 1. Ca 1310 agn. contre roller « vérifier (des comptes en inscrivant sur un second registre), soumettre à un contrôle » (Ms. Cott. Tib. E viij lf 49 – Housch. Ord. Edw. II – ds NED); 1446 controoler (ISAMBERT, Rec. gén. d. anc. lois franç., IX, 126 ds BARB. Misc. 14, no 5); 1636 controler (MONET); d'où 2.1437 conteroller « examiner minutieusement » (Arch. de Bretagne, iii, 159 ds BARB. Misc. 14, no 5); 1541 contreroler « examiner; critiquer » (CALVIN, Institut., 263 ds GDF. Compl.); 1563 controler (RONSARD, Responce aux injures, éd. P. Laumonier, t. 11, p. 164, vers 954); 3. 1740 contrôler « imprimer un poinçon sur les ouvrages d'orfèverie » (Ac.). B.[Av. 1662 « exercer une surveillance dominatrice » (PASCAL, Pensées, section 2, éd. L. Brunschvicg, t. 13, p. 2 : Cette superbe puissance [de l'imagination], ennemie de la raison, qui se plaît à la contrôler et à la dominer, pour montrer combien elle peut en toutes choses, a établi dans l'homme une seconde nature), attest. isolée]; 1903 part. passé adjectivé (JANET, Obsess. et psychasth., p. 73 : ... si l'on pouvait changer l'usage, il vaudrait mieux dire qu'il s'agit d'obsession avec jugement, d'obsession contrôlée ou critiquée par le malade); 1910 se contrôler « se dominer » (P. ADAM, Rail Sauveur, p. 73 ds BONN., p. 37); 1915 contrôler ses nerfs (BOURGET, Sens mort, p. 208); 2. 1895 « avoir sous sa domination (ici, gérer des biens » (BOURGET, Outremer, II, 108 ds BONN., p. 36); 1904 (SAYOUS, R. d'Écon. Pol., p. 756, ibid. : ... il contrôlait le chemin de fer de Philadelphie à Trenton). A 1 malgré le hiatus chronol., dér. decontrôle* « registre tenu en double », dés. -er; cf. lat. médiév. *contrarotulare*, 1298 ds LATHAM. B peut-être empr. à l'angl. to control « exercer puissance ou autorité sur » (1495 Act. II Hen. VII, C. 22 § 6 ds NED : comptroll), « dominer ses sentiments » (1818 SHELLEY LAON, Ded., IV, 8, ibid. : controul), « se dominer » (1855 KINGSLEY, Heroes, II, 231, ibid.: control), p. ext. de sens de to control « vérifier » empr. au fr.; v. aussi FEW t. 10, p. 516 b et 517 a et t. 18, p. 46. Centre national de ressources textuelles et lexicales, "Contrôler : étymologie de contrôler."

²² For a fascinating description of the control environment in Medieval England (where the word 'control' was first coined in the sense here discussed), see Jones, "Internal control, accountability and corporate governance." The author makes it clear that stewardship and personal accountability were the core elements of medieval internal control and suggests that the renewed focus on enhanced personal accountability of individuals after various recent financial scandals also harks back to the original roots of the concept in medieval thinking.

²³ Customs duties were collected by wealthy London merchants who had made large loans to the king, in return for which they were allowed to collect customs on all foreign trade. The collectors who collected these customs on behalf of the merchants kept an account of their collections on parchment rolls recording the 'bills of content' (e.g. the name of the ship's master, the name of the ship, the ship's homeport, the contents and their value with the names of the importers) and exports. It was Chaucer's duty as controller (contrarotulator) to keep, in his own hand and on behalf of the king, a 'counter-roll' (contrarotulus) in order to check the

chain next to and distinct from the original reporting chain is an idea we will also return to in this paper.

Pigeau and McCann claim that the term 'command' only appeared in military writing in the mid-20th century. Prior to that the concept of command was often subsumed under the concept of 'generalship'²⁴. They also claim the compound term 'command and control' is of even more recent vintage, and only appeared with the advent of information technology (IT) in the 1960s. Allan English, a Canadian military historian, points out that neither the term "command and control" nor, indeed, the term "control" was used in an address entitled "Higher Command in War" made by General Slim to the US Command and General Staff College on 8 Apr 1952²⁵. In it, Slim speaks extensively about command, but though he talks about headquarters and their organizations, he doesn't use the word 'control' at all. English takes this as good evidence that before IT, people considered command as the overarching activity, and that it was only with the advent of IT that the term C2 appeared".

It has been remarked by some²⁶ that the two concepts 'command' and 'control' may in some sense contradict each other, and that the compound term 'command and control' may be a *contradictio in terminis*. It is indeed interesting to observe that in most other walks of life, the 'command' function and the 'control' function are often separated by design. In politics, for instance, various checks and balances separate decision making from oversight. Also in business, the 'accounting' and 'controlling' functions within an organization are increasingly functionally separated from the executive management functions, and much effort is devoted to external accounting and controlling mechanisms. In the past few decades, as developed economies increasingly move into the post-industrial era, this trend has been strengthened significantly in the business world. But whereas in all these other environments the command and control functions are separated, in the military world the two continue to be merged in the single person of the commander, who exercises command and control and within whose staff structure the command and control functions are not separated – all of this in the name of the hallowed principle of 'unity of command'.

