The Revolution in Military Affairs, Transformation and the Defence Industry

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Revolutions in Military Affairs (RMA) and transformations are uncommon phenomena. They entail fundamental and disruptive discontinuities. To date, the US transformation enterprise has fallen short of the RMA hype. It entails incremental advances with little evidence of generation-skipping technologies and has so far had only modest impact on US procurement programs. Hence US military transformation is unlikely to pose insurmountable challenges for the US defence industrial sector. In particular, the systems integration innovation required to realise network centric warfare is primarily sustaining rather than disruptive, requiring suppliers to build on existing, not develop new, capabilities. Close supplier-customer relationships in this sector, the emphasis on sustaining innovation, and the scale of the systems integration work required constitute formidable barriers to entry for new systems integrators, including commercial information technology (IT) firms. These barriers are being reinforced as Boeing, General Dynamics, Lockheed Martin, Northrop Grumman, and Raytheon invest heavily in organic IT capabilities.

The world's militaries are said to be in the throes of a revolution that will fundamentally and profoundly alter the future conduct of war. Characterised variously as a "military technological revolution", a "revolution in military affairs", and "transformation", the spur to this ongoing military revolution is the broader Information Revolution.[1] In what has become known as the Information Technology Revolution in Military Affairs (IT-RMA), military establishments are transitioning from the Industrial Age to the Information Age. As in the past, military change is a response to more far-reaching societal change. Technological, organisational, and doctrinal change are again in the offing. Far-reaching military innovation is the order of the day.

The post-cold war US defence establishment has been in the vanguard of military transformation. Despite its stark military advantage over foes and friends alike, US leaders intend to not merely maintain but increase US military dominance. The message to military competitors is clear: challenging the United States is futile.[2]

[1] Peter Dombrowski and Eugene Gholz, *Selling Military Transformation: Technological Innovation and the Defense Industry* (New York: Columbia University Press, 2006).

[2] In making the case for transformation, former Secretary Rumsfeld, America's foremost recent civilian champion of transformation, was quite explicit on this point when he declared that 'we must develop new assets, the mere possession of which discourages adversaries from

Military change diffuses, however, whether slowly or rapidly. Innovators such as the United States do not long maintain their competitive advantage. Allies, competitors, and even potential adversaries will emulate, adapt, improve upon, and counter their innovations.[3] The spread of recent US innovations to Asia, Europe, and the Middle East is already evident. China, for example, currently pursues defence modernisation under the rubric of "informatisation", a process that sounds quite similar to US transformation, with its emphasis on information intensive warfare. As Richard Bitzinger has observed, the Chinese version of transformation relies on

> short-duration, high-intensity conflicts characterized by mobility, speed and long-range attack, employing joint operations fought simultaneously throughout the entire air, land, sea, space and electromagnetic battlespace, and relying heavily upon extremely lethal high-technology weapons.[4]

Since the concept of military transformation entered the national security lexicon, analysts have sought to determine how the RMA will affect the multi-billion dollar defence industrial sector both in the United States and across the globe. The answer lies in the evolving nature of military transformation and ongoing changes in the defence sector. Our assessment here focuses on (1) the current state of military transformation in the United States; and (2) the implications of current trends in military transformation for the global defence industry.

The RMA/Transformation Enterprise

Recognition of an apparently emerging RMA and the subsequent call for transformation predated the administration of George W. Bush by more than a decade.[5] During the waning years of the cold war, Soviet observers of US military doctrine and capabilities diagnosed a military technological revolution in the making. Early MTR[6]/RMA stirrings in the United States yielded Andrew Krepinevich's Office of Net Assessment (ONA) 1992 report

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competing.' Donald H. Rumsfeld, 'Transforming the Military', *Foreign Affairs*, Vol. 81, No. 3 (May/June 2002), p. 27.

[3] Emily O. Goldman and Leslie C. Eliason, eds., *The Diffusion of Military Technology And Ideas* (Stanford: Stanford University Press, 2003).

[4] Richard Bitzinger, 'China Adapts to US Defense Transformation', Institute of Defence and Strategic Studies, Nanyang Technological University (November 10, 2006). Available at <http://www.isn.ethz.ch> [Accessed 12 May 2008].

[5] For a useful recent account, and critique, of the development of the US transformation enterprise see Frederick W. Kagan, *Finding the Target: The Transformation of American Military Policy* (New York: Encounter Books, 2006). Other scholars trace the current period of transformation back more than thirty years, to the 'Assault Breaker' and Joint Air Land Battle innovations of the 1970s and 1980s. See Robert R. Tomes, *US Defense Strategy From Vietnam To Operation Iraqi Freedom : Military Innovation And The New American Way Of War, 1973-2003* (London: Routledge, 2007).

[6] MTR-Military Technological Revolution

on *The Military-Technical Revolution: A Preliminary Assessment*.[7] During the Clinton administration's first term, ONA director Andrew W. Marshall emerged as the central intellectual and organisational/bureaucratic advocate for an RMA within the Office of the Secretary of Defense (OSD). In a 1993 memorandum entitled "Some Thoughts on Military Revolutions", Marshall speculated about "the **emerging** military revolution, or the **potential** military revolution" and "periods of revolution where the character of warfare itself changes" and foreshadowed what was to come:

> There may not be any new platforms (e.g., carriers) for innovators to rally round and commit themselves to…. The technologies (information, computational, communication) that seem central suffuse everything.[8]

Following the display of US military prowess during the 1991 Gulf War, the RMA became a central preoccupation of the American national security and defence community. The subsequent RMA campaign evolved into the transformation enterprise during the course of the 1990s. Transformation transitioned from a rather diffuse set of ideas and concepts loosely supported by historical scholarship to an "enterprise"—a complex, risky political-economic undertaking in which the US government sought to enhance its military capabilities and the private defence-industrial sector sought to reap renewed profits from defence sales at home and abroad.

"Transformation" has proved to be a nebulous concept often employed to justify—or sell—programs whether they fit the profile of transformation or were distinctly non-transformational.[9] For some, apparently, this was a virtue. According to E. C. "Pete" Aldridge, Jr., a former Under Secretary of Defense (Acquisition, Technology and Logistics), "transformation is a loose concept and we are the better for it".[10] This "loose" approach may have served the purposes of the visionaries and defence firms simply interested in increasing sales, but it did not provide clear guidelines for the defence planners charged with the task of implementing transformation. The 2001 *Quadrennial Defense Review Report (QDR)* imbued transformation with greater specificity:

> Transformation results from *the exploitation of new approaches to operational concepts and capabilities*, the use of old and new technologies, and *new forms of organization* that more effectively anticipate new or still emerging strategic and operational challenges and opportunities and that

[7] Andrew F. Krepinevich, Jr., *The Military-Technical Revolution: A Preliminary Assessment* (Washington, DC: Center for Strategic and Budgetary Assessments, 2002 [1992]).
[8] A. W. Marshall, 'Some Thoughts on Military Revolutions', Memorandum for the Record, 27 July 1993; emphasis in the original. A profile of Marshall and ONA is provided by Nicholas Lemann, 'Dreaming about War', *The New Yorker*, 16 July 2001, pp. 32-38.
[9] The meaning of 'transformation' is probed as well by Derrick J. Neal, 'Do We Really Understand What Is Meant by Transformational Change for Defence?', *Defence Studies*, Vol. 6, No. 1 (March 2006), pp. 73-96. The short answer to the question posed by Neal is 'no.'
[10] E. C. 'Pete' Aldridge, Jr., 'Technology and National Defense', address to DARPA Tech, 30 July 2002.

