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**The Defence Industry in the Post-Transformational World:
Implications for the United States and Singapore**

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ABSTRACT

The transformation of the U.S. armed forces was initially promoted as nothing less than a fundamental shift in the way wars would be fought in the future. Such far-reaching and ambitious aims naturally implied significant changes for the U.S. defence industrial base. In particular, would new requirements for network-centric warfare undermine the long-standing predominance of the U.S. military's traditional suppliers and thereby shift defence work in favour of a new cadre of firms, particularly those drawn from the commercial information technologies (IT) sector? Would specialized "boutique firms" and foreign suppliers find a stronger niche in the transformed U.S. defence industrial environment?

In fact, given that unfolding U.S. defence transformation efforts resembles more a process of sustaining rather than disruptive, innovation and change, the impact on the defence industry has been slight. Large, traditionally defence-oriented firms continue to dominate U.S. defence contracting. Interestingly, commercial IT firms are not becoming directly involved in defence work, tending to act mainly as subcontractors to traditional defence companies. As the U.S. defence contracting business remains largely unchanged, the role of foreign firms in this process will also remain limited, and overseas defence companies, in Singapore and elsewhere, will continue to find it a challenge to penetrate the U.S. defence market.

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The Defence Industry in the Post-Transformational World: Implications for the United States and Singapore

The belief that modern militaries are on the cusp of a “revolution in military affairs” (RMA), driven in particular by recent advances in information technologies (IT), has long been an increasingly powerful and persuasive school of military thought.¹ For more than a decade, in fact, it has been fashionable—almost obligatory, in fact—to acknowledge the so-called IT-RMA when talking about the future of warfare and war-fighting. Consequently, the idea that armed forces must be “transformed” along the lines of the IT-RMA and other technological breakthroughs has taken particular hold in the minds of many leading proponents of military reform.

Nowhere was this commitment to defence transformation more pervasive than within the U.S. Department of Defense (DoD) under Secretary Donald Rumsfeld from 2001 to 2006. Under his stewardship, transformation became the guiding principle of the U.S. military. Terms such as “information superiority,” “situational awareness,” “network-centric warfare,” “precision-strike,” “deployability,” “flexibility,” and “jointness” were given increasing credence in Rumsfeld’s Defense Department, and the belief in the power of defence transformation to bring about a dramatic expansion in the capabilities and effectiveness of the U.S. military became almost an article of faith.

The transformation of the U.S. armed forces was initially promoted as nothing less than a fundamental shift in the way wars would be fought in the future. Nothing was sacred: every piece of defence dogma was on the table for debate and discussion—force structure, organization, equipment, budgets, doctrine, and strategy. As such, defence transformation was to be a process of unsettling, even bewildering, change, but the end result was supposed to be a U.S. military capable of wringing the maximum amount of effectiveness from the tools it was given, and which would cement the ascendancy of U.S. military power for the next several decades.

Such far-reaching and ambitious aims implied significant changes for the U.S. defence industrial base. How would it function in an environment that called for such sweeping changes in military force structure, doctrine and strategy? What new technologies and systems would it be expected to provide a transformed U.S. military, and how would it supply these? Would new suppliers arise and old ones fall? Would the U.S. military-

¹ An earlier version of this paper was presented to the Swedish National Defence Research Agency in October 2007.

industrial complex—forged in the Second World War and solidified during the Cold War—have to transform itself as well?

This paper will address the current state of affairs within the U.S. military when it comes to defence transformation, starting with its founding precepts and its conceptualization under Rumsfeld, proceeding through successes and failures in implementation, and, finally, its present state. It will then address how developments in U.S. defence transformation may affect the U.S. defence industry. Finally, the paper will conclude with a discussion of possible implications for Singapore’s defence industry.

What Do We Mean By Defence Transformation?

Defence (or military) transformation has preoccupied the U.S. Defense Department ever since the Bush administration came into office in early 2001. Secretary of Defense Rumsfeld made overhauling the U.S. military and reorienting U.S. armed forces—in terms of operations, capabilities, strategy, organization, and global posture—a paramount objective in light of new twenty-first century security threats arising from terrorist non-state actors, adversarial states armed with weapons of mass destruction, and the potential rise of “peer competitors,” such as China.²

At the same time, defence transformation has remained an ambiguous and elusive concept. No strong consensus has ever existed as to what “defence transformation” exactly means or entails. According to the Defense Department’s now-defunct Office of Force Transformation (OFT)—which under Rumsfeld was the Pentagon’s leading internal body for thinking about and implementing transformation—“defence transformation” was defined as

a process that shapes the changing nature of military competition and cooperation through new combinations of concepts, capabilities, people, and organizations that exploit our nation’s advantages and protect against our asymmetric vulnerabilities to sustain our strategic position, which helps under peace and stability in the world.³

This definition, however, still left much to be desired as a roadmap for understanding what such transformation entails in a practical sense and why it is a critical process. Consequently, many analysts and proponents of transformation came to view it as simply another name for

² U.S. Department of Defense, Office of the Secretary of Defense, *Quadrennial Defense Review Report* (pp. 19–39). Washington, DC: Office of the Secretary of Defense, 6 February 2006.