The contemporary caricature of command and control is based on presumed elements of blind obedience to the commander – a sentiment that was strongly instilled in the various defence academies of yesteryear. "Soldiers, Frederick repeatedly had warned, 'can be held in check only through fear' and should therefore be made to 'fear their officers more than all the dangers to which they are exposed... Good will can never induce the common soldier to stand up to such dangers; he will only do so through fear.'"²⁷ A former Israeli paratrooper nicely summarizes the underlying sentiment "Primarily, the idea is that people do what you tell them to do, and if they don't, you yell at them until they do, and if they still don't, you throw them in the brig for a while, and if that doesn't teach them, you put them in charge of peeling onions on a submarine, sharing two cubic feet of personal space with a lad from a farm who really never quite learned about brushing his teeth."²⁸

This very negative view of command and control has become – not entirely unjustifiably from our point of view – very popular in the current business management literature. They caricature the very forceful, top-down nature of command and control; downplay its leadership aspects and mission control dimensions, and come to the conclusion that the term is beyond salvation. It has become a

roll of the collectors. The controller entered the same details on his counter-roll, using the bills of content, not copying from the collector's roll. At approximately half way through the accounting year, often at Easter, an audit or 'view of account' (*visus compoti*) was held at the upper exchequer (the exchequer of receipt). The collectors appeared in person and the total amount which the collectors ought to have received was recorded and set against the total paid into the exchequer, special assignments paid out of customs, and the proportion of the collectors' fees and wages paid to that date. To 'control' all of this, the collector's accounts were checked against those of the controller's. The view of account concluded with the sum owing to the exchequer, or the surplus in favour of the collectors. See Parker, "Accounting in Chaucer's *Canterbury Tales*."

²⁴ They refer to Fuller, *Generalship. Its Diseases and their Cure*.

²⁵ Reprinted in *Military Review*, Vol. 70, No. 5 (May 1990), pp. 10-21.

²⁶ McCann and Pigeau, "The human in command.;" Alberts and Hayes, *Understanding command and control*.

²⁷ Luvaas, "Military History: Is It Still Practicable?," 85.

²⁸ Spolsky, "The Command and Control Management Method."

synonym for everything that is wrong with the more directive forms of management. While sharing some sympathy for the criticism of the caricature view of C2 (which, despite being exaggerated, is unfortunately not without foundation), we have argued that our current understanding of 'command and control' has become much more 'directive', hierarchical and 'top-down' than its etymological roots suggest. We conjecture that the industrial age may have played a big role in morphing the initial 'softer' concepts of command into 'harder', more directive ones. But we observe that the etymological roots are actually much closer to more 'modern' views of management than is widely acknowledged, and that therefore there might be good grounds NOT to abandon the terms altogether, but to take them back to their etymological roots.

2.2.1 Conclusion

This overview of the historical roots of the concepts of 'armed force' and 'command and control' will – we hope – put the current discussions about new C2 paradigms in a different light. Many of us may not be fully aware of the impact that previous epochal changes have had not only on the very nature of armed forces, but also on the ways in which they were commanded and controlled. These changes altered armed forces and C2 beyond recognition. The forces themselves changed radically in the post-Napoleonic era, the physical technologies used changed and the increased complexity of this new force imposed radically new social technologies. The changes since then, while they may seem immense to the contemporary observer, pale in comparison with that epochal transition. And this raises the question what the implications of the current epochal changes might be on our current command and control system. That is the question the final part of this paper will address.

3 Towards Post-Industrial C2

There is an increasing feeling in the analytical community that the industrial-age version of the 'command and control' concept is no longer adequate for the post-industrial age. Command and control has proven to be such a 'holy cow' in the military world that fundamental criticism of the concept has remained fairly muted to date. In most other walks of life, however, and probably most prominently in management theory, many (even most) specialists now hold that the concept of 'command and control' has become obsolete. Dee Hock, founder and former CEO of the VISA credit card company put this idea very aptly:

*"I believe that purpose and principle, clearly understood and articulated, and commonly shared, are the genetic code of any healthy organization. To the degree that you hold purpose and principles in common among you, you can dispense with command and control. People will know how to behave in accordance with them, and they'll do it in thousands of unimaginable, creative ways. The organization will become a vital, living set of beliefs."*²⁹

The main claim that is made in the recent literature is that new C2 paradigms (as visualized in the Alberts and Hayes diagram) have now become possible, and even obligatory (in light of the increased complexity of the endeavours in which our defence organisations are engaging). From the dominant industrial-age 'classical' C2 model, today's realities – so Alberts and Hayes claim – necessitate also other forms of C2, some more peer-to-peer, less constrained, more distributed. The consensus that is likely to emerge is that it will become ever more important for defence organizations to be able to quickly shift gears across the various areas within that three-dimensional space. Under certain circumstances, defence forces will still be able to operate under the traditional C2 paradigm. But under other circumstances, those very same defence forces will also require the agility to operate with more distributed forms of 'command and control'³⁰.

We suspect the current literature on information-age C2 still underestimates three important aspects of change, which we will address in this section of the paper:

- The changes in the nature of the armed forces themselves (and what they mean for C2);
- Changes in the role armed forces will play in emerging security ecosystems (and what they mean for C2); and
- the extent to which the 'command' and the 'control' functions may have to be separated.

We will examine these points in turn in this section of the paper.

3.1 C2 That! How to command and control emergent new social technologies

We have pointed out that the very nature of 'armed force' – and therewith the principles and reality behind C2 – have changed dramatically across historical epochs. It is also clear that the precise nature of these changes do not lend themselves to either straightforward extrapolation from the past or elegant deductive reasoning.

One essential element of the information age and the revolutionary nature of the ICT revolution is often underappreciated is the emergence of new social technologies. Bill Gates, then still Chairman of the Microsoft Corporation, suggested that a "new world of work" is emerging and that "the software challenges that lie ahead are less about getting access to the information people need, and more about making sense of the information they have"³¹. The power to connect with each other

²⁹ "Business transformation through chaos theory - interview with Dee Hock."