> *render previous methods of conducting war obsolete or subordinate*. Transformation can involve *fundamental change in the form of military operations*, as well as a potential change in their scale. It can encompass the *displacement of one form of war with another*, such as *fundamental change in the ways war is waged* in the air, on land and at sea. It can also involve the *emergence of new kinds of war*, such as armed conflict in *new dimensions of the battlespace*.[11]

Later the 2003 *Transformation Planning Guidance (TPG)* characterised transformation 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….[12]

This process entails "redefining standards for military success by accomplishing military missions that were previously unimaginable or impossible" and calls for "new operating concepts that employ new organisational constructs, capabilities, and doctrine".[13] Proponents believe the process will eventually realise the strategic and operational promise of the RMA.

RMA concepts and language appeared in early post-cold war service documents such as the Army's *Force XXI*, the Navy's *…From the Sea* and *Forward …From the Sea*, the Marine Corps' *Operational Maneuver …From the Sea*, and the Air Force's *Global Reach, Global Power.* Paul Bracken's 1993 article on "the military after next" helped inspire research into the Army, Navy, and Air Force after next.[14] Military champions such as Admiral William A. Owens and Vice Admiral Arthur K. Cebrowski preached the religion of transformation and revolution. Admiral Owens argued that the RMA required the creation of a "system of systems" that consisted of "battlespace awareness", "advanced C4I", and "precision force" systems.[15] During Owens's tenure as Vice Chairman of the Joint Chiefs of Staff, the 1996 *Joint Vision 2010*, which emphasised the massing of effects rather than forces, "information superiority", technological innovation, and the emerging operational concepts of "dominant manoeuvre", precision engagement", "focused logistics", and "full-dimensional protection", was developed.

[11] Department of Defense, *Quadrennial Defense Review Report* (Washington, DC: Department of Defense, 2001), p. 29. Emphasis added.
[12] Department of Defense, *Transformation Planning Guidance* (Washington, DC: Department of Defense, April 2003), p. 3. Emphasis added.
[13] Ibid., pp. 3-4.
[14] Paul Bracken, 'The Military after Next', *The Washington Quarterly*, Vol. 16, No. 4 (Autumn 1993), pp. 157-174.
[15] William A. Owens, 'The Emerging System of Systems', U.S. Naval Institute *Proceedings*, May 1995, pp. 36-39. After his retirement from active duty service Owens continued to promote the RMA in work such as *Lifting the Fog of War* (with Ed Offley), (Baltimore: The Johns Hopkins University Press, 2001), and 'The Once and Future Revolution in Military Affairs', *Joint Forces Quarterly*, No. 31 (Summer 2002), pp. 55-61.

Admiral Cebrowski, who upon his retirement from the US Navy became the first Director of OSD's Office of Force Transformation, relentlessly promoted the concept of network-centric warfare that now pervades joint and service RMA/transformation plans and programs.[16]

From the perspective of RMA and transformation advocates, initial post-cold war defence posture reviews were rather stolid undertakings.[17] Revolutionary and transformational considerations were notably absent in the rationale provided for the Base Force in 1992.[18] *The Bottom-Up Review* of 1993 was virtually devoid of any real recognition of the need to remake the US military.[19] Even the 1997 *QDR*, which more prominently featured transformation issues, was more about modernisation and reform than revolution.[20]

The National Defense Panel's (NDP) December 1997 report, *Transforming Defense: National Security in the 21st Century*, was a tipping point for the RMA/transformation enterprise.[21] Having been mandated by Congress to provide an independent assessment of the Clinton administration's 1997 *QDR* and to fundamentally rethink the US defence posture, the NDP obliged. The RMA and transformation were unequivocally embraced. "The United States", the panel declared, "needs to launch a transformation strategy *now*"[22] and ensure that Department of Defense (DoD) and the services "accord the highest priority to executing" it.[23] It asserted that the future is

[16] Arthur K. Cebrowski and John J. Garstka, 'Network-Centric Warfare: Its Origin and Future', U.S. Naval Institute *Proceedings* (January 1998), pp. 28-35. A central, but near-impenetrable, text on network-centric warfare is David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2nd ed., revised, (Washington, DC: C4ISR Cooperative Research Program, 1999). For more accessible accounts of network-centric warfare, see Peter J. Dombrowski and Andrew L. Ross, 'Transforming the Navy: Punching a Featherbed?', *Naval War College Review*, Vol. LVI, No. 3 (Summer 2003), pp. 107-131; and Paul T. Mitchell, *Network Centric Warfare: Coalition Operations in the Age of US Military Primacy*, Adelphi Paper 385 (London and New York: Routledge, for the International Institute for Strategic Studies, 2006). A penetrating analytical critique of NCW is provided by Darryn J. Reid, Graham Goodman, Wayne Johnson, and Ralph E. Giffin, 'All that Glistens: Is Network-Centric Warfare Really Scientific?', *Defense & Security Analysis*, Vol. 21, No. 4 (December 2005), pp. 335-367. At OFT, Cebrowski continued to call for 'placing a few big bets.' See <http://www.oft.osd.mil/what_is_transformation.cfm>.

[17] A valuable assessment of the Base Force, *BUR*, and 1997 *QDR* is provided by Eric V. Larson, David T. Orletsky, and Kristen Leuschner, *Defense Planning in a Decade of Change: Lessons from the Base Force, Bottom-Up Review, and Quadrennial Defense Review*, (Santa Monica: RAND, 2001).

[18] General Colin L. Powell, *National Military Strategy of the United States* (Washington, DC: Joint Chiefs of Staff, January 1992).

[19] Les Aspin, *Report on the Bottom-Up Review* (Washington, DC: Department of Defense, October 1993).

[20] William S. Cohen, *Report of the Quadrennial Defense Review* (Washington, DC: Department of Defense, May 1997).

[21] National Defense Panel, *Transforming Defense: National Security in the 21st Century*, (Arlington, VA: National Defense Panel, December 1997).

[22] Ibid., p. i; emphasis added.

[23] Ibid., p. iv.

more important than the present, that the capabilities the military needs for the future are not those it then possessed, that the utility of legacy systems must be reexamined, and that the commitment to jointness must be serious. The panel contested challenged many verities including the need for "balance", as endorsed by Clinton Secretary of Defense William Cohen. It supported exploiting "rapid advances in information and information-related technologies" as emphasised in *Joint Vision 2010*. [24] Critical future capabilities identified by the NDP included information systems architectures, information operations and infrastructure protection, automation, mobility, stealth, speed, deep and precision strike.[25] As Steven Metz has noted, subsequent Clinton administration national security and defence planning documents supported transformation.[26]

Transformation's technological, doctrinal, and organisational components, and the multidimensional, synergistic relationships among them, are evident in both the 2001 *QDR* and the *TPG*.[27] Transformation requires both "hardware" (technology, weapons, and platforms) innovation and "software" (organisational and doctrinal) innovation. Planning documents emphasise "new" rather than "improved", discontinuous rather than incremental change, and disruptive, even revolutionary, rather than sustaining, evolutionary innovation. The military must leap ahead by skipping generations of technology. Transformation is more than routine modernisation. Creativity, innovation, and experimentation, even risk taking, are to be front and center. To achieve the IT-RMA the military services, OSD, and the defence industry must abandon business as usual.