³ U.S. Department of Defense, Office of Force Transformation (OFT), *Elements of Defense Transformation* (p. 2). Washington, DC: Office of the Secretary of Defense, October 2004.

the so-called “revolution in military affairs.” Certainly the two terms are used increasingly interchangeably. But what, then, do we mean by the RMA, and what in particular does the *current* RMA stand for? Furthermore, is defence transformation merely the process of implementing an RMA, or does it entail other objectives and processes?

Above all, in the minds of its proponents and advocates, the defence transformation/RMA model is necessarily a process of *discontinuous*, *disruptive*, and *revolutionary* change. Andrew Krepinevich, for example, argues that a revolution in military affairs occurs when

the application of new technologies into a significant number of military systems combines with innovative operational concepts and organizational adaptation in a way that fundamentally alters the character and conduct of a conflict. It does so by producing a dramatic increase...in the combat potential and military effectiveness of armed forces.⁴

In short, defence transformation was nothing less than a “paradigm shift” in the manner in which U.S. armed forces will conduct future warfare operations. As OFT put it:

In the process of transforming the way that we fight, we should emerge with a force that is more *expeditionary*, *agile and lethal* than the present force and more capable of employing *operational manoeuvre and precision effects* capabilities to achieve victory. The battlespace is expected to be a more dispersed one, within which our forces will conduct non-contiguous, mutually supporting operations. These operations will seamlessly tie in other government agencies, as well as multinational partners...⁵

Transformation was also an *effects-* and *capabilities-based* approach. Effects-based operations (EBO) implied a shift away from “traditional” attrition-based warfare in favour of attacking the enemy so as to achieve certain political-military results, e.g. his willingness to fight. The emphasis on capabilities meant adopting a defence strategy based less on fixed threat scenarios than on the anticipated capabilities of a likely adversary and, in turn, on the required capabilities of U.S. forces needed to deter or defeat such an enemy. As such, transformation was about achieving capabilities and effects, and no longer about sheer numbers.

⁴ Andrew Krepinevich, “From Cavalry to Computer: The Pattern of Military Revolutions”. *The National Interest* (p. 30), Fall 1994,.

⁵ OFT, *Elements of Defense Transformation*, p. 8 (emphasis in the original).

In general, as the U.S. military sought to transform itself, it emphasized acquiring the following capabilities:

- A highly networked organism of command, control, communications, computing, intelligence, surveillance, and reconnaissance (C4ISR) systems, weapons and platforms
- Improved, shared situational awareness, both of the immediate battlespace and beyond
- More accurate, stand-off engagement capacity
- Greater speed, agility, rapid deployability, and flexibility
- Jointness and interoperability⁶

In this regard, the current U.S. transformational/RMA model was inexorably linked to the emerging notions of *network-centric warfare* (NCW), sometimes also referred to as “network-enabled capabilities” or “network-based defence”—the operative word, of course, being “networked.” According to the NCW concepts, the ongoing revolution in information technologies (IT) has made possible significant innovation and improvement in the fields of sensors, seekers, data management, computing and communications, automation, range and precision. Correspondingly, NCW seeks to exploit these breakthroughs in information technology in order to achieve exponential improvements in battlefield knowledge, connectivity and response. Network-centric warfare, according to OFT,

generates increased combat power by networking sensors, decision makers and shooters to achieve shared awareness, increased speed of command, high tempo of operations, greater lethality, increased survivability and a degree of self-synchronization.⁷

Moreover, NCW is about the “linking of people, platforms, weapons, sensors and decision aids into a single network” that “creates a whole that is clearly greater than the sum of its parts”, resulting in “networked forces that operate with increased speed and synchronization and are capable of achieving massed effects...”.⁸ In other words, defence transformation was also intended to be *synergistic* and *holistic*, as it entailed the integration and employment of C4ISR systems, platforms, and weapons (particularly smart munitions) in ways that increase

⁶ Andrew Ross, “Transformation: What is it? What Does it Mean for the Defense Industry”. Powerpoint briefing presented at the conference on “Defense Transformation in the Asia-Pacific: Meeting the Challenge” (p. 2), 30 March–1 April 2004, Honolulu, Hawaii.