³⁰ Stewart, Keith G., "Mission Command in the Networked Era."

³¹ Gates, "The New World of Work."

independent of space and time is fundamentally changing how people are organised and/or organise themselves using physical technologies to overcome limitations of space and time.

NEC (the embodiment of the ICT revolution in a military context) has so far been primarily seen as the introduction of a set of **physical** technological innovations: the ICT hard- and software. But that introduction has so far not really led to adaptation or innovation of the **social** technologies within which they are embedded. In the military world, this would imply significant changes in the way our defence organizations structure their value chains and their own structures, their doctrines, concepts of operations, etc.

As the Venezuelan scholar and expert on technology and socio-economic development Carlota Perez observes, in many technological breakthroughs an irruption of a promising new physical technology often leads to an influx of funding for that physical technology, which in turn leads to a somewhat frenzied roll-out within the existing social technologies³². Not infrequently, this leads to a crisis in which the existing social technologies collapse and give rise to new (often more optimal) social technologies that the physical ones enabled. Only after this crisis does the full socio-technological potential of the technological innovation get realized.

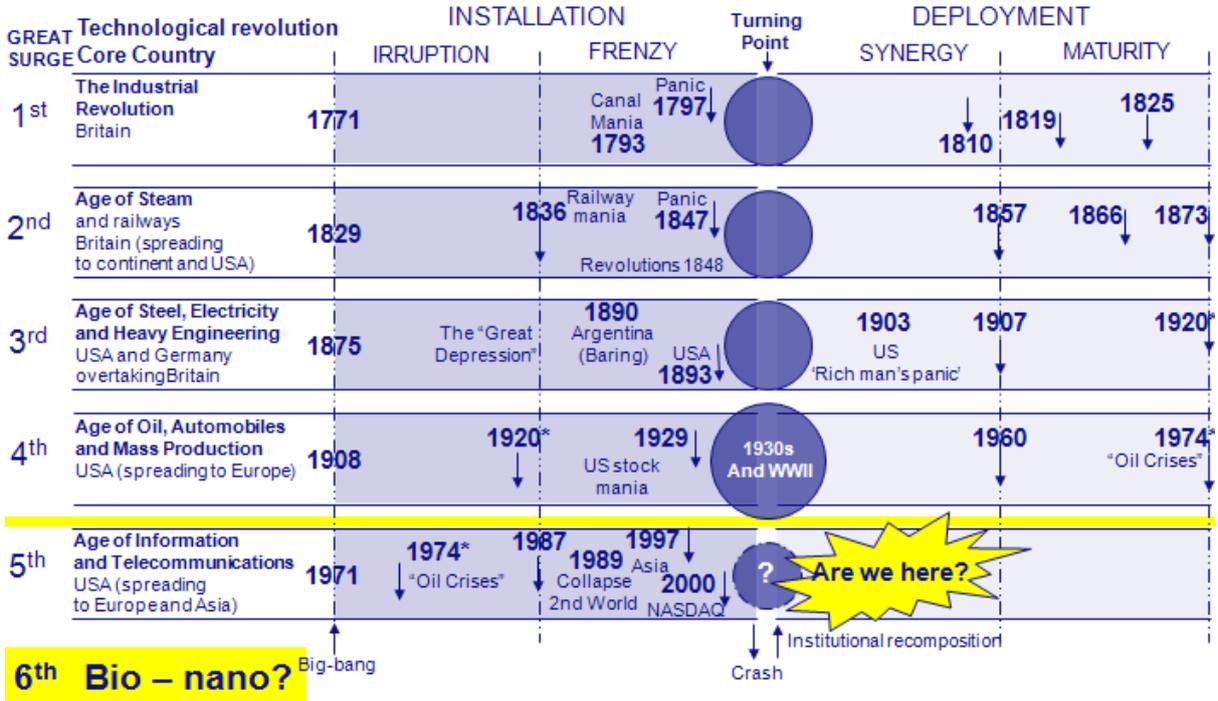


Figure 2 Carlota Perez' view of technological revolutions

The business world's experience with the ICT revolution is an excellent example of this phenomenon – and one that may prove very revealing for the military world as well. Businesses started investing heavily into ICT in the 90s, mostly because it was widely felt that this would enable companies to do the things they were doing more effectively and efficiently. Interestingly enough, it took a long time before the hoped-for efficiency gains could also be observed in the statistics – and then only AFTER a major crisis of the financial system (the stock-market crash of 2000 and the dot.com bubble) . This paradox is now known as the Solow-paradox after the Nobel-prize laureate

³² Perez, *Technological revolutions and financial capital*..

Figure 3

Robert Solow who had famously remarked in 1987 that “You can see the computer age everywhere these days, except in the productivity statistics”³³.

Just like the business world in the 90s, defence organizations today still mostly see NEC – the embodiment of the ICT revolution in the defence sphere – as enabling them to do the same things better, cheaper, faster – maybe even (a bit) differently. ICT was – quite naturally – seen as a (physical) tool that would enable commanders to achieve more situational awareness of their ‘traditional’ world and therefore to improve ‘traditional’ command and control. There is also some evidence that (some) military commanders and political leaders at this stage did/do indeed succumb to the temptation to use ‘NEC’ for precisely this reason (witness the discussion on 7000-mile screwdrivers³⁴). And interestingly enough, we now also see a military equivalent of the Solow paradox. Many professionals (military and non-military alike) observe that all the investments in NEC do not seem to translate in better military performance, certainly not in the hybrid conflicts in which we now find ourselves. This is even leading – maybe not surprisingly – to somewhat of a backlash against the NEC-philosophy. A recent IBM Institute for Business Value study, for instance, indicates that a fairly large sample of military officers who participated in multinational operations feel that the quality of cooperation has declined in the past decade instead of increasing³⁵.