TRANSFORMATION AND THE BUSH ADMINISTRATION

Transformation came to be closely associated with the Bush administration, particularly with former Secretary of Defense Donald Rumsfeld. In January 2001, the administration of George W. Bush assumed office determined to institutionalise military transformation. The new president's commitment to transformation had been markedly evident on the campaign trail. In a 23 September 1999 speech at The Citadel, then-Governor Bush spoke of "creating the military of the next century" and "a revolution in the technology of war." He declared that the US military "must be agile, lethal, readily deployable, and require a minimum of logistical support…." "The real goal", he emphasised, "is to move beyond marginal improvements … to skip a generation of technology." He proclaimed the need for "a new spirit of innovation" that would result in the lighter land forces, stealthy naval vessels,

[24] Ibid., p. 43.
[25] Ibid., pp. 43-48.
[26] Steven Metz, 'America's Defense Transformation: A Conceptual and Political History', *Defence Studies*, Vol. 6, No. 1 (March 2006), pp. 1-25.
[27] The multidimensional nature of an RMA or transformation is emphasised as well in Colin S. Gray, 'Technology as a Dynamic of Defence Transformation', *Defence Studies*, Vol. 6, No. 1 (March 2006), pp. 26-51.

and long-range, precision-strike airpower (unmanned as well as manned) required for the future.[28]

The Bush administration's support for transformation was formalised in the September 2001 *QDR*:

> A fundamental challenge confronting DoD is ensuring that U.S. forces have the capabilities they need to carry out the new defense strategy and meet the demands of the 21st century. Toward that end, *it is imperative that the United States invests and transforms its forces and capabilities*.[29]

Seeking to reinvigorate and institutionalise the enterprise, a multitude of transformation visions, guidance, and roadmaps were added to the Joint Staff's foundation document of *Joint Vision 2020*. Within the Pentagon and across the functional and geographic commands and the services, the language of transformation became ubiquitous.

The 2006 *QDR*[30] reaffirmed the Bush Administration's commitment to transformation even as it fought the Global War on Terror in addition to wars in Afghanistan and Iraq. With the flurry of OSD, Joint Staff, and service transformation visions, guidance, and roadmaps—and the multitude of operational concepts, goals, pillars, elements, and capabilities generated by *Joint Vision 2010* and *Joint Vision 2020*—the primary features of a transformed military have become more readily apparent. They include:

- Networked "nodes"—platforms, weapons, sensors, and, particularly, C4ISR assets;
- Distributed forces and capabilities;
- Speed (of command, deployment, and employment);
- Light, agile, nimble forces able to operate simultaneously in geographically and environmentally distinct theatres;
- Expeditionary forces;
- Precision engagement (i.e., global precision strike capabilities);

[28] Governor George W. Bush, 'A Period of Consequences', speech at The Citadel, 23 September 1999.
[29] Department of Defense, *Quadrennial Defense Review Report* (Washington, DC: Department of Defense, September 2001), p. 40. Emphasis added.
[30] *Quadrennial Defense Review Report* (Washington, DC: Department of Defense, February 2006), pp. vi and ix.

- Shared situational awareness (networked ubiquitous sensors are to provide a common operational picture that facilitates collaboration and self-synchronisation);
- Flexible/adaptable/modular forces;
- Stealth ("low observable" forces);
- Joint (interdependent and integrated)/interoperable forces;
- Sustainable forces.

Transformation proponents envision a vast array of new and emerging technologies and capabilities. Unmanned systems will saturate the battlespace from space to under the oceans. Sensors will be ubiquitous. Smaller, faster, lighter ships sporting new hull forms will ply the seas. Forces will be based at sea. Hypersonic craft will blur the distinction between the atmosphere and space. New forms of kinetic energy will be deployed. Nanotechnologies will be pervasive. Biotechnology will erode the distinction between human and machine. Nonlethal technologies will be employed to disable enemy combatants and may well rival lethal technologies.

But IT lies at the centre of the transformation enterprise.[31] As Alberts, Garstka and Stein put it, "Information Technology is the DNA of the Information Age."[32] IT's privileged position has long been acknowledged.[33] *Joint Vision 2020*, like *Joint Vision 2010*, singled out information superiority as "a key enabler" of transformation. Information and knowledge superiority are to be the source of the future joint force's full spectrum dominance and promise dominant manoeuvre, precision engagement, focused logistics, and full dimensional protection. IT makes possible the critical characteristic of a transformed, information age force: networked nodes. Networking allows for distributing forces and capabilities; speed of command, deployment, and employment; lighter, agile, nimble, modular, more expeditionary forces; real-time precision strike; the collaboration and self-synchronisation provided by shared situational awareness; and integrated, interdependent, sustainable joint operations.

[31] Note the centrality of IT in the discussions of transformation's technology requirements provided by Bruce Berkowitz, *The New Face of War: How War Will Be Fought in the 21st Century* (New York: The Free Press, 2003); Owens *Lifting the Fog of War*, pp. 97-149; and Douglas A. Macgregor, *Transformation Under Fire: Revolutionizing How America Fights* (Westport: Praeger, 2003), pp. 249-283.

[32] Alberts, Garstka, and Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, p. 15.

[33] For an exploration of the implications of the IT revolution for international security see Emily O. Goldman, ed., *National Security in the Information Age* (London: Frank Cass, 2004).

If transformation succeeds future military operations will be network-centric rather than platform-centric. Networked capabilities and forces will be distributed rather than massed; fires rather than forces will be massed. Information operations and cyber operations will rival conventional operations. Platforms will be tailored to the network, not the network to platforms. Traditional "hardware" will no longer have pride of place. IT software will be the new hardware. Information architecture already is at the heart of new systems. Lancaster's equations are giving way to Moore's Law and Metcalfe's Law. C4ISR[34] will rule. The competition among warfighters for more bits and bytes will be fiercer than the competition for bullets and bombs. Demand for bandwidth will outstrip demand for throw weight.[35] Processing power will displace explosive yield. The collection, processing, fusion, and dissemination of data will be the new logistics.

THE STATUS OF MILITARY TRANSFORMATION

With the Bush Administration's tenure coming to an end, it is possible to take stock of the progress made toward military transformation. Although then Secretary of Defense Rumsfeld had moved rapidly to implement his President's campaign rhetoric in support of an RMA in 2001, the success of this effort was in doubt after the first nine months of the new administration. Secretary Rumsfeld, it was claimed, was not up to the task of overcoming resistance within the military to many tenets of the RMA; some officers and experts argued that the benefits of transformation were illusory; others argued that so-called legacy programs were still valuable in the post-Cold War security environment. With September 11, the Bush administration was reenergised, not only to hunt down al Qaeda and state supporters of terrorism, but also to push forward with rebuilding US military forces.

What was labelled "the Long War"[36]—roughly the campaigns in Afghanistan and Iraq plus an alleged "global war on terror"—affected both the pace and extent of transformation. The perception of heightened external threat levels after 9/11 and renewed support for higher military spending provided opportunities for transformation advocates and industry alike. Military spending increased rapidly and the Afghan and Iraq campaigns further tested, on a much grander scale, weapons and systems that first appeared with the Persian Gulf War and in the Balkans during the 1990s. Some accounts attribute the operational successes in the Persian Gulf War to

[34] C4ISR-Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance.

[35] On DoD's enormous bandwidth requirements, see Tim Weiner, 'Pentagon Envisioning a Costly Internet for War', *The New York Times*, 13 November 2004, pp. A1 and B2; and Susan M. Menke, 'Pentagon Weighs Satellite Needs', *The Washington Post*, 22 November 2004, p. E4.

[36] Rumsfeld's 'Long War' speech on February 2, 2006, came on the eve of the Pentagon's release of its 2006 *QDR*.

military transformation.[37] This certainly was the position taken by its advocates, including those in the Office of Force Transformation.

Broad-based transformation goals may have suffered as the operational challenges of ongoing campaigns served to focus research and development (R&D) resources on technologies and systems barely on the radar screen of early transformation advocates. Two programs illustrate this dynamic: the search for solutions to the tactical problems posed by Improvised Explosive Devices (IEDs) and accelerated programs to develop Mine Resistant Ambush Protected vehicles (MRAPs). Both programs, however necessary for war fighters, have been costly in terms of research dollars and the attention of the research and acquisition communities.