⁷ U.S. Department of Defense, Office of Defense Transformation, *Network-Centric Warfare: Creating a Decisive Warfighting Advantage* Washington, (p. 2). Washington DC: U.S. Department of Defense, 2003.

⁸ OFT, *Elements of Defense Transformation*, p. 8.

their effectiveness and capabilities beyond their individual sets. This bundling together is reminiscent of Admiral William Owens's "system of systems" concept, in that it entails the linking together of several types of discrete and even disparate systems across a broad geographical, inter-service and electronic spectrum in order to create new core competencies in war-fighting.

The U.S. defence transformational model implied more a simple overlay of new technologies and new hardware over existing force structures; it required fundamental changes in military doctrine, operations and organization. Hardware and technology are obviously crucial and primary components when it comes to transformation—they are, in fact, the fundamental building blocks in a modern, IT-based RMA centred on network-centric warfare and reconnaissance-strike complexes. Transformation is not supposed to be just a techno-fix, however. Rather, it entails a fundamental change in the way a military does its business—doctrinally, organizationally and institutionally. Defence transformation, therefore, also requires advanced systems integration skills to knit together disparate military systems into complex operational networks. Finally, it demands elemental changes in the ways militaries procure critical military equipment, and reform of the national and defence technological and industrial bases that contribute to development and production of transformational systems. All this, in turn, requires vision and leadership at the top in order to develop the basic concepts of defence transformation, establish the crucial institutional and political momentum for implementing transformation, and allocate the financial resources and human capital necessary for the task of implementation. Obviously, therefore, defence transformation entailed much more than the "mere" modernization of one's armed forces.

Beyond Models and Concepts: Implementing Transformation

Overall, defence transformation presented a picture of a new U.S. military that is (1) more operationally flexible and agile; (2) more mobile, more expeditionary, and more rapidly deployable; and (3) more capable of dealing with global as well as regional contingencies. In other words, the U.S. military seeks to fight "mobile high-tech wars", mostly by substituting speed for mass, and information for armour.

This new operational concept is already apparent in some of the U.S. military's current and projected restructuring and procurement plans. The U.S. Army, for instance, is reorganizing its force structure, de-emphasizing larger, more static division-sized forces in favour of new modular brigades—in particular, the Brigade Combat Team (BCT, sometimes

referred to as a Brigade Unit of Action), a lighter, more deployable, more flexible, and more independently operational brigade force. Some of these BCTs will be supported by a dedicated, integrated reconnaissance battalion, equipped with unmanned aerial vehicles (UAVs) and other sensors, capable of providing the BCT with an integral intelligence-gathering capability. The first BCTs are being initially outfitted with the Stryker light armoured vehicle, which will subsequently be replaced by the Future Combat System (FCS), a US\$160 billion programme to develop a fleet of eighteen different versions of a single type of modularized light combat vehicle, which in turn will be linked together by a communications systems capable of providing real-time intelligence, command and control to troops on the move. The U.S. Army plans to restructure into 70 BCTs (including 28 Army National Guard BCTs) and 211 support brigades (75 Regular Army, 78 National Guard, and 58 Army Reserve).

At the same time, the other services are planning their own transformations. The U.S. Navy is expanding its close-to-the-shore combat capability with the planned procurement of 55 Littoral Combat Ships, as well as building a new class of Maritime Prepositioning ships to aid in the rapid deployability of ground forces. The Air Force considers its two next-generation fighters—the F/A-22 and the F-35 Joint Strike Fighter (JSF), both of which will be armed with advanced precision-guided munitions (PGMs), such as the Joint Direct Attack Munition (JDAM)—to be transformational systems, along with the long-term development of an unmanned combat aerial vehicle (UCAV).

More important to the process of transforming the U.S. armed forces, however, is the implementation of “net-centricity,” at the heart of which is the creation of the Global Information Grid (GIG). The GIG is a globally-connected constellation of systems and capabilities for collecting, processing, storing, disseminating, managing and sharing information within the U.S. military and with other partners. The GIG is actually a collection of several different NCW programmes, including the Transformation Satellite communication system, the Joint Tactical Radio System (which will be the backbone of the FCS communication system, providing real-time, “on-the-move” voice, data and video), and the Bandwidth Expansion Project (and, of course, the software, to tie it all together). Net-centricity, therefore, is fundamental to shifting from a service-based information-sharing culture to one that is joint and interoperable not only across the entire spectrum of the U.S. military, but also with other federal and local security-related and law enforcement authorities, and even foreign partners.

