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## SUMMARY

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Declining defense budgets and growing weapon system procurement costs, combined with advances in commercial technologies, have led some observers to advocate the integration of the U.S. civilian and military industrial bases, a concept commonly referred to as Civil-Military Integration (CMI). As discussed in Chapter Two of this report, CMI advocates believe that DoD adoption of CMI would

- Reduce costs of acquiring and supporting weapon systems
- Improve performance throughout the life-cycle of a weapon system
- Shorten development times
- Improve reliability and maintainability
- Help maintain the defense-relevant portion of the industrial base.

To achieve the benefits of CMI, advocates call for a relaxation of the government-imposed oversight framework of regulatory restrictions that segregate weapon system acquisition from common commercial market practice and impose a regulatory cost premium on items purchased by the government. They base their arguments on two types of assumptions. First, they assume that an extensive “dual-use” overlap between commercial and military process and product technologies creates the potential for significant economies of scope and scale. Second, they assume that commercial business practices, together with the competitive incentives and constraints provided by a commercial-like market structure, will spur the development of

high-performance weapon systems at lower cost than can be achieved under the current heavily regulated military acquisition process.

Critics of CMI respond that there is in fact little dual-use overlap between commercial and military products and processes in most crucial technology areas, so that integration of the defense and commercial industrial bases is simply not possible. Thus, CMI offers no real prospect for increased economies of scope or scale. Further, critics argue, DoD adoption of commercial business practices is unlikely to ensure DoD access to high-performance weapon systems at a reasonable price. They believe that relaxation of close government supervision over product development, together with removal of various other regulatory safeguards, will simply result in price-gouging by contractors and perhaps even outright fraud.

#### **THE NATURE OF THE DUAL-USE OVERLAP: RF/MICROWAVE DEVICES**

Trends in DoD market shares for many military-relevant avionics parts, together with supplier base shrinkage and obsolescence issues, indicate that the use of commercial-grade parts will increase dramatically whether or not a comprehensive CMI strategy is already in place. There is little question that, in some technology areas that are not defense-unique, the commercial sector is more technologically advanced than the military sector. These areas, sometimes referred to as the “low-hanging fruit” of DoD acquisition reform efforts, include items such as personal computers and certain microprocessors. Many efforts are now under way with little controversy to procure such items in the same way as in the commercial world.

For a rigorous comparison of the claims and counterclaims about the nature of the dual-use overlap between commercial and military product and process technologies, however, it is necessary to examine a product area that historically has been dominated by defense purchases. We select the area of radio frequency (RF)/microwave devices because it has traditionally been largely defense-specific, and because products such as fighter fire-control radars and fighter electronic warfare systems are of critical importance to future Air Force combat aircraft capabilities.

The questions we address are:

- Is the commercial market in military-relevant electronics large enough to encompass an adequate range of technologies, parts, and components required to support a comprehensive CMI strategy for military-specific microwave subsystems such as fire-control radars? (Chapter Three)
- Is the civilian market driving technology at a rate and in a direction that meets national security requirements? In other words, can CMI provide the necessary and desired performance capabilities? (Chapter Four)
- Are there cost and schedule benefits from inserting commercially derived parts and technology into RF/microwave systems? (Chapter Five)

We conclude that, in the critical area of defense-related microwave and millimeter-wave technologies, the dual-use promise of CMI is likely to be realized. Specifically, we find that the civilian market is beginning to drive the development of new technologies and lower-cost manufacturing processes in many types of RF/microwave products relevant to the military. Commercial design methodologies and process technologies are of growing relevance to military avionics system design and development, and commercial demand for many types of sophisticated RF/microwave parts and devices has already outstripped military demand. Commercially developed RF/microwave parts and components are also becoming increasingly available for incorporation in military systems. This implies that the technological breadth and depth in the commercial RF/microwave market necessary to support a comprehensive CMI strategy are emerging.

We also find evidence to suggest that commercial-grade parts and components can be successfully inserted into RF/microwave military avionics systems without degrading system performance. In fact, some commercially derived designs, technologies, and processes have the potential to increase performance. However, legitimate concerns remain about the long-term reliability and durability of commercial-grade parts and components.

Our response to the question of cost and schedule benefits is generally supportive of the dual-use nature of at least some RF/microwave technologies. The systematic insertion of commercial parts and technologies, combined with dual-use automated manufacturing processes, has the potential to shorten R&D schedules and reduce costs. There is some evidence to suggest that such a strategy could reduce costs of digital military avionics modules by as much as 20–50 percent. To achieve these cost and schedule benefits, however, contractors may have to be granted greater configuration control and change authority not only during the R&D phase but throughout the life-cycle of a weapon system. More analysis of this question needs to be undertaken.

### **ELEMENTS OF A COMMERCIAL-LIKE APPROACH TO ACQUISITION**

Whether or not there is a large overlap between civilian and military products and processes, most CMI advocates believe DoD would benefit from adopting a more “commercial-like” approach to weapon system acquisition. Advocates claim that reliance on common commercial business practices, rather than regulation, will improve DoD access to low-cost, high-performance products.