The costs of the ongoing wars, both material and intellectual, have slowed transformation and diverted attention from long term objectives. Already some of the more truly transformational programs launched during the Bush administration, including the Navy's Littoral Combat Ship (LCS) and the Army's ambitious Future Combat System (FCS) program, have been cut back or delayed. The effects of Iraq and Afghanistan will linger, perhaps long after the wars are brought to conclusion. "Resetting the force" especially for the US Army and Marine Corps will be extremely expensive. Although the Army has already received $38 billion to "reset" more than 300,000 pieces of major equipment, the Congressional Budget Office estimated that it will require roughly

> $13 billion annually for such purposes for as long as the war in Iraq continues at its current level and for at least two years after U.S. forces are withdrawn.[38]

How long Iraq operations will last is unclear; Senator John McCain, the Republican presidential nominee, backed off his startling, off-the-cuff assertion that the United States may remain in Iraq for one hundred years. In May 2008 he estimated 2013 as a likely pull out date.[39] This would require approximately $91 billion in reset monies for the Army and, presumably significantly more for US Marine and Air Force units directly engaged in combat operations.

Beyond spending patterns for research, development, technology, evaluation and procurement, the reduced attention to transformation has also manifested itself in terms of rhetoric and organisational emphases. While former Secretary of Defense Rumsfeld continued to focus on transformation goals even as it became increasing clear that Iraq was consuming virtual all

[37] Max Boot, *War Made New: Technology, Warfare, and the Course of History,1500 to Today* (New York: Gotham Books: 2006).
[38] Congressional Budget Office, *Replacing and Repairing Aging Equipment used in Iraq and Afghanistan: The Army's Reset Program* (Washington, DC: CBO, September 2007), p. ix.
[39] Elisabeth Bumiller, 'McCain Sees Troops Coming Home by 2013', *New York Times*, 15 May 2008.

of the energy and resources of the US military, his successor, Robert Gates, has been much more circumspect, as was evident during the course of both his December 2006 Senate confirmation hearing and his swearing-in ceremony remarks.[40]

Organisationally the fate of the Office of Force Transformation (OFT) is instructive. With the untimely death of its initial director, Vice Admiral (ret) Arthur Cebrowski, OFT quickly was sidetracked into "science experiments." Shortly thereafter it was downgraded and then disestablished. Yet while Cebrowski's departure as director of OFT and the subsequent demise of the office had given rise to concerns, the establishment of a deputy assistant secretary for forces transformation in the Office of the Undersecretary of Defense for Policy may be interpreted as evidence of the continuing institutionalisation of transformation within DoD. That institutionalisation is evident as well in the Deputy Security of Defense's August 9, 2007 memorandum on "DoD Transformation Priorities" and the "CJCS Guidance for 2007-2008", which features RMA and transformation language in its call for a "commitment to change", "effects-based thinking", "different kinds of warfighters, mission systems and strategies" a military that is "smarter, lighter, more agile, and more lethal", and "increased precision, speed and agility", and for "push[ing] new boundaries, seek[ing] new opportunities and challenge[ing] existing assumptions."[41]

Ironically, however, the institutionalisation of transformation within OSD and the military services by its champions in the Bush administration have may well have rendered it mundane. After all, it is the rhetoric rather than the reality of transformation that has been institutionalised. True transformation, clearly, requires more than the standard issue evolutionary technological, doctrinal, or organisational advances that amount to only as business as usual. It entails not incremental, evolutionary change but discontinuous, disruptive innovation. However, the US transformation enterprise thus far falls short. Joint and service plans and programs have yet to match up to transformation visions. While the visions promise discontinuity and disruption, plans and programs support only incremental, sustaining advances. Technological generation-skipping is nowhere to be found. Doctrine development is more linear than nonlinear. Organisational change features evolution and adaptation rather than recreation or, even, restructuring. Unless the gap between visions and plans and programs can

[40] Secretary Gates' responses to the advance policy questions posed by the SASC are available at <http://armed-services.senate.gov/statemnt/2006/December/Gates%2012-05-06.pdf> [Accessed 15 March 2007]. Robert Gates, Swearing-In Remarks, The Pentagon, 18 December 2006; <http://www.defenselink.mil/speeches/speech.aspx?speechid=1077> [Accessed 15 March 2007].

[41] Admiral M. G. Mullen, USN, Chairman of the Joint Chiefs of Staff, 'CJCS Guidance for 2007-2008', 1 October 2007.

be bridged, transformation is fated to be little more than routine modernisation. At best, it will amount to "modernisation plus".[42]

Thus the proffered new order has been absorbed by the old order, the new rule set subsumed by the old rule set. Its institutionalisation appears to have made transformation non-threatening, toothless, and even benign. Instead of disguising disruptive innovation as sustaining innovation in an effort to protect it, overcome inertia and resistance, and disarm opponents,[43] champions of the contemporary transformation enterprise have been reduced to disguising sustaining innovation as disruptive innovation.

The Transformation Enterprise and Industry

In a market economy, the demand for the technological innovations required to bring about military transformation must, for the most part,[44] be met by private industry. The ability of private sector defence firms to support the transformation enterprise is thus critical to its success.[45] If these firms cannot produce the innovations deemed necessary to fulfill the promise of transformation and do so at a reasonable cost, the entire enterprise will be endangered. Moreover, the overall health of the defence market in the United States and across the globe will affect the ability of firms, no matter how attentive to the military's demands for innovation and no how well run, to meet transformation requirements effectively.

THE POST-COLD WAR DEFENCE SECTOR[46]

As the transformation enterprise gained traction within the national security community and the military services, the US defence industry was undergoing a major shake out. First, and most important, declining defence budgets decreased demand, especially for major new weapons systems. With too many defence firms chasing too few dollars, the American defence industry began a period of consolidation, looking for new ways to remain

[42] For a systematic assessment of the gap between transformation visions and rhetoric and USN plans and programs, see Dombrowski and Ross, 'Transforming the Navy: Punching a Featherbed?', pp. 107-131.

[43] As disruptive disruption's champions have done in the past; see Terry C. Pierce, *Warfighting and Disruptive Technologies: Disguising Innovation* (London and New York: Frank Cass, 2004).

[44] Important exceptions to this generalisation are the resources controlled by government agencies like the Defense Advanced Research Projects Agency, the Office of Naval Research, and the numerous federal laboratories, among many others, that disburse taxpayer dollars for science & technology and research & development projects. In theory, the military benefits not only from OSD and service funded projects but also from civilian programs run by organisations like the National Science Foundation. For overview of federal spending in these areas see Michael E. Davey, et al., *Federal Research and Development Funding, FY2008* (Washington DC, Congressional Research Service, updated 26 July 2007).

[45] A point recognised by the National Defense Panel's discussion of 'Transforming the Industrial Base' in *Transforming Defense*, pp. 74-77.

[46] For more details see, among others, Peter J. Dombrowski, Eugene Gholz, and Andrew L. Ross, *Military Transformation and the Defense Industry After Next*, Newport Paper 18 (Newport, RI: Naval War College Press, 2003), pp. 21-28.

healthy and profitable. Some firms closed or sold off defence product lines while others took the reverse position of trimming non-defence work in order to protect core competencies. Second, as economic globalisation accelerated in diverse sectors ranging from finance to transportation some US firms sought overseas sales by either buying into existing markets or seeking relief from US export controls, which made it difficult and expensive for US firms to sell equipment and services abroad. Consolidation, globalisation, and commercial-military integration have been highlighted in assessments of the post-cold war US defence industry.