Implementing Transformation: Implications for Defence Industry

A transformed military would have important implications for those industrial sectors that will supply the armed forces with the means it needs to carry out its missions. Transformation advocates argued that the U.S. defence industrial base would have to undergo its own revolution. For example, in early 2003, the Office of the Under Secretary of Defense for Industrial Policy (OUSD/IP) published a study, entitled *Transforming the Defense Industrial Base: A Roadmap*, which laid out several recommendations for aligning U.S. defence industrial policy in accordance with Rumsfeld's transformational vision. This document recommended that the Defense Department treat the *national* industrial base (both civilian and defence-specific) as a cluster of "effects-based sectors"—such as combat support, power projection, precision engagement, etc.—that could support defence transformation. OUSD/IP also proposed that acquisition decision-making be reorganized around operational effects and *not* "programmes, platforms, or weapons systems".⁹ In particular, the report recommended that the Defense Department strive to identify new sources of industrial-technological innovation amongst small or non-traditional firms that often do not supply directly to the Defense Department.¹⁰

In particular, transformation was seen as having the *potential* to affect the defence industry in a number of ways:

- ***Shifting defence work from suppliers of legacy systems to suppliers of transformational systems.*** Firms that provide the military with systems or services that support defence transformation could profit at the expense of firms that supply only (or mainly) non-transformational products, particularly so-called legacy platforms, such as heavy armoured vehicles or unguided weapons.
- ***Shifting defence work in favour of firms that undertake large-scale systems integration work on behalf of the military.*** Many large-scale transformation projects have entailed the use of firms acting as "lead systems integrators" (LSIs). LSIs manage very large, complicated acquisition programmes that require amalgamating several disparate pieces of military hardware (and, increasingly, software) into a single functioning "system of systems". LSIs have become increasingly instrumental for managing large multiplatform systems, such as the Future Combat System (Boeing/SAIC) or the U.S. Coast Guard's Deepwater programme (Lockheed

⁹ Office of the Under Secretary of Defense for Industrial Policy (OUSD/IP), *Transforming the Defense Industrial Base: A Roadmap* (p. 2). Washington, DC: Department of Defense, February 2003.

¹⁰ Ibid, pp. 13–15.

Martin/Northrop Grumman).¹¹ As LSIs, these firms are given considerable authority to create, design, and execute a comprehensive solution to a pressing military need, including hiring and overseeing subcontractors, managing costs and schedules, and even setting requirements.

- ***Shifting defence work from large megafirms to smaller, specialized suppliers.*** Small, “boutique” defence contractors, providing highly-specialized systems or services, could be more nimble and responsive to the needs of a transformed armed force, particularly when it comes to NCW solutions. Large, traditional defence firms, because they are more oriented toward large-scale weapons programmes, may actually lack the manpower skills to engage in certain kinds of esoteric innovation.
- ***Opening up more defence work to specialized foreign firms.*** As a corollary to the last point, foreign firms that can provide esoteric transformational technologies *not found* in the U.S. defence industrial base could find a more receptive audience in a transformed U.S. military. For example, one of the U.S. Navy’s prototypes for the Littoral Combat Ship (LCS) utilizes a unique Australian-supplied trimaran hull.
- ***Shifting defence work toward suppliers of dual-use commercial systems.*** If commercial off-the-shelf (COTS) technologies—particularly information technologies—are truly destined to fundamentally alter the prosecution of future warfare, then non-traditional defence contractors who can engage in civil-military integration (CMI) could become more critical suppliers to the military. In particular, companies such as Microsoft, Sun, and Cisco could benefit at the expense of traditional defence firms.¹²

The Uncertain Future of U.S. Defence Transformation

The current information technologies-led RMA and the subsequent process of defence transformation is, for many, a defining moment in the character and conduct of modern warfare. The IT-RMA entails the combination of new technologies and innovative operational and organizational concepts that are supposed to fundamentally alter the way one

¹¹ Deepwater is a multifaceted programme to outfit the U.S. Coast Guard with new surface vessels, helicopters, patrol aircraft and UAVs, and to link their operations with a state-of-the-art C4ISR network in a system-of-systems approach.

¹² See Ronald O’Rourke, *Defense Transformation: Background and Oversight Issues for Congress* (pp. 14–15) Washington, DC: Congressional Research Service, 9 November 2006; Peter J. Dombrowski and Andrew L. Ross, “Transforming the Navy: Punching the Feather Bed?” *Naval War College Review*, Summer 2003; OUSD/IP, *Transforming the Defense Industrial Base: A Roadmap*.

thinks about war and war-fighting. Certainly, the IT-RMA has the potential to be truly revolutionary in its impact on the future of the U.S. military and how it conducts military operations.