The interesting lesson from the business world does not, however, stop with the (disappointing) Solow paradox. What we have seen in the business world after the ‘crash’ (in Perez’ terminology) is that businesses started developing new **social technologies** that the ICT revolution enabled. One of the key changes here is that the ICT revolution enabled a much more radical reconfiguration of companies’ value chains than they had ever envisaged when they embarked upon their ‘transformations’ (in the form of fairly large-scale investment in ICT-technologies). There too, the initial idea was that the same companies would do the same things better, faster, cheaper, etc. What happened however is that many companies started doing very different things in unanticipated new ways, thereby not only changing what they were doing, but even radically changing who they were themselves. IBM is an impressive example of this – after almost going bankrupt with a spectacularly misguided ‘command’ decision (to go for mainframe computers and to ignore the personal computer market), they entirely transformed themselves from a hardware company to essentially a service company (which increasingly embraces various forms of ‘open innovation’ – see below). Their ‘core’ (a phenomenal knowledge and research base in IT and related technologies) itself has not changed, but almost everything around it has³⁶. Could there be a lesson for our defence organizations in this?

The industrial age, because of its highly ‘bulky’ nature and because of the extreme difficulty of generating and exchanging information and knowledge, could essentially only generate ‘economies’ through economies of scale (or scope). In the business world, researching, developing, manufacturing and selling the objects that created value in the industrial era typically required mass – only strategically (co-)located large assembly lines allowed for the economies of scale that could radically lower per-unit production costs and thus increase profitability. Also in the military world, obtaining maximum value out of a defence effort required massing inputs (troops, firepower, etc.) to achieve massive effects. In other words, effects (business profit or military effectiveness) required mass, and mass required early and tightly coupled (and controlled) processes. And all of this put a premium on keeping as much as possible of one’s value chain WITHIN one’s own organization³⁷. The potential costs of dependence on ‘others’ in a system with such high ‘friction’ (because of high transaction costs) outweighed its benefits. Therefore being on top of one’s own value chain, and being able to fully ‘command and control’ it was thought to be of the essence.

³³ Solow, “We’d Better Watch Out.” See also Brynjolfsson, “Beyond the Productivity Paradox.”

³⁴ Ignatius, “The Defense Secretary We Had; Tough -- and Unaccountable.”

³⁵ Baldwin, *Bridging the collaboration gap. Results from a global defense survey on collaboration during coalition operations.*

³⁶ Christensen, *The innovator's dilemma.*

³⁷ Goldratt, *The race.*

One of the key radical changes in the information age (just as reduced transportation costs were one of the key enablers of the industrial age) is the dramatically reduced cost of storing and exchanging information (and from there, knowledge). This also radically changes the entire issue of how one wants to structure one's value change.

In a recent effort³⁸, we tried to identify some of the main insights about what the turbulent changes in the technological and economic environment have meant for a number of non-defence disciplines – primarily complex systems engineering, software engineering and business management. We were struck by some of the parallels across these disciplines³⁹. For the purpose of this paper, we would like to focus on two clusters of these insights and examine what they might mean for C2:

- Changes in the internal composition of armed forces; and
- Changes in the role armed forces may play in broader (external) security ecosystems.

3.2 Internal changes

Two important new IVT-driven 'social technologies' that seem quite robust across a number of disciplines are 1) more far-reaching forms of modularity; and 2) more late/loose coupling instead of early tight coupling.

Baldwin and Clark⁴⁰ describe **modularity** as "building a complex product or process from smaller subsystems that can be designed independently yet function together as a whole." 'Modularity' as an idea is nothing new, but the concept has gained importance in recent years because it helps organizations develop adaptability in turbulent environments. Within the military domain, it has become fashionable to think in 'modules' or 'building blocks', each with a clear and distinct 'functional profile'. The modules are part of a 'toolbox' which, as a whole, offers the flexibility to face a range of challenges and tasks through recombining these modules into new, tailor-made configurations or 'task forces'.

Early applications focused on the modular design of products and the implications of modularity on manufacturing processes and product innovation. Modular systems are set against integrated systems. As a rule of thumb, modular systems are more expensive to build/purchase, but are specifically designed to be adaptable (i.e. cheap upgrades and downgrades). Integrated systems are often cheaper to build/purchase initially, but may be prohibitively expensive to adapt. Over its full life cycle, both usability and total costs of a modularly designed system can be far more favourable than of an integrated system. "High modularity costs some design time but pays back well through clarity, elegance, maintainability and flexibility".⁴¹ This, however, has to be set against the synergistic specificity of an integrated system, stemming from the fact that some combinations of components function better together than other configurations.⁴²

Associated concepts strengthen the added value modularity can offer. **Loose coupling** minimizes the dependencies between modules, making the interfaces (technically and functionally) as simple and self-contained as possible.⁴³ This allows the quick assembly of different operational solutions from different combinations of modules. What is required is a good functional decomposition. The concept of Service Oriented Architecture, stemming from the field of software engineering but

³⁸ De Spiegeleire and Bekkers, *Who says generals can't dance: Strategic agility and defence capability options*.

³⁹ For another excellent overview of what flexibility means across different disciplines, see Saleh, Mark, and Jordan, "Flexibility."

⁴⁰ Baldwin and Clark, "Managing in an age of modularity."

⁴¹ mat.sourceforge.net/manual/appendix/glossary.html

⁴² The move from stand-alone software products – e.g. Microsoft Word and Excel - to integrated software packages - Microsoft Office - is a good example of this phenomenon.