Consolidation. Defence industrial consolidation refers to the mergers and acquisitions that have transformed the defence industrial landscape.[47] From the end of the cold war to roughly 9/11 that landscape was dramatically altered by consolidation. The number of separate businesses plunged in many sectors of the defence industry during the 1990s. Many of the most famous names in American industry, from General Motors and Ford to Hughes Aircraft and McDonnell Douglas, either left the defence business or exist today only as divisions of larger enterprises. The few remaining big defence firms generally comprise several formerly independent companies or defence-oriented divisions sold by other companies that have themselves left the defence business. Post-cold war consolidation peaked in 1999 and was not surpassed until 2006 when defence and aerospace companies worldwide completed merger and acquisition (M&A) deals worth more than $40 billion in a total of 370 transactions.[48]

With consolidation, the largest defence firms maintain multiple "centers of excellence", allowing them to bid on a wide range of platforms and integration programs. Mergers and acquisitions have broadened the defence conglomerates' portfolios of programs. Post-consolidation integration and restructuring at the level of design teams and production facilities is loose at best. At the same time, by adding military businesses and spinning off commercially oriented facilities, the parent companies in the defence industry have typically become even more dependent on military customers than the largest defence firms were in the past.

Even in acquisition programs in which multiple suppliers bid for a development or production contract, political and bureaucratic forces often ensure that competition is stunted. Weapon system competitions are often not "winner take all" affairs but rather design competitions in which different firms compete only for the selection of their respective approaches. A prime is selected, but the "losers" share in production. In some cases sharing

[47] The post Cold War era was hardly the first period of defence industry consolidation. For a historical perspective see, for example, Aaron L. Friedberg, *In the Shadow of the Garrison State: America's Anti-Statism and its Cold War Strategy* (Princeton: Princeton University Press, 2000) especially, chs. 6-7.

[48] 'Defense Mergers & Acquisitions Tallies $40 Billion in 2006 Deals; 2007 Sizzles With $25 Billion in Deals to Date', *PRNewswire* (7 April 2007).

means that each firm builds entire platforms or systems; in others it means that losing firms become subcontractors to the winning firm or team of firms. Politicians and industrial-base advocates often justify such production sharing by arguing that it helps to maintain firms with core defence-production capacities so that they might bid on future projects. In reality, shared production results also from the concerns of DoD and Congress about the domestic political impact of closing defence plants—often with little regard for the economic cost. The result is that the salutary effect of competition on prices touted by economic theorists is considerably diluted in the defence industry.

A related criticism of defence industry consolidation—that it may limit the industry's propensity to innovate—is tied directly to the implementation of transformation. When firms invest in innovation, their goal is to create new products and thus potential new sources of revenue. However, firms are especially interested in products that are already programmed into the defence budget; because of the up-front investment required for innovation, defence suppliers are biased toward extending the production of current systems rather than pushing the technological envelope for new products. Many critics of consolidation presume that the key motivation to innovate in the defence sector comes from industry competition—that it is firms not currently selling "legacy" systems that will be most motivated to develop new products, in the hope of replacing established sellers.

Incentives for innovation in the defence market actually differ somewhat from this traditional economic view, because the military market is a near monopsony, and the military customer demands unique products. Even in sectors in which suppliers face demand from perfectly competitive consumers, the economics literature does not provide a clear picture of the role of competition in promoting innovation.[49] Competition may provide firms with an incentive to innovate, but it reduces their capability to earn returns that recoup up-front investment; firms in competitive industries may accordingly invest less in R&D. In the defence industry, however, a powerful, single customer directly pays for the initial R&D investment and sets the agenda for innovation. True consolidation of production lines in the defence industry may even free resources that the military could use to support additional R&D.

Consolidation has thus had potentially serious implications for military transformation in terms of price and innovation. Analysts generally believe that less competition among defence contractors will lead to increased prices, decreased responsiveness to the needs of the military, and less innovation. This logic largely tracks with standard economic theory, but it must be applied to the defence sector with care. As we will demonstrate

[49] Linda R. Cohen and Roger Noll, 'Government Support for R&D', in Linda R. Cohen and Roger Noll, eds., *The Technology Pork Barrel* (Washington, DC: Brookings Institution, 1991), p. 25.

shortly, consolidation may also have important implications for government-industry relations in terms of who performs systems integration functions and under what conditions.

Globalisation. Despite the hype,[50] defence industrial globalisation is more mirage than reality. There are numerous dimensions of economic globalisation, including, most prominently trade, investment, and technology diffusion. On all three counts, there is reason to doubt that the defence sector will follow other sectors, such as the automobile industry or machine tools, much less service industries like banking and transportation, down the road toward globalisation.

There are many impediments to higher levels of cross-border defence-related trade, investment, and technology flows. First, impediments to defence exports, from limited demand to concerns about regional instability and proliferation, are legitimate, however much the defence industry would like a freer hand to peddle its wares overseas. Second, cross-border defence industry investments, with some significant exceptions, often generate security concerns in host-nation governments, including the United States. Even if the worldwide trend toward reducing regulation and privatising public services continues, most countries will still believe that controlling basic weapons production facilities is prudent. Third, advanced military technologies in the United States and elsewhere are largely the product of public investment; few government officials want to share the public patrimony even with close allies—much less with countries that qualify merely as potential allies or "friends". These limits also apply to firms that produce dual-use rather than military-unique technologies.

In addition, defence industrial "globalisation" is an uneven process. For much of the world, it consists largely of imports and limited licensing agreements to assemble, and perhaps produce, lower-end systems and components; there is no requirement for technology-intensive, transformed forces. For many countries, the potential for globalisation is also constrained by the limited resources available for defence.[51]

Commercial-Military Integration. Throughout the 1990s and the first years of the twenty-first century, political leaders and defence industry analysts called for replacing a defence industrial base separated from commercial industry with a single, integrated industrial base that would serve multiple

[50] For example, Ann Markusen, 'The Rise of World Weapons', *Foreign Policy*, No. 114 (Spring 1999), pp. 40-51.
[51] Some of these themes are further developed in Andrew L. Ross 'Defense Industry Globalization: Contrarian Observations', in *Defense Industry Globalization* (Washington, DC: The Atlantic Council of the United States, February 2002), pp. 35-42.

customers.[52] Some argued that the integrated industrial base would be necessary to give defence customers access to more advanced technology under continuous development for commercial applications. Many transformation advocates argued that a military intent on transforming itself should turn away from traditional suppliers and toward firms at the forefront of the "New Economy". Others suggested that the transition to commercial-military integration had already taken place.[53] That assessment was premature; if anything, as we approach the second decade of the 21st century many defence firms have shed commercial divisions and product lines while acquiring more defence-related capabilities through mergers and acquisitions. Commercial firms were, and are, for the most part, relatively uninterested in commercial-military integration; for firms like Microsoft the US military does not represent a large enough market to justify entering into much more than sales agreements. Commercial-military integration may have some impact on inexpensive, low-end, simplified acquisition threshold products and on subcomponent purchases, but for the primary systems under consideration with respect to military transformation, the military customer need not, can not, and should not rely on commercial-military integration.

Links between the commercial world and the defence industry have been developed as a result of DoD's push to integrate Commercial-Off-The-Shelf technologies (COTS) into its defence systems as a way to reduce costs, increase capabilities, and shorten weapons-acquisition and development cycles. Incorporating those subsystems into military products can help the military avoid technological obsolescence in the face of nimble overseas competitors, who might be able to "cherry-pick" the best and most affordable commercial systems for their own limited defence investments. The defence acquisition community needs to develop the organisational capability to scan commercial innovation so that it can choose suitable technologies to integrate into weapons systems. Practically speaking, that scanning function is one of the services that DoD can and should purchase from technical advisors, systems integrators, and prime contractors. Direct contact between the military customer and commercial suppliers is not necessarily required.

Commercial information-technology firms that are ready to serve as component suppliers are unlikely to transform the defence industry as whole, however. The process of civil-military integration has not progressed much beyond strategic teaming arrangements, licensing agreements, and the

[52] John A. Alic, L.M. Branscomb, A.B. Carter, and G.L. Epstein, *Beyond Spinoff: Military and Commercial Technologies in a Changing World* (Boston: Harvard Business School Press, 1992).