At the same time, there may be less than meets the eye still when it comes to U.S. defence transformation. New capabilities and requirements have promised to make defence transformation truly revolutionary in its impact on the future of the U.S. military, how it conducts military operations, and how it will interact with allies and potential partners. And yet, in the post-Rumsfeld Defense Department it is not at all certain that transformation will be as far-reaching a solution as originally envisioned or intended.

In the first place, U.S. force transformation is perhaps not nearly as radical or as comprehensive as many proponents of the RMA would prefer. To quote two sceptics of transformation:

Transformation's champions call for more than the standard issue evolutionary technological, doctrinal, or organizational advances. They promise discontinuous, disruptive innovation. However, the U.S. transformation enterprise thus far falls short of the hype. Joint and service plans and programmes have yet to match up to transformation visions. While the visions promise discontinuity and disruption, plans and programmes support only incremental, sustaining advances. Generation-skipping technologies are few and far between. Few modernization programmes that offer merely improved versions of existing capabilities have been abandoned in favor of transformational programmes; legacy programmes rule. Doctrine development has been more linear than nonlinear. Organizational change features evolution and adaptation rather than re-creation and even restructuring. Unless the gap between visions and plans and programmes can be bridged, transformation is fated to be little more than routine modernization. At best, it will amount to "modernization plus".¹³

In addition, while defence transformation is not simply supposed to be a techno-fix overlaid on top of an existing force structure and defence doctrine, the U.S. military still appears be infatuated with technology for its own sake. Defence transformation's strength is supposed to lie in its ability to span "the realm of ideas, innovation and technology", and yet there is still

¹³ Peter Dombrowski and Andrew Ross, "Military Transformation and the Defense Industry" (p. 11). Paper presented at the conference on "State of the Art in the Global Defense Industry: Implications for the RMA", 1–2 November 2007, Singapore.

a widespread tendency among the U.S. military toward “techno-faddism”—viewing technology as the central and most critical factor in transformation. At the same time, the U.S. military also appears to be still wedded to “canonical weapons platforms”—tanks, fighter jets, large surface combatants, etc. Despite everything, warfare is still basically seen as platform-centric.¹⁴

Moreover, as current operations in Afghanistan and Iraq have demonstrated, transformative technologies may be ill suited for certain missions, for instance, against low-level threats such as terrorism or counter-insurgencies. In particular, substituting information for armour or for mass may not always be the wisest course of action. As post-war operations against insurgents in Iraq have demonstrated, small, lightly armoured units operating in areas where information concerning the adversary’s whereabouts or strengths is imperfect or changing rapidly have found that a little extra protection can be lifesaving.

As a corollary, an adversary may also try to defeat a transformed, high-tech conventional force by pursuing a variety of offsetting asymmetric responses. These include engaging in low-intensity insurgency and guerrilla tactics, emphasizing WMD capabilities (particularly nuclear weapons and ballistic missile delivery systems), or pursuing offensive information warfare (to blind and disrupt an armed force heavily dependent upon C4ISR and other network-centric systems).

Finally, the current process of defence transformation is complicated by the fact that the U.S. Defense Department remains overly ambiguous as to its own vision of transformation and how precisely to implement it. Too often, those who were charged with thinking about defence transformation failed to bridge the gap between their ideas and those in the military who must implement transformation in a practical sense. For example, the Office of Force Transformation (which has since been disbanded) typically described transformation as a “continuous process”, with “no definite end state in mind”, but this does little to help war planners.¹⁵ As three serving U.S. Army officers point out:

While [force transformation is] clearly an ongoing procedure, the lack of precisely defined waypoints, operating parameters, a bounded and developed transformational concept for joint operations, or disciplined programmatics

¹⁴ Edward N. Luttwak, “Breaking the Bank: Why Weapons are so Expensive”. *The American Interest* (p. 51), September/October 2007.