⁴³ Loose coupling is evident when elements affect each other "suddenly (rather than continuously), occasionally (rather than constantly), negligibly (rather than significantly), indirectly (rather than directly), and eventually (rather than immediately)" [Weick 1982].

becoming increasingly popular as a paradigm for developing and analyzing complex systems⁴⁴, pursues just that. It approaches a system as a combination of modules that offer a service or implement an application at the request of other modules. Ideally, interactions between modules are managed locally, but SOA recognizes the need of – and offers best practices for - exercising central control to e.g. resolve priority conflicts etc.

When translated to the defence world, modularity and loose coupling suggest a very different type of ‘armed force’ than the ones we are currently accustomed to. In a more genuinely modular and more ‘loosely coupled’ armed force, alignment of behavior along a common goal may become much more difficult – as indeed it has become in the private sector as well. Complex, diversified corporations competing in challenging markets tend to rely on subordinate operating units (or lines of business) not only to carry out strategy but also to provide the prism through which they can assess the likely results, risks, and costs of strategy before embarking on it. Reliance on operating units is a proven way for corporations to maintain oversight without quashing initiative and to marry strategic direction with market-based responsiveness and opportunism. For all the differences between the corporate and defence worlds, reliance on operating units both to analyze and to execute strategy is a common key idea. Indeed, as with other complex enterprises operating in turbulent environments, a NDO needs visibility into operations without micromanaging them; it needs to shape but not dictate how subordinate line organizations respond to conditions; and it needs to know how to align resources to achieve the operating objectives that flow from national strategy⁴⁵.

However, in order to counter the tendency to operate in a dispersed manner, a ‘collective commitment’ to joint objectives is necessary. The need for collective commitments arises from the notion that choices are highly interdependent and cannot be made without considering the impact of a strategy on the operations of individual business units and vice versa. A collective commitment emerges when there is a focus on corporate rather than business-unit issues and the organization fosters mutual dependency among top-level team members. A trade-off has to be made between individual business unit performance and overall organizational performance. This means collective commitments can sometimes have an adverse affect on the former, but the contribution of individual businesses to the corporate value creation logic always needs to be recognized and rewarded. It means fighting intellectual and managerial stovepipes⁴⁶.

To avoid ill-informed choices and fragmented, disjointed decision making, management has to take into account the concerns at multiple levels of the organization, ranging from subunits to the top management. Doz and Kosonen⁴⁷ argue that most high-powered executives rarely have time to engage in in-depth dialogues causing the bandwidth of discussable items to shrink gradually and make the enforcement of collective decision-making harder. However, in order to take care of the numerous strategic and operational integration needs, an organization’s top-level management needs to ensure that each business unit head not only feels responsible for its own division, but also for the performance of other business units. Such an integrated strategy often requires a tremendous shift in the company’s strategic scheme, i.e. its culture and heuristics⁴⁸.

In order to promote mutual dependence, companies can foster engagement among senior executives to grant them responsibility for different stages in the company’s value chain rather than merely a single business unit⁴⁹. By organizing along functional lines, none of the top-level team can function in isolation since it depends on resources that reside in their colleagues’ functional areas. Basically, it forces them to collaborate closely to develop and implement the company’s overall

⁴⁴ For a great introduction to SOA, watch the first 1:48 of <http://video.google.com/videoplay?docid=-2552983384395697940#>.

⁴⁵ Gompert et al., *Analysis of Strategy and Strategies of Analysis*.

⁴⁶ Doz, *Fast strategy*.

⁴⁷ *Ibid.*

⁴⁸ Volberda, *Building the flexible firm*.

⁴⁹ One anonymous reviewer pointed out that 3M has required product divisions to invest a certain percentage of their development resources in other divisions in quest for cross-pollination opportunities.

strategy and to overcome tensions⁵⁰. Another common approach to enhance collective commitment is by designing and assigning distributed leadership roles to top-level managers, i.e. institutionalized job rotation. The purpose is to shift their attention to broader corporate issues in top team meetings and perhaps balance power-distances between executives with different corporate-level roles so as to increase awareness about each other's responsibilities. Constructive dialogues are easier when top team members have an experience-based view on each other's responsibility areas. This process should be further supported by having a corporate-wide agenda that makes executives focus on common challenges and opportunities instead of specific sub unit agendas. Mutual dependency enhances the willingness to make joint commitments and fight against 'management divergence'.

3.3 Ecosystem changes

The more important changes in social technologies might not so much be internal, but external to an organization. This may also prove to be the most challenging – but at the same time also most potentially value-enhancing – change for NDOs. The application of the concept of an 'ecosystem' to a non-ecological environment was first made by James Moore in 1996: "Business ecosystems span a variety of industries. The companies within them coevolve capabilities around [an] innovation and work cooperatively and competitively to support new products, satisfy customer needs, and incorporate the next round of innovation."⁵¹

In the business world, value in post-industrial sectors is increasingly created and extracted not within a company but in a network of diverse relationships. "The metaphor of a "value creating ecology" is developed to describe the operation of the creative industries. This encapsulates three important trends, namely the shift from consumers to co-creators of value; the shift from thinking about product value to thinking about network value; and the shift from thinking about cooperation or competition to thinking about co-opetition (see Table 2)."⁵²

Table 2 Values of strategic elements

Strategy elements	Supply chain	Value Chain	Value Ecology
Customers	Consumers	Consumers	Consumers, suppliers, competitors, etc.,
Environment	Static/stable	Static/stable	Chaotic/uncertain
Focus	Supply side OR demand side, not both	Supply and demand sides	Supply and demand sides
Value creation	Limited emphasis on value creation	Emphasizes a value creation approach which adds value at every node	Emphasizes a holistic approach to value creation throughout the ecosystem
Relationship type	Vertical integration	Timid teaming	Dynamic and evolving
Risk	Low	Medium	High
Profit focus	Increase own profits	Increase own profits	Increase ecosystems profits
Cost focus	Minimize own cost	Optimise own cost	Share cost

⁵⁰ Doz, *Fast strategy*.