[53] For a positive assessment see Michael Oden, 'Cashing In, Cashing Out, and Converting: Restructuring the Defense Industrial Base in the 1990s', in Ann R. Markusen and Sean S. Costigan (eds.), *Arming the Future: A Defense Industry for the 21st Century* (New York: Council on Foreign Relations Press, 1999), pp. 74-105.

purchase of COTS subsystems, and the reasons for limited commercial-military integration are unlikely to change. Other practical difficulties inhibit commercial-military integration as well: Government contracting requires specialised competencies that are not usually found in the commercial IT sector (for example, dealing with Federal Acquisition Regulations).

Defence contractors' organisational cultures and personnel are well suited to keeping the DoD customer happy, while the more informal ways of the IT sector often produces culture shock in the military acquisition system. The necessary concern of the military with secrecy, accuracy, and information assurance—more important than ever in the post–September 11 government-contracting environment—runs contrary to the instincts of many IT firms. Acquisition reform efforts may sometimes make it easier for nontraditional defence suppliers to enter the defence procurement marketplace; time, experience, and the generational shifts that all organisations will encounter in the coming years may help overcome the informal barriers to cooperation between the commercial IT world and the DoD. But the incentives to surmount the barriers will remain weak, because the entire defence budget for science and technology, R&D, and procurement represents a relatively small prize for American industry. As a result, defence firms will continue to guard their core competencies at the level of systems contracting, and commercial IT firms are not likely to alter their business practices to try to become systems suppliers.

Defence Industry and Transformation

In the early stages of the US infatuation with transformation, some analysts speculated that the defence industry itself would be transformed in the effort to realise an IT-RMA. After all, in the United States most defence firms rely heavily on government contracts;[54] few have pursued a business strategy of diversification, or what has been called civil-military integration, with sufficient vigour to make them independent.[55] Demand, expressed in government contracts for transformational systems, might force the entire industry to adapt, willingly or not. It now appears that the broader defence sector dynamics brought about by the end of the cold war aside, the government's push for military transformation has affected the defence sector, but not necessarily in the ways experts predicted or in ways that should be judged transformative.

Previously, we argued that the posited transformation of the defence industry depends largely on the weapons, weapons systems, and defence industrial

[54] As Terrence Guay observes this is not necessarily the case in other countries and regions. In Europe, for example, a number of large defence contractors also are major players in civilian markets. Terrence R. Guay, *Globalization and its Implications for the Defense Industrial Base* (Carlisle, PA: US Army War College, 2007).

[55] Large defence firms that rely on both military and civilian contracts, like Boeing for example, do so for historical reasons and/or because of the unique characteristics of their sector.

sector under consideration.[56] In short, there is no one model for defence industry transformation. Dombrowski and Gholz extended this argument still farther in concluding that, for the most part, large traditional defence suppliers, the so-called prime contractors or primes, were well positioned to provide transformational systems.[57] In short, the basic characteristics of the defence sector will not change under the influence of military transformation. Traditional suppliers will supply transformational equipment, however, it is defined; non-traditional firms like those from the IT sector will enter the market largely by teaming with existing defence firms, as component supplies, or through M&A; non-US firms will attempt to enter US markets because that is where the money is, but they will do so largely by acquiring American firms,[58] selling components, licensing technologies or partnering with American firms.

Although we stand by these arguments, several developments suggest that while most of the macro-changes to the defence industry originally envisioned by transformation advocates have not materialised, there are signs of other unanticipated shifts with consequences for the US defence industrial sector, progress toward military transformation, and the spread of both transformation and defence firms capable of supporting transformation across the globe. One significant shift is the ascendance of systems integration as the key defence industrial sector and an essential competency of prime contractors. To be effective, the networks demanded by the 2001 and 2006 *QDR*s and other strategic documents—the systems of linked platforms, weapons, sensors, and, particularly, C4ISR assets—must be designed and built together, most preferably overseen by a single entity.

By definition, the IT-RMA depends upon the more intensive use of a wide range of technologies ranging from computing to communications into both (1) individual weapons and military platforms and (2) the entire complex of weapons systems and supporting technologies used by the military. One problem with this process is that increasingly the US government does not possess the in-house technical knowledge and managerial capabilities necessary to procure transformational systems. This shortfall in know-how is exacerbated by an overly bureaucratic and increasingly antiquated acquisition system ill-prepared to cope with new, more complex systems. Modest reforms such as spiral development have not been helpful; indeed, they have worsened existing procurement problems.

Why, then, are prime contractors emerging as the critical systems integrators during this period of military transformation? After all, possible integrators

[56] Dombrowski, Gholz, and Ross, *Military Transformation and the Defense Industry After Next*.
[57] Peter Dombrowski and Eugene Gholz, *Buying Military Transformation: Technological Innovation and the Defense Industry* (New York: Columbia University Press, 2006).
[58] See for example BAE which bought a number of mid-tier American firms but has been forced by US regulations to firewall its American operations from those in the United Kingdom or elsewhere.

include the government itself, a private firm such as a prime contractor, or an independent organisation.[59] As numerous independent audits suggest, the government as represented by DoD and the service acquisition communities is far less able to provide systems of systems integration than in the past; a shrinking workforce,[60] lost expertise and other institutional factors have reduced government acquisition management capabilities and capacities. Independent organisations such as Federally Funded Research and Development Corporations (FFRDCs) have much to recommend them, at least in theory, but have little support within the overall national security community. MITRE, RAND, JPL and other FFRDCs have limited systems integration capabilities.

By default, then, the task of providing the systems of system integration required by a military dead set on transformation or forcing an IT-RMA, falls to the private sector—or more properly the prime contractors with the financial, intellectual, and experiential wherewithal to undertake multi-billion dollar, multi-year, inherently risky development, engineering, and production programs. Prime contractors do not need to be encouraged by the government; they have plenty of incentives to participate and actively market their competency in systems integration.[61] Thus, we agree with Hartley and Sandler that

> [t]he future defense firm will be a global company focusing on prime contracting/systems integration, supplying world markets and buying-in specialist tasks from suppliers throughout the world rather than undertaking work in-house and relying on national suppliers.[62]

In fact, the future is now.

Systems integration has thus become one of the core capabilities claimed by defence firms and a key service offered to purchasers of major weapons systems. Two major acquisition programs requiring different levels of systems integration illustrate the difficulties facing both advocates of transformation and the defence industry as systems integration migrates to the private sector:[63] (1) the LCS of the United States Navy which requires platform integration and (2) the FCS of the United States Army which requires systems of systems integration. There are, of course, other weapons system described as transformative that we could have used to

[59] Dombrowski and Gholz, *Buying Military Transformation*, pp. 132-135.
[60] For one example, on the decreased size of the acquisition workforce and its implications see Stephen Howard Chadwick*, Defense Acquisition: Overview, Issues, and Options for Congress*, CRS Report for Congress (Washington, DC: Congressional Research Service, updated 20 June 2007). p. 28
[61] Dombrowski and Gholz, *Buying Military Transformation*, p. 132.
[62] Keith Hartley and Todd Sandler, 'The Future of the Defense Firm', <www.york.ac.uk/depts/econ/documents/research/region.pdf> [Accessed 20 May 2008].
[63] On the three levels of systems integration see Dombrowski and Gholz, *Buying Military Transformation*, pp. 112-115.

illustrate our argument, including, for example, the US Coast Guard's Deepwater program and the multi-service, multi-role Joint Strike Fighter. Moreover, any of the systems identified as necessary for developing a network-centric force—from the Global Information Grid to the Army's Warfighter Information Network programs—would also have sufficed.[64]

LITTORAL COMBAT SHIP (LCS)

The LCS is a relatively small, relatively fast, and relatively inexpensive combat ship. It is designed to be modular; the basic sea frame will be outfitted with one of three alternative mission packages—anti-submarine warfare, mine warfare and surface warfare. Each mission module includes weapons, vehicles, and sensors, as well as supporting equipment, containers and software. The Navy wants to procure a total of 55 LCSs as well as 64 warfare packages—16 anti-submarine, 24 mine and 24 surface packages—to outfit the LCSs.[65] This new class of ships represents the backbone of the Navy's FY09 thirty year shipbuilding program to reach a force level of 313 ships of all types.[66] As Chief of Naval Operations Admiral Gary Roughhead has argued, "[y]ou can look at the shipbuilding plan and you can see that LCS is the major driver of the number, and it's not just to drive the number higher."[67]

The LCS is part of the Navy's new "Family of Ships" that includes the US Navy's next-generation destroyer, DDG 1000, and cruiser, CG(X). It complements the capabilities of the DDG 1000 and the CG(X) by focusing on littoral missions and, in particular, asymmetric threats. The family of ships is to be interlinked both by networks and by the insertion of common technologies across classes using spiral development. Further, in the case of the LCS, each vessel will require integration with the various components of its modular mission packages (such as UAVs and UUVs) and, if early operational concepts hold, with squadrons of other LCS fighting in concert.