But, as discussed in Chapter Two, there are many possible interpretations of what constitutes common commercial business practice, interpretations that depend on the nature of the products and product markets being considered. We therefore examine the commercial transport aircraft market, which has many structural similarities to the military aircraft market, to see what sorts of mechanisms commercial aircraft integrators, the suppliers of major aircraft systems, and the suppliers of aircraft parts and components are using to minimize their risks. We argue that these mechanisms may also effectively reduce the risks associated with the development, production, and maintenance of large and complicated weapons systems.

To assess the extent to which, and with what success, commercial-like approaches are being applied in military weapons programs, we examine experimental and pilot programs initiated by the Air Force, the Defense Advanced Research Projects Agency (DARPA), and the other services that contain key elements of the commercial ap-

proach. The programs we review include three “smart” munitions programs [the Joint Direct Attack Munition (JDAM), the Wind Corrected Munitions Dispenser (WCMD), and the Joint Air-to-Surface Stand-Off Missile (JASSM)]; two programs for the development and possible production of high-altitude endurance unpiloted air vehicles (DarkStar and Global Hawk);<sup>1</sup> plus an innovative modification program, DoD’s Commercial Operations and Support Savings Initiative (COSSI).

The questions we address in Chapters Six and Seven are:

- What mechanisms have commercial market participants evolved to reduce risks associated with the development, production, and maintenance of large transport aircraft? To what extent are they relevant to DoD? (Chapter Six)
- To what extent, and with what success, have commercial-like approaches based on market mechanisms been applied to military programs, and what can be learned from them for future efforts? (Chapter Seven)

With respect to the first question, we find that the binding cost constraints introduced by airline deregulation have encouraged airframe integrators to forgo economically unnecessary performance innovations in order to adhere closely to production price targets. To achieve these targets, commercial airframe integrators increasingly are partnering with a small number of domestic and international suppliers with whom they share sensitive cost and technical data. These suppliers often provide their own financial capital as well as technical capabilities. To reduce risks for all concerned, the airframe integrators are strengthening lines of communication among their airline customers, their suppliers, and themselves through mechanisms such as integrated product teams (IPTs). Their contract structures are flexible, reflecting the relative commitments of the partners. For example, where risks are relatively low, such as for commodity purchases, firm-fixed-price contracts or simple purchase orders are common. Finally, to promote the reliability and maintainability of systems over time, there is a growing trend among air-

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<sup>1</sup>The DarkStar program was cancelled in early 1999.

lines to outsource life-cycle system support services to original equipment manufacturers on the basis of fixed-price contracts.

Our examination of the commercial aircraft industry suggests that many commercial business practices are indeed relevant to military acquisition programs. Examples include IPTs, “best value” sourcing through preferred providers, and flexible contract structures that allow varying degrees of risk-sharing. Nevertheless, it can still be argued that important differences remain between the commercial aircraft and the military aircraft markets. Most notable of these are, first, the existence (in most cases) of a single buyer in military markets, and second, the tendency (or necessity) of military programs to incorporate high-risk (less mature) technologies to achieve the highest possible performance. These differences raise serious questions in the minds of some CMI opponents as to the applicability of commercial market mechanisms to military acquisition programs.

Our final set of case studies of the JDAM, JASSM, and WCMD munitions programs strongly indicates that a commercial-like acquisition strategy can be applied to military-unique items, and that significant benefits, particularly in terms of production price, can be achieved. In all three munitions programs, the likely acquisition prices appear to be considerably less than half of what they would be in a traditional military procurement program, and with the large procurement numbers involved, this should result in significant savings to the government. Further, although R&D is not complete on all of these programs and some technical problems have been encountered, operational performance capabilities appear on the whole to be meeting or exceeding original requirements, and the R&D phase for all three has remained relatively short by traditional military developmental standards.

In our judgment, the key aspects of the munitions pilot programs that have helped to achieve these successes are:

- Requirements reform and a closer customer-developer relationship through mechanisms such as IPTs, within an environment of binding cost constraints
- Contractor ownership of and responsibility for design, technical content, performance, reliability, and price.

However, we also believe that contractors could have taken on greater price risk in the production phase as well as cost risk in the R&D phase. Commercial transport aircraft developers price even their first aircraft according to a projected average recurring and nonrecurring cost over a relatively large production run, even though they have no guarantee that they will sell any aircraft at all. This is because customer airlines in the commercial marketplace would not tolerate paying the high price necessary to cover the actual recurring costs to the manufacturer of the early production aircraft. The experiences of DarkStar, Global Hawk, and COSSI suggest that greater cost risk sharing between the government and defense contractors is also possible, resulting in significant further cost reductions to the government of weapon system acquisition.

Finally, we conclude by cautioning that a CMI acquisition strategy does hold potential for a real loss of military capability. To the extent that the old flexible budget approach to acquisition resulted in weapon systems with many unnecessary features (“gold-plating”), a more commercial-like approach to weapon system acquisition would lead to a more responsible, cost-effective stewardship of the nations’ resources. However, to avoid accidentally sacrificing features that may be crucial to successful mission completion, DoD must thoroughly understand the performance, schedule, and cost priorities for each new weapon system it solicits. Perhaps no less important, DoD must be able to communicate effectively those priorities to the program managers and private-sector contractors who have responsibility for making the tradeoffs between them.