⁵¹ Moore, *The death of competition*, 15. For a more recent overview: Moore, "Business ecosystems and the view from the firm."

⁵² Hearn, Roodhouse, and Blakey, "From Value Chain to Value Creating Ecology."

Knowledge leverage	Within the enterprise	Within the enterprise	Across the ecosystem
Knowledge approach	Storing	Hoarding	Sharing
Resource approach	Defending	Guarding	Sharing
Time orientation	Short term	Long term	Long term
Key driver	Cost	Revenue	Knowledge

NDOs are accustomed to thinking of themselves as ‘stars’. Increasingly, however, they too might have to accept the maxim ‘don’t be a star, be a galaxy’⁵³. In times of deep uncertainty being a ‘lone star’ is neither affordable nor wise. Diverse and dynamic security challenges require ‘smart power’: a strategy of for each situation picking the right tool, or combination of tools, out of the full range of instruments of power a state has available – diplomatic, economic, military, political, legal, and cultural. To be able to achieve the level of trust and understanding needed in an effective ‘smart power’ constellation (including the ability to work together seamlessly), established *structural* relationships or even partnerships are a pre-requisite⁵⁴.

Not only in an operational context but also for defence capability development, a relevant network of partners can yield substantial benefits through increased strategic flexibility and adaptivity. In the business world, the concept of organizational inter-firm networks and dynamic partnering activities (as opposed to the first generation partnering: stable mergers & acquisitions) is of growing importance. Drivers are globalization, technology development, changing customer needs and fragmented markets, and the trend towards a knowledge economy. All these drivers also affect the military. In fact, facing an increasingly complex and demanding environment, an ‘integrated solution’ is no longer feasible: it is unlikely that NDOs can master all the key competencies needed in the course of military operations. Collaboration with other organizations in a so-called ‘ecosystem’ is essential to enhance their scope. Economic reasoning also applies: better access to new technology, obtaining economies of scale in joint research & acquisition building complementary skills, sharing risks for activities, etc.

There are different types of ecosystems, both open and closed, different control mechanisms (self-organizing or hierarchical) and different levels of value integration⁵⁵. An open defence ecosystem is based on the idea that the NDO could partner with any other organization or agency as long as it offers products or services meet certain agreed upon standards. A closed ecosystem involves developing and nurturing relations with known partners, to mobilize that network, more comparable with a vertically integrated value chain but with multiple, different partners. This for instance involves optimizing cooperation with specific allied countries, or outsourcing activities to organizations with whom there exists an established relationship. For several reasons, for core capability development, and certainly for system / capability integration, defence organizations prefer relatively closed relationships with strategic partners. These reasons include security of supply, security of sensitive information and relatively long life of type for major weapon platforms. More open networks are preferable for products and services that have a close resemblance to commercial variants. With the influx of civil technology, this category is broadening up.

Let us take a closer look at another sector – and not just any sector but one of the main traditional ‘pillars’ of the industrial age that spawned many of the fundamental social technologies⁵⁶ of the industrial age⁵⁷. but is in the throes of disruptive change right now: the automobile industry. For a

⁵³ Gloor and Cooper, *Coolhunting*.

⁵⁴ Hunter, *Integrating instruments of power and influence*.

⁵⁵ Tapscott and Williams, “Realizing the power of innovation webs.”

⁵⁶ See footnote 6.

⁵⁷ Think of Ford’s Model T and mass production, Taylor’s ‘scientific management’ and his idea of ‘scientific management’ through task-oriented optimization of work tasks – both concepts with immediate parallels in the defence world. The modern multidivisional firm was invented largely in the automobile industry in the first third of the 20th century, was immensely advanced

very long time, this was (just like defence today) a very 'command and control' -type of industry. A recent *Wired* article⁵⁸ nicely illustrates the problems this created for the companies:

"Detroit has long worked with outside suppliers, but the relationship has typically been one-way and often hostile; car companies specify exactly what services they need and how much they'll pay for them.

*Since the 1990s, the Big Three have forced suppliers' prices down so much that many are edging toward bankruptcy. At the same time, the industry has tried to loosen up, outsourcing production to independent firms. However, these efforts have done little to change the underlying dynamic, in which the automakers exert an enormous amount of **control** [emphasis added] over a handful of giant suppliers. None of the big manufacturers have regularly allowed Silicon Valley-style innovators... into the core of their products. Even inside the companies themselves, the industry draws on a narrow well of innovation. Detroit does work with the University of Michigan, an excellent school. But the Big Three pull in few employees from other top colleges. In its insularity, the auto industry is increasingly an outlier. A growing number of firms have adopted what UC Berkeley's Chesbrough dubbed 'open innovation' – accelerating change by letting ideas flow much more freely in and out of companies. Rather than depending primarily on their own engineers, he says, auto companies should leverage the insights of others, outsourcing much or most R&D to an ecosystem of small, agile entities outside the factory walls. Unsurprisingly, open innovation is seen most clearly in firms like IBM, Alcatel-Lucent, and Millennium Pharmaceuticals, but Chesbrough argues that it has been picked up with success by companies in fields ranging from chemicals and packaged goods to lubricants and home-improvement gadgets. "The auto industry is different," he says. "It hasn't learned that no one company or industry has a monopoly on useful ideas." Nobody can say which companies will come up with the inventions that revive the auto industry—Transonic, Fallbrook, any of the other startups, or some company yet to be created.*

A few years ago, a 1978 photo of Microsoft's founders—a dishevelled bunch of geeks—made the email rounds under the subject line "Would you have invested?" No single company could have foreseen or designed the modern computer industry, just as the Big Three cannot predict the eventual shape of the US auto industry. But they can build the ecosystem that allows it to develop."

by Pierre S. du Pont and Alfred P. Sloan, Jr., and written about by their brilliant chronicler Alfred Chandler. The challenge of early 20th century industry was, as Chandler has written, managerial control.* The auto industry was the paradigm of this task, a capital-intensive business with multiyear product cycles, massive retooling for each generation of cars, and a semiskilled labour force of thousands.