The initial approach to developing the LCS had five teams competing for the opportunity to design the new class of vessels. In 2004 two teams, one headed by Lockheed Martin and the other headed by General Dynamics, were awarded final design contracts.[68] For this account we will focus on the Lockheed Martin variant. The LCS project represented a challenge to Lockheed-Martin because it is not a shipbuilder per se. Its experience with

[64] Clay Wilson, *Network Centric Operations: Background and Oversight Issues for Congress* (Washington, DC: Congressional Research Service, updated 15 March 2007), pp. 35-41.
[65] Rebekah Gordon, 'Littoral Combat Ship Mission Modules To Be Tested On Other Vessels', *Inside the Navy* (12 May 2008).
[66] Ron O'Rourke, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress* (Washington, DC: Congressional Research Service, updated 27 March 2008), especially p. 5.
[67] Dan Taylor, 'Roughhead: Navy Looking For A Ceiling Over The 313-Ship Floor', *Inside the Navy* (18 February 2008).
[68] Scott C. Truver, 'Taking Back the Littoral: US Navy Littoral Combat Ship Programme Update . . . And More!', *Naval Forces*, Vol. 27, No. 3 (2006).

naval vessels is largely as a ship system integrator, a role it played most prominently perhaps on the so-called Blue Team that produced one of the designs for the DD-21 in the late-1990s. To build the hull or sea frame, Lockheed Martin contracted with Marinette Marine.[69] Marinette Marine, despite having a long history of building naval and Coast Guard vessels, was apparently unprepared for the LCS project's complexity and program management and technical challenges.[70] Reports indicate that neither the Navy nor Lockheed Martin provided sufficient oversight to catch difficulties with the program or Marinette Marine's activities.[71]

Modularity of various types—principally, construction, configuration and mission—adds to the importance of systems integration for the LCS. Mission modules are being developed separately and will include initial testing on other classes of ships due to delays in production of the two initial LCS sea frames. Modularity compounds the more general configuration integration problem both because of the extent of mission package modularity required and the complexity of testing without actual sea frames. At an even more basic level, both Marinette Marine and Bollinger, the hull builder for the General Dynamics version, the LCS-2, will employ modular construction techniques such as building portions of the vessel out of sequence and at different sites only to be assembled into the final hull.[72]

Many of the numerous program management problems that have surfaced with the LCS can be linked to the issue of systems integration. Government audits indicate that Marinette Marine, the firm building Freedom (LCS 1) for Lockheed Martin, has experienced major difficulties in managing the program. In response to challenges, Congress and OSD have periodically threatened LCS funding and imposed restrictions on Navy plans. To date, while the entire program remains on track, the fate of the next several LCS to be produced remain in doubt.[73]

FUTURE COMBAT SYSTEM (FCS)

According to the US Army, the FCS represents its first major modernisation program in four decades; it is intended to implement the Army future warfare

[69] Geoff Fein, 'Team Effort Leads Lockheed Martin LCS Design', *Defense Daily*, Vol. 226, No. 22 (2 May 2005), p. 1.
[70] The Freedom's hull design was commercial and designers underestimated the difficulty of modifying it to make it suitable for naval operations.
[71] Christopher J. Castelli, 'Audit Exposes Failed Management of Troubled Littoral Warship', *Inside the Navy* (4 February 2008).
[72] On modularity variants in the context of the LCS program, see Robert O. Work, *Naval Transformation and the Littoral Combat Ship*, (Washington, DC: Center for Strategic and Budgetary Assessments, February 2004), especially pp. 119-121.
[73] Ronald O'Rourke, *Navy Littoral Combat Ship (LCS) Program: Background, Oversight Issues, and Options for Congress* (Washington, DC: Congressional Research Service, updated 7 April 2008).

vision.[74] According to Boeing, the co-lead systems integrator with Science Applications International Corporation (SAIC) for the FCS, the program is

> an Army modernization initiative designed to link soldiers to a wide range of weapons, sensors, and information systems by means of a mobile ad hoc network architecture that will enable unprecedented levels of joint interoperability, shared situational awareness and the ability to execute highly synchronized mission operations.[75]

Ultimately, a complex, multilevel network of networks (including standards, transport, services, applications, sensors and platforms) is to link individual soldiers with at least 14 combat systems ranging from manned and unmanned ground vehicles to unmanned aerial vehicles and sensors of many types. The FCS is to be developed in three stages—(1) concept and technology development, (2) system design and demonstration, and (3) production—by 2014.

If the Army succeeds with FCS it will outfit nearly one-third of its 70 combat brigades with the FCS for a total cost of perhaps $300 billion. The stakes are huge. By 2015 when the first combat brigade is scheduled to field the FSC, the program is expected to consume fully 40 percent of the entire Army procurement budget; it is expected to continue to do so at similar or higher levels until 2025 according to the Congressional Budget Office.[76]

To date, FCS has run into three major difficulties: (1) cost increases, (2) timeline slippages and (3) performance shortfalls. One major explanation for the weaknesses of the FCS is the assignment of Boeing and SAIC as lead-systems integrators.[77] Lead systems integrators play a dual role in defence acquisitions; they serve as traditional contractors by providing a product for the customer but also serve as partners in managing the program itself.[78] As the Army's experience with Boeing and SAIC indicate, it is not clear that even the most capable of defence firms are up to the greater than expected systems integration challenges posed by transformation.

The LCS and FCS examples represent two cases where the US Government turned to private firms to perform the systems integration role traditionally undertaken by the government itself. In both cases, false starts, delays, cost increases and increasingly adversarial oversight by Congress and OSD have damaged program credibility in Congress and thus endangered funding in the long-run. These are not, of course, the only

[74] Whether the FCS will actually fulfill this role is unclear.
[75] <http://www.boeing.com/defense-space/ic/fcs/bia/index.html>.
[76] Congressional Budget Office, *The Army's Future Combat Systems Program and Alternatives* (Washington, DC: Congressional Budget Office, August 2006), p. 40.
[77] General Accounting Office, *Defense Acquisitions: Role of Lead Systems Integrator on Future Combat Systems Programs Poses Oversight Challenges* GAO-07-380 (Washington DC: GAO, June 2007).
[78] Ibid. Definition adapted from page 1.

programs in the history of US military acquisition to experience such troubles. But, the ongoing complications are taking place at a point in history where the United States might be facing a window of vulnerability. Senior political and military leaders have promised military transformation, but defence industrial issues, particularly on-going difficulties with systems integration, remain an impediment.