¹⁵ OFT, *Military Transformation: A Strategic Approach*, p. 8.

means that service and joint planner cannot easily prioritize programmes and resources to satisfy what remains an ambiguous agenda.¹⁶

Consequently, defence transformation is still a “somewhat elliptically” defined process, and, to their own ultimate disadvantage, the prophets and advocates of transformation have done a poor job delineating their conceptualization of what transformation is supposed to be operationally and organizationally. These efforts are not helped by the fact that most advocates of transformation are still being informed by highly abstract vision of the RMA. Translating the RMA into defence transformation will be a difficult, if not unattainable task, so long as we still lack good definitions of what is meant by “disruptive” innovation, or how we will know when we have truly arrived at a “paradigm shift” that “fundamentally alters” the character and conduct of warfare.¹⁷

This is not to say that many of the ideas behind the IT-led RMA are no longer relevant, or, in particular, that network-centric warfare and new reconnaissance-strike systems will not make a significant contribution to future military capabilities and effectiveness and perhaps, in the long run, truly alter the warfare and war-fighting. But it is legitimate to question whether we are really in a “revolutionary” state, or whether it is even valid to speak of a revolutionary process of change.¹⁸ Force transformation, as it is currently being implemented by the U.S. Defense Department, is not nearly as radical or as comprehensive as many proponents of the RMA would prefer. Current transformational activities may be noteworthy, but they are still more indicative of a process of *sustaining* and *evolutionary* change, rather than disruptive, revolutionary change.¹⁹

Implications of the Post-Transformation Era for the U.S. Defence Industry

So if defence transformation is “dead”—that is, if we are simply in a process of “modernization-plus”, i.e. of sustaining technological innovation and evolutionary advances in the process of warfare—how does that affect the defence industry? In fact, probably very little. Technology, and therefore military platforms, is hardly going to go away as a crucial force multiplier—after all, the sad fact of war is that it is intended to *kill* the enemy, and

¹⁶ Richard D. Hooker, Jr., H.R. McMaster and Dave Grey, “Getting Transformation Right”. *Joint Forces Quarterly*, No. 38, p. 21 (July 2005).

¹⁷ For an excellent discussion of the lack of intellectual rigor often found in transformational arguments, see William F. Owen, “Are We That Stupid?” Paper presented at the “Land Warfare Conference 2007”, Adelaide, October 2007.

¹⁸ See “Brains, Not Bullets”, *The Economist* (p. 15), 27 October 2007.

¹⁹ See Dombrowski and Ross, “Transforming the Navy: Punching the Feather Bed?”

therefore weapons, especially high-tech systems, will continue to be valued by war-fighters. By now, almost all armed forces recognize the value of high technology when it comes to increasing military effectiveness. One does not need to believe in the RMA or military transformation in order to appreciate the importance of precision-guided weapons, fourth-generation-plus fighter jets, submarines, unmanned aerial vehicles, satellites, missile defences and so on. Such technological developments are critical to providing important increases in the lethality, accuracy, and stand-off capability of modern firepower, in improving battlespace knowledge and command and control, in enhancing force projection, and in expanding operational manoeuvre, speed and stealth.

If warfare remains overwhelmingly platform-centric, therefore, then the U.S. military will likely continue to rely heavily on traditional defence firms as prime contractors when it comes to designing, developing, and manufacturing future weapons systems. The large defence companies that currently comprise much of the U.S. defence sector—Lockheed Martin, Boeing, Northrop Grumman, Raytheon, General Dynamics, etc.—are “quite up to the task of supporting” the apparently modest modernization-plus process of transformation that is going on within the U.S. military.²⁰ In fact, they may be *better* suited than non-traditional suppliers at providing the kind of sustaining innovation that the U.S. Defense Department seems to desire, since they are well-acquainted with the unique needs of its customer base, how to translate those requirements into tangible military programmes, and how to weave their way through the Defense Department’s often Byzantine acquisition process.

In fact, the large “defence-dominant” firm—that is, a company whose business activities are overwhelmingly in defence prime contracting²¹—is hardly going the way of the dodo, and we see this over and over again when we examine many so-called “transformational” programmes currently underway. The U.S. Army’s Future Combat System, for example, is being run by Boeing and SAIC, one the country’s second largest defence contractor, the other a heavily defence-dependent systems integration shop; leading subcontractors to the FCS programme include United Defense, General Dynamics Land Systems, TRW, and Hughes—all significant players in the defence sector. The two competing teams for the U.S. Navy’s Littoral Combat Ship are led by Lockheed Martin and Northrop Grumman, while the traditional shipbuilders Bath Iron Works (owned by General

²⁰ Dombrowski and Ross, “Military Transformation and the Defense Industry” (p. 20).

²¹ For example, in 2006, Lockheed Martin, the largest U.S. defence contractor, derived 91 per cent of its revenues from defence work; Northrop Grumman received 78 per cent of its income from defence, Raytheon, 96 per cent, and General Dynamics, 78 per cent. Even highly diversified Boeing relied on defence work for half of its income in 2006. See *Defense News Top 100 Defense Companies* (www.defencenews.com/index.php?S=07top100).