⁵⁸ Mann, "Beyond Detroit: On the Road to Recovery, Let the Little Guys Drive."

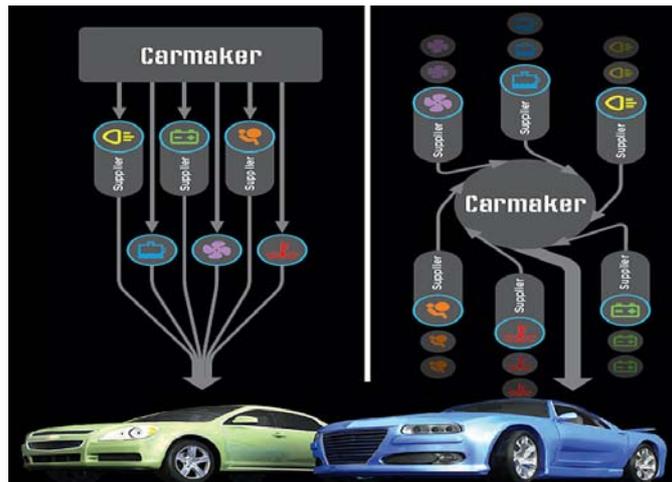


Figure 4 Manufacturing, Retooled

Figure 4 shows on the left the carmakers' old top-down system, which had themselves as 'stars' on top of a R&D and manufacturing chain that was entirely driven from within the company. The Big Three were on top and they designed and manufactured their parts in-house or dictated their design and production to a small group of suppliers.

It is not inconceivable that defence organizations might undergo a similar transformation. They have already gone through a transformation that has seen their main *raison d'être* shift from (collective) territorial defence to expeditionary operations throughout the violence spectrum. Most recent foresight exercises indicate deep uncertainty⁵⁹. This suggests that changes in the very nature and essence of defence.

Whereas previously, many companies typically had the entire 'value chain' (as illustrated on the top of this slide) 'in-house', they now often have more effective, cheaper, but also less 'controllable' supply chain partners that provide the services for them. The owner of the business can no more 'command' these partners than she can control them. How then can she make her business operate in a reliable way without 'owning' some of the key links in her value chain? And can we still talk about 'command and control' in such an environment? Here again, the parallel with the military world may be revealing – even if possible not as extreme as in Figure xx. We already today see that parts of the defence and security 'value chain' are no longer under the direct control of the defence organization. Much of the R&D is currently done outside of the defence organizations (who are having an ever harder time to steer these efforts). Many value chain partners (other nations, consultants, private companies, international organizations, etc.) provide critical elements of the defence value chain. And the relationship with these value chain partners is – again already today – of a radically different nature as the traditional 'command and control' system our defence organizations are so familiar with. Professor N. Venkat *Venkatraman* from Boston University School of Management has argued that this change has led to a new concept of strategic alignment in which direct ownership no longer plays the central role, but in which strategic portfolios of capabilities and relationships do⁶⁰.

⁵⁹ De Spiegeleire and Bekkers, "Deep Uncertainty – Implications for Defence Planning."

⁶⁰ Venkatraman, "Strategy 2.0: Winning in a Network Era."

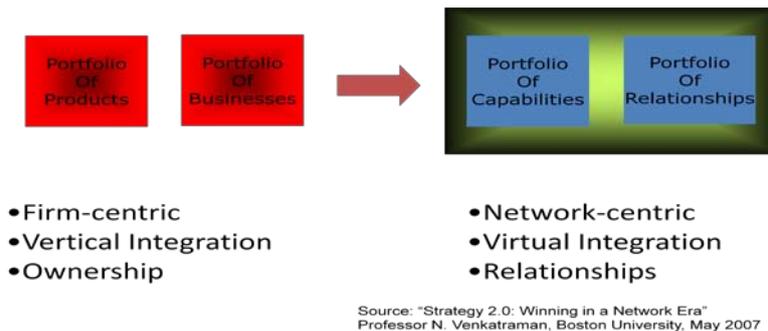


Figure 5 From a portfolio of products and businesses to a portfolio of capabilities and relationships

We surmise a similar trend will become much more dominant in the post-industrial age in the defence world as well.

3.4 Command and control decoupled?

In most walks of life – both public and private – and unlike in the military world, the functions of ‘command’ (decisionmaking, executive management, etc.) and ‘control’ (oversight, audit, ...) are usually separated. In most democratic *political* systems, the executive branch of government is entitled to make executive decisions (‘command’), but these decisions are fiercely ‘controlled’ by various other bodies (leading to adjustments from the executive branch). These include the legislative branch, which demands accountability from the executive and typically has various mechanisms to reign in the executive when it feels it has transgressed its authority, or has made unacceptable mistakes. These also include the judicial branch, which ‘controls’ the congruence of executive decisions with various fundamental ‘rules of the game’ and also often has the opportunity to mandate change through judicial activism. We find back this same separation of the command and control powers in the private sector, where the Chief Executive Officer is (even increasingly) subject to various control mechanisms through which shareholders exercise their rights. In many countries, this control function is exercised on a permanent basis by a supervisory board. At the same time, business ‘commanders’ are also subject to various internal and external control mechanisms – with the latter (accounting firms) gaining increasing strength.