Systems integration difficulties have been brought to the fore by the Government Accountability Office (GAO) and the Congressional Research Service (CRS). With regard to the FCS, GAO analysts argue that

> the vast scope of the FCS and the synonymy of the program with the future Army, poses risks for the Army's ability to provide independent oversight in the long term.[79]

In brief, GAO believes that the close relationship between the Army, Boeing and SAIC, the FCS systems integrators, weakens Army control over the program. The systems integrators both develop and manage the programs under contractual conditions that do necessarily provide appropriate incentives. The more general CRS analysis argues that the role of lead systems integrators (LSI) raises numerous oversight issues for Congress, including problems with inadequate transparency, potential conflicts of interest, questions about who certifies that work has been completed, whether it is possible to recompete LSI arrangements, and whether performing an LSI function gives a firm unfair advantages in future contract competitions.[80]

The 2008 House Defense Authorization Bill proposed prohibiting DoD from awarding any new contracts for LSI functions in the procurement of major systems as of 1 October 2011. Although the Senate version of the bill did not specifically mention LSIs, Section 807 of the National Defense Authorization Act for Fiscal Year 2007 imposes limits on contractors acting as lead system integrators in the acquisition of major DoD systems.[81] DoD issued an interim rule, which took effect on 10 February 2008, amending the Defense Federal Acquisition Regulation (DFAR) Supplement to implement Section 807.

Yet the attention and oversight of auditors and Congress may not be enough to overcome the trend toward the use of major contractors as systems integrators in the long run. The lack of experienced and appropriately trained government personnel, and the ever increasing pressure to decrease

[79] Ibid., p. 10.
[80] Valerie Bailey Grasso*, Defense Acquisition: Use of Lead System Integrators—Background, Oversight, Issues and Options for Congress*, (Washington, DC: Congressional Research Service, 6 March 2007), pp. 3-5.
[81] Robert Brodsky, Zack Phillips, Katherine McIntire Peters, 'Big Contracts, Big Problems', *Government Executive*, Vol. 39, No. 14 (15 August 2007), p. 27.

the number of government employees, may ensure that the systems integrator issue will be revisited in the near to medium term.

Global Impact of US Defence Industry Responses to Military Transformation

The implications of current US difficulties executing programs requiring a high degree of systems integration at all levels—from weapons to platform to system—have both domestic and international implications. On the domestic side, cost increases and program delays may hinder the scope and pace of transformation, regardless of whether transformation is or is not in the best interests of the nation. They also have encouraged greater Congressional oversight and added impetus to calls for acquisition reform including the jargon-laden approaches like the so-called revolution in business affairs. Depending on where one sits these may be positive developments, but certainly they portend more institutional and programmatic turmoil as institutional arrangements and rules continue to be revised and reformed.

The international implications of the movement of large contractors toward systems integration are diverse. Large European firms including BAE Systems, EADS, and Finmeccanica have largely followed, with a slight delay, their North American counterparts. In the post-cold war period they too went through bouts of consolidation and civil-military integration not to mention a long-term infatuation with globalisation. Globalisation, in particular, encouraged European firms as they sought to break down barriers to the North American market and link when possible with US and other non-European firms to acquire technologies and entry into markets. More to the point, with US defence budgets shrinking more slowly than their European counterparts during the 1990s and rising more rapidly after September 11, European firms sought globalisation (or better perhaps Americanisation) to follow the money and hence profits. Today they too are positioning themselves as systems integrators in Europe, when possible in the United States, and globally.

With regard to the relationship between military transformation in other countries aside from North America, Europe and one or two other countries (like China), the move toward systems integration as a core business capability (even if by necessity) may provide even greater commercial advantages to the ten or twenty largest defence firms. Countries seeking to purchase transformative military systems and equipment may have to rely even more heavily on non-indigenous producers or risk fielding inferior weapons and systems.

At a more modest level, using prime contractors as integrators allows second and third tier producers to enter markets, including the US, as subcomponent suppliers and design agents, for example, with less direct

interaction with the military acquisition system. In the case of the LCS, for example, the two sea fames adapted for LCS 1 and 2 came from overseas firms. This may provide opportunities for individual firms but it may also add to the integration difficulties with systems of systems programs. COTS, especially from offshore vendors, may reduce costs while increasing management burdens. Moreover, as with all prime contractors, LSIs will continue to be tempted to buy internally. And less than adequate government enforcement of rules and norms favouring greater competition will undermine the entry of new firms, foreign or otherwise, into the US defence market.

Conclusion

Defence transformation remains a priority of the United States military, but the ability of the OSD and the four military services to deliver on the promise of the IT-RMA is in doubt, at least at the pace and to the extent envisioned by early transformation proponents. The Iraq and Afghanistan campaigns have cost the US military, especially the Army and the Marine Corps, an enormous amount of equipment that will have to be reset and/or replaced. Whether recapitalisation will lead to more innovative systems such as the FCS or less futuristic modernisation is as yet unclear. Post-war recapitalisation will, in all likelihood, take into account the hard fought lessons of actual combat in the post-9/11 era; Secretary of Defense Robert Gates clearly weighed in on the side of worrying more about current conflicts than the next war, much less the war after next.[82] Some assumptions of early transformation proponents have fallen by the wayside. Smaller, faster and lighter may make sense in theory but in reality America's enemies have proved resilient and adaptive. Light ground systems have proved vulnerable to increasingly powerful IEDs and small arms.[83] The perceived need to maintain a naval forward presence, particularly "credible combat power forward",[84] at a time when the number of ships available to both the US Navy and major US allies such as Great Britain is declining suggests that smaller, less expensive vessels will remain appealing. Yet, rapidly increasing shipbuilding costs may ultimately limit the size of the force, even when large numbers of vessels, like the LCS, are meant to be smaller, cheaper and tailored to a new international security environment.

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[82] Thom Shanker, 'Gates Says New Arms Must Play Role Now', *New York Times*, 14 May 2008. Relevant excerpts from the Gates speech at a Heritage Foundation sponsored conference include: 'I have noticed too much of a tendency towards what might be called next-war-itis — the propensity of much of the defence establishment to be in favour of what might be needed in a future conflict . . . Over all, the kinds of capabilities we will most likely need in the years ahead will often resemble the kinds of capabilities we need today.'

[83] GAO, *Defense Acquisitions*, p. 63

[84] On the imperatives of the new tri-service maritime strategy see *A Cooperative Strategy for 21st Century Seapower*, first presented by the Chief of Naval Operations and the Commandants of the US Marine Corps and US Coast Guard at the International Seapower Symposium in Newport, R.I. on 17 October 2007.

The defence industry did adapt to the transformation mandate in the late 1990s and the first years of the 21st century, but events overcame the best of intentions. Industry trends since the demise of the Soviet threat reduced the ability of industry to respond to calls for transformation. In particular, the imperative for systems integration implied by network centric approaches to warfare has not been always been well served by the large prime contractors that emerged triumphant in the late 1990s. COTS technologies once thought to promise cost savings and innovative, cutting edge technologies for military systems have sometimes proved chimerical. Military purchasers have ceded oversight to private firms working on their own accounts and, perhaps, more willing to misrepresent technological possibilities and challenges.

Globalisation also remains a fact of life with paradoxical affects on American defence firms. The spread of technologies and knowledge continues apace despite restrictions imposed by the United States and other western governments. The restrictions on American firms—such as "Buy American" provisions, DFAR regulations, export controls, and Exon-Florio restrictions—have prevented them from fully exploiting the potential advantages of partnering and purchasing aboard but have only slowed the spread of technologies. The critical role of systems integration in military transformation provides opportunities for American prime contractors but it may also encourage other government and non-government competitors to develop the necessary capabilities. The Chinese military, for example, has managed to leap ahead in some key war-fighting areas with help from foreign military purchases and its own society's growing technical sophistication. It may be just a matter of time before demand combined with the diffusion of knowledge undermines the advantages of the US military and its partners in the transformation enterprise.

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