John A. Alic, *Trillions For Military Technology: How The Pentagon Innovates And Why It Costs So Much*

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Since the end of the Second World War, the United States has spent some US$2 trillion (in year 2000 dollars) on defence R&D. Some of the outcomes have been extraordinary — terrifyingly destructive nuclear weapons; ever-more lethal missiles and bombs, capable of being targeted with ever-greater precision; stealthy planes with radar signatures the size of a golf ball; extremely accurate global positioning systems; computer networking and, of course, the Internet.

But there has also been a long string of disappointments, stark failures and frequent cost overruns and delays.

Few analysts are better equipped than John Alic to assess and explain the pattern of success and failure, and draw lessons for the future. Alic cogently explains the unique difficulties that beset major innovations in weapons systems: the ever-growing complexity of those systems; the fact that they need to operate in an environment subject to destructive attack; and the difficulties that come from very infrequent use for their intended purpose, which limits the scope for learning and incremental improvement. But, Alic argues, these inherent problems are compounded by three additional sources of failure.

The first is failures in military planning and doctrine; that is, in the foresight of the military missions that will be required and of the role weapons systems will play in these missions. The overwhelming concentration in the 1950s on nuclear strategy, for example, led the US Air Force to focus development and procurement on the high-speed fighter-bomber interceptors of the so-called Century Series.[2] As a consequence, the Air Force was very poorly prepared for the air-to-air combat and (even more so) ground-support functions required in Vietnam, with the result that losses were extremely high.

A second source of failure is the refusal by the services to define rationally the requirements for the systems they seek to procure. Engineering design is about making trade-offs based on the value to users of the various features a

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[2] These included the F101 Voodoo, the first USAF aircraft to exceed 1000mph, and to be armed with nuclear air-to-air missiles.

system can provide. In the private sector, those trade-offs are forced on suppliers by the drive for profit-maximisation and by the threat of displacement. In defence, those forces are blunted by soft budget constraints. The distortions soft budget constraints create are compounded by the fact that as systems become ever costlier, fewer items are purchased, and system development times and service lives become ever longer — inducing each defence arm to try to cram into the initial design all the capabilities a system may ever need. A classic, much studied, case is the B-1B bomber (the intended successor of the B52 Stratofortress), whose design was fatally compromised from the start by the Air Force's insistence on the incompatible requirements of both high-altitude supersonic flight and terrain-hugging bombing runs at treetop level.

Third and last (but by no means least), the defence system environment is often poorly adapted to learning, both as between successive system development efforts and within the lifetime of individual systems. The acquisition process can be good at generating product variety but then does not perform as well in selection, ongoing learning and system adaptation. This reflects two features of the defence environment: the fact that there is no market-like mechanism that can weed out inefficient approaches and properly reward ongoing improvement; and the infrequency with which most systems are ever used in combat, and hence the limited scope for learning and forced selection.

Alic also notes the many difficulties in assessing the performance of defence system development efforts. In particular, it cannot be stressed too much that 'failures' are not only inevitable but also often valuable; they allow learning to occur. Few significant innovations in defence systems spring forth fully formed; rather, those innovations are typically the outcome of a complex, messy, often very prolonged process, in which dry wells abound. Research to reduce radar reflections from aircraft began in the early 1950s; but it was only when Lockheed built two stealthy planes in the mid-1970s that it became clear that such planes could be built at all; and the effectiveness of stealth was not tested and shown in a war-fighting situation until 1991, when the F-117 was used to considerable effect in Iraq. A fear of failure would have been fatal to this innovation.

This is, in my view, especially important because the difficulties of defence innovation tend to be more visible, and the memory of them more enduring, than the successes. Massive cost blow-outs have blighted many civilian R&D projects, such as IBM's landmark development of its 360 series in the early 1960s. But what is remembered today about the 360 series is that it was the key to IBM's 25-year dominance of the computer market, bringing profits many times its costs.

In defence, however, there is no market that gauges and translates into a visible indicator (as profits and losses are in the private sector) the 'military value' arising from successful innovation. As a result, while the cost blow-outs

become engraved in public consciousness, there is no offsetting accounting of the gains. Australia's acquisition of the F-111 is a case in point, a project so troubled as to almost cost Malcolm Fraser his job as Defence Minister. Yet the system itself has provided outstanding service for several decades. Any retrospective cost-benefit analysis would likely find that the cost over-runs were trivial compared to the gains.

The challenges of defence innovation will only become greater in the years ahead. Budgetary stringency in the US seems certain to reverse the enormous expansion in defence outlays of recent years. At the same time, the technological complexities involved in defence innovation are not diminishing. Software development, which accounts for an ever-higher share of defence R&D outlays, poses formidable problems of cost predictability and project management, as well as of quality assurance. The attempt to develop truly 'networked' war-fighting capabilities, involves a massive software challenge, in which only very limited progress has been made to date.

Alic believes that if these challenges, and the many others facing the defence innovation system, are to be met, major changes are needed to the way the system works. In particular, he sees great value in returning to the McNamara vision of civilian control over weapons-system development choices, control exercised through the systematic use of cost-benefit and cost-effectiveness studies. The Planning, Programming and Budgeting System (PPBS) that McNamara and his team of economists — including Charles Hitch and Alain Enthoven[3] — brought to the Pentagon, and that Sir Arthur Tange sought to introduce into the Australian defence establishment, would be given a fresh lease of life, and used to force discipline on the services in the structuring of individual projects and of choices between alternative projects.

Unfortunately, Alic's treatment of how this would be done is rather cursory. It is not clear from his discussion why PPBS failed in the first place. There is some truth in the proposition that PPBS was made into a convenient scapegoat for the failures in Vietnam, despite the fact that it worked reasonably well in that conflict, but as Enthoven himself recognised (see Enthoven and Smith 1971), that is not the whole story.

Alic's failure to thoroughly develop his proposed solution is one of the book's few weaknesses. These weaknesses notwithstanding, this is a very valuable book indeed, and I highly recommend it to all those with an interest in the economics of defence innovation. It is a pity that there is so little interest in Australia in

[3] Hitch was Assistant Secretary of Defence 1961–65 while Enthoven was Deputy Assistant Secretary of Defence over the same period. Charles Hitch is perhaps best known among economists for his exploration with Robert L. Hall of the 'kinked demand curve' theory of pricing.

the economics of defence system acquisition. Our own, often troubled, acquisition processes would be the better for it.[4]

References

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[4] It is probably not entirely coincidental that at university Tange had studied economics, under E. O. G. Shann.