Dynamics) and Litton Ingalls (owned by Northrop Grumman) are slogging it out for the DDG-1000 next-generation destroyer programme.

If anything, the defence-oriented megafirm is becoming more crucial in the U.S. defence sector, due to the extensive process of defence industrial consolidation that took place during the 1990s. As a result, most of the largest U.S. defence firms are broad-based enough to contain in-house many of the technologies and skill sets necessary to design and develop next-generation military systems. Where they are not, they generally know with whom to partner in order to gain access to those technologies and skills—and, in fact, teaming has become a nearly inescapable part of large-scale military programmes (e.g. FCS, the Joint Strike Fighter, and the DDG-1000).

At the same time, the future of the lead systems integrator concept is increasingly doubtful. LSIs required large firms with manifold expertise and considerable engineering and management capabilities, and these are still most often found in the defence industrial sector. This tended to benefit large firms already present in the defence contracting system, such as Boeing, Lockheed Martin, or Northrop Grumman. However, the LSI approach has been greatly undermined by its own failure to effectively manage large-scale programmes. The Future Combat System, for example, has more than doubled in price while a number of originally planned-for capabilities were jettisoned as “technologically unfeasible, fiscally unaffordable, or both”.²² The Littoral Combat Ship (LCS) and the Coast Guard’s Deepwater programme, two other LSI-led programmes, have both experienced significant cost growth, while performance targets were unfulfilled; in the case of the LCS, three of the first six ships were cancelled and the programme was restructured. In late 2007, the U.S. Congress voted to end the LSI system altogether.²³

For their part, small and foreign firms will likely find the potential to play a part in large mega-programmes as second- and third-tier suppliers of critical niche technologies and systems that can then be integrated in these larger programmes (e.g. the trimaran hull for the Littoral Combat Ship, built by Austal of Australia). At the same time, many small, start-up firms will find their future in defence production mainly as junior partners teamed with established defence primes, who then do the heavy lifting of systems integration and contracting.²⁴

²² William Matthews, “An End to Lead Systems Integrators”. *Defense News*, 10 December 2007.

²³ Matthews, “An End to Lead Systems Integrators”.

²⁴ Dombrowski and Ross, for example, relate the experience of Insitu, a small startup company that developed a small, low-cost, long-endurance UAV, which Boeing subsequently marketed the

While warfare is likely to remain more or less platform-centric, it will nevertheless certainly be more *network-enabled*. As with other aspects of high-tech warfare, the benefits of improved C4ISR to future war-fighting are self-evident. Networking remains a critical force multiplier, and consequently militaries will obviously find growing value in such things as new or better sensors for battlespace intelligence, improved data-management and data-distribution capabilities, upgraded command and control systems, etc.

Again, however, defence-dominant firms will likely be critical to this process of integrating networks with platforms. It has been argued that traditional defence contractors are well-positioned to deliver specialized IT solutions to the U.S. military, as they already have an intimate familiarity with C4ISR requirements, technologies and architectures, and they already possess, either in-house or through links to specialized subcontractors, the necessary skills to execute such integration. For example, most leading defence primes are members of the Network Centric Operations Industry Consortium, and Lockheed Martin operates a Center for Innovation that is focused on network-centric solutions for defence.²⁵ In addition, the U.S. defence industrial sector already possesses a number of “dedicated systems integration houses”, such as the Aerospace Corporation, MITRE, and SAIC, that can contribute to network-enabled warfare.²⁶

On the other hand, commercial IT firms may be less likely than one would think to make a significant contribution to DoD networking solutions. According to Dombrowski, Gholz, and Ross, “leading commercial IT firms are unlikely to be as responsive as the established defence industrial suppliers to the military’s technical and investment demands.” Such companies, they state, “are happy to sell [off-the-shelf products] to military customers”, but “the prospect of a DoD contract may not be worth enough to...justify much effort to customize a commercial product” for a military end-user.²⁷ At the very most, therefore, commercial IT firms are likely to serve as second- or third-tier players in the U.S. defence industrial base, supplying components or COTS technologies to prime contractors, who will then adapt and integrate these systems into military architectures.

programme on their behalf to military customers. See Dombrowski and Ross, “Military Transformation and the Defense Industry” (pp. 22–23).

²⁵ See <http://www.ncioc.org> and www.lockheedmartin.com.