As our recent survey of strategic defence management practices in a number of defence organizations has shown⁶¹, we are witnessing a clear trend towards similar management mechanisms within defence organizations. This is certainly the case at the strategic level, and we suspect that the current financial-economic crisis will only increase the pressures for transparent performance management of all government departments at all levels, including the operational one. The Defence Organizations will not be spared these pressures, requiring an increased division between management and control.

⁶¹ De Spiegeleire et al., *Closing the Loop. Towards Strategic Defence Management*.

4 Discussion: 'C2 That!' – Implications for Post-Industrial Armed Forces

We see three major developments for the armed forces that operate as a driving force in the transformation toward post-industrial concepts of C2:

- The development of ICT (NEC) which facilitates sharing of information and enable direct interaction between partners and associates;
- The change in operational concepts from mass toward small distributed teams and fast results by defeat toward mission specific precision hits and long term safety effects;
- The increased focus on collaboration at all levels of operations with diverse partners in coalition and comprehensive approaches to operations.

Although these developments have to a large extent different origins they interact in catalytic ways. In the development of NEC a gradual development from technological provisions of information sharing to collaboration was foreseen. In one of the iconic models of NEC, the value-chain, the idea was given that robust networks enable of result in better information distribution, information sharing, and collaboration. Also in another iconic model⁶², the 5-level maturity model the underlying idea is that intensive collaboration (with sharing information and planning) represents the highest levels of maturity. The political and societal demands for high levels of collaboration do not expect the military and the partners to wait until the technological provisions are completed. The realisation of comprehensive approach has more to do with the intention of collaboration than of development of technology or institutionalisation. Effective collaboration requires a culture of cooperation and joint planning, execution and evaluation of operational activities. In practice, institutionalization has not led to improved cooperation (Jacobsen, 2008). The idea to force all actors into one organization, system or plan is a control concept that does not fit the reality of diversity of involved parties (MNE5, 2009). These are independent parties in an operational and political context that requires them to operate interdependently. One complexity in this collaboration process is achieving some level of agreement on long term effects, and the uncertainty of what current activities and actions may have on these long term effects. In this context it has to be accepted that may be only on a global level there may be some agreement on high level objectives and purpose.

How do we 'C2 That' with multiple partners diversity of values, while lacking unity of command? As argued earlier the historical roots of the word 'command' suggest shared mandate based on elements of 'commitment' and 'trust' ('shared intent'). The parties form the ecosystem for the military forces, they are interacting and set current requirements of a post-industrial force. To be able to achieve an effective 'smart power' constellation, established relationships or even partnerships to co-create values that reinforce achievement of each other's objectives are a prerequisite.

It is as yet unclear which models of collaboration born out the 'cum-mandere' perspective suit diverse levels of interdependencies in networked C2 – they remain to be developed, studied, and experienced. Systematic monitoring, assessment and analysis of their applications should be performed in order to learn fast and deliberate such that full development of post-industrial force in a modern operations be can achieved.

⁶² NATO RTO Working Groups SAS-065 "NATO Network Enabled Capability (NNEC) C2 Maturity Model." The scientific report of the working group has not been made available (http://www.rta.nato.int/Activity_Meta.asp?Act=SAS-065), but the maturity levels are described in

5 Conclusion

We would like to wrap up this paper by restating the main insights we attempted to convey to our readers:

- **Epochs** (e.g. the industrial age) **matter** enormously to both armed forces and to command and control systems – albeit it in ways that cannot fully be anticipated.
- The current **transition to a post-industrial age is likely to pose some unprecedented challenges to our C2 systems** – ones that we have barely begun to address.
- The (forgotten) **etymological roots of command and control may be of some assistance in navigating the transition** from an industrial to a post-industrial age. They suggest a more consensual ('cum-mandare') and less directive form of command. They also suggest a somewhat different view of control – more in line with the way control is conceived in other areas of public and private life ('contrarotulus').
- **'Armed forces' today may look as different from their future instantiations as from their stone- age counterparts**
- NEC seen as the application of ICT in an operational context builds strongly on traditional command concepts, and is still in the phase of automation and initial experimentation. For NEC to realise its true potential value, it will have to move **from NEC 1.0** (using the physical technologies of the ICT-revolution to obtain desired security effects by enabling the same organization to do the same things better, faster, cheaper,...) **to NEC 2.0** (developing and applying new social technologies to obtain desired security effects by having transformed defense organizations do different things in a network (ecosystem) with other security-providers)
 - **Internally**, future armed forces may prove to be much **more 'modular' and 'loosely coupled'** than today's . This means command and control will have to adapt to this, and will have to find different ways to maintain collective alignment and commitment.
 - **Externally**, future armed forces may have to behave less like 'stars' and more like 'galaxies' with a wide variety of value chain partners that will not be subordinate to (and hence 'controllable' by) the defence organization. Exercising command and control over such a 'galaxy' will undoubtedly require other mechanisms – more likely to be based on relationships and contracts than on 'commands' as currently understood.
- There is an overall trend towards 'softer' and more diverse views of C2 which is better able to address the collective approach of diverse partners. Focus should be on establishing unity of purpose and develop that into unity of effort. This fits easily the original meanings of the words command ('cum-mandare').
- The broadening of the role of diverse partners in missions and the (societal) need for independent views on progress brings forward the requirement that the functions of **command and control may once again have to be segregated from each other** – as they are in many other walks of life.

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