²⁶ Peter J. Dombrowski, Eugene Gholz, and Andrew L. Ross, “Selling Military Transformation: The Defense Industry and Innovation”, *Orbis*, Summer 2002, p. 533; Dombrowski and Ross, “Military Transformation and the Defense Industry”, p. 23. To reiterate, SAIC is partnered with Boeing on the Future Combat System and is providing the programme’s network-centric systems architecture.

²⁷ Dombrowski, Gholz, and Ross, “Selling Military Transformation”, pp. 532–533.

Conclusions: Implications for Singapore's Defence Industry

Overall, defence transformation—particularly the watered-down version that appears to be ascendant within the U.S. military—will be “less disruptive for industry” than many had once assumed.²⁸ If we are in a situation of platform-centric but *network-enhanced* warfare, then it could be said that it is simply business as usual for the defence industrial base. Certainly nothing ever came of the Under Secretary of Defense for Industrial Policy's ambitious *Roadmap* for shaking-up and reorienting the U.S. defence industrial base, as there has basically been no *military* need to do so.

Consequently, when we refer back to the bulleted points made on pages 8-9, we discover that very little has actually changed (or is likely to change) in the U.S. defence industrial base. Defence work has *not* shifted dramatically away from large defence primes to non-traditional suppliers, small firms, or providers of dual-use systems. Rather, the traditional suppliers have adapted themselves to a slightly changing (i.e. sustaining innovation-type) production system. In this regard, the emergence of the lead systems integrator system is particularly noteworthy. Overall, however, as Dombrowski and Gholz note:

Contrary to the expectations of transformation theorists, many military officers, and most high-ranking officials within the Department of Defense...transformative weapons and supporting technologies will come, with a few noteworthy exceptions, from the same firms that have been supplying the nation's military needs since the end of the Second World War.²⁹

So what does all this mean for small arms-producing countries like Singapore? In the first place, directly selling to the U.S. defence market will remain a challenge for overseas defence companies. Foreign defence firms, in general, will continue to find it difficult to penetrate the U.S. market, with the possible exception of Britain's BAE Systems, which has established a sizable industrial footprint in the United States (mainly through acquisitions). As in the past, most successes in selling to the U.S. military will likely come in the form of partnering with U.S. defence primes, in which the foreign firm is able to supply some kind of specialized niche technology or capability, or possibly licensing the manufacture of foreign-

²⁸ Dombrowski, Gholz, and Ross, “Selling Military Transformation”, p. 534.

²⁹ Peter J. Dombrowski and Eugene Gholz, *Buying Military Transformation: Technological Innovation and the Defense Industry* (pp. xii–xiii). New York: Columbia University Press, 2006.

designed military systems.³⁰ Even then, foreign firms will have to contend with U.S. export and technology transfer restrictions and continuing American resistance (in Congress, in the Executive Branch, and among the general public) to opening up the U.S. defence industry to foreign contractors. In addition, finding opportunities for licensing out the production of foreign-designed armaments will continue to be an exasperating uphill battle, particularly in the face of the U.S. military's traditional reluctance to embrace "not-invented-here" products.

Flagging U.S. interest in defence transformation may also sap support in Singapore and elsewhere for pursuing its own revolution in military affairs. The waning of the U.S. intellectual and programmatic vanguard in such areas as network-centric warfare, other nations may reassess their own commitments to transforming their militaries along the lines of the IT-RMA. While it is doubtful whether a U.S. failure to press transformation would undermine ongoing work in Singapore on network-based defences, or affect such programmes as the Singapore Armed Forces' Integrated Knowledge-based Command and Control (IKC2) system, it could take the wind out of the sails when it comes to more far-reaching transformation.

Overall, U.S. defence transformation, even if imperfect and less "revolutionary" than originally intended, may still have considerable implications for the future nature and conduct of warfare, and this in turn will likely have considerable impact on militaries around the world. Efforts to modernize the U.S. military along the lines of network-enabled warfare, to make it more expeditionary and more strategically flexible and still be able to deliver considerable firepower, to refocus its overseas force structure and basing from providing for local static defences to a posture geared toward rapidly deployable forces capable of engaging adversaries both regionally and in other parts of the world—all of these developments will resonate throughout the world, and even limited changes could have significant consequences. U.S. defence transformation will affect a number of critical regional security concerns around, particularly when it comes to interoperability with allies and friendly nations, regional security considerations, and local force modernization activities. While the defence industrial landscape will change much less, there will certainly be some impact on arms producers around the world. Above all, the U.S. defence industry will continue to dominate the global arms industry, and how it adapts to the unfolding process of change and evolution in the U.S. military establishment will likely be a guide to developments elsewhere.

³⁰ For example, the U.S. licensed-production of the Swedish AT-4 anti-armour weapon.

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