Integrators in Defence:
Is There a Trade-off Between Gate-Keeping and Innovation?[1]

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Draft (June, 2005)

Abstract

The concept of system integrators in defence has resulted in a major contractor providing a complete system-solution to defence agencies and armed forces. Armed forces, then simply operate, while in the past they acted more as 'black boxes' in putting such systems together using assets from different contractors. The maintenance of few consolidated firms has the advantage of gate-keeping the necessary technologies, while the armed forces become more of an end-user. This emphasis on the 'network-providing' characteristics of the consolidated defence firms could result in the integrator obtaining more of an expert status compared to the armed forces and consequently determine the technological feasible level of operations, as well as, raise the barriers to entry for new firms which can lead to a reduction in the level of innovation for novel products.

[1] Paper presented at the 9th Annual Conference on Economics and Security, June, 2005, UWE, Bristol, U.K. I am indebted to Peter Swann for his useful comments, the usual disclaimer applies.

I. INTRODUCTION

In assessing the role of integrators and the post-cold war consolidated industries in Europe and the US it is important to look at the technical perceived advantages of a vertically integrated firm in developing modern weapons systems and networks.

Highly sophisticated computer based systems were enjoying a low esteem to the eyes of weapon systems developers during the cold war owing to their vulnerability to e-network based systems on nuclear attacks and electro-magnetic (ECM) pulse. The Cold War called for standoff dogmas and defence system development at a high pace; in that sense it was more of a race.

From the mid-1990s onwards the threat of a nuclear world war III has diminished, but there is ongoing defence system development at strategic level by Russia and the US, as well as China and other powers. This was made vivid by the decision of the US to maintain the option of developing space-based defence systems in the early 2000s and reserve the right to protect space assets (David, 2005). Technology permitting, weaponization of space would lead to assets that are the dream of every computer game and star-wars fan. Such assets can give a different dimension to the concept of a one-aircraft air force as the aircraft can also a spaceship, a launcher, a satellite and a bomber providing a new meaning to the term revolution in military affairs (RMA- see Cohen, 1998). An aerospace-plane (ASP) that can gather its own space-based intelligence, identify targets and strike them – all in one asset. The developments of such integrated defence systems, as well as the e-network development are two key factors of having a system integrator over contracting firms whose assets are technically fixed together by the armed forces.

The drawback of a ‘one aircraft’ air force is that it can result in a ‘one firm’ industry that builds it not only for economic reasons (lower of transaction costs, economies of size), but also for better security in leaks of the respective technologies (gate-keeping).

This is an IBM-type model of product and industrial integration, but without the contestability elements the respective firm experienced from other firms developing the stand-alone personal computer (see Dorfman, 1987; Flamm, 1988 and Langlois, 1992). This would result in short run savings for the government, as a larger part of the role of the armed forces is contracted out and having one integrator in charge of a defence system can potentially reduce technology security leaks, but the gate-keeper of the technology and future technological feasibility becomes the firm.

The profound dangers of consolidation for innovation owing to the presence of non-contestable domestic monopolies (see Flamm, 2005, Merle, 2003) are therefore augmented by the qualitative factor of diminished technical feasibility of the government-customer.

This paper analyses the advantages and drawbacks of contracting-out of national security and the customer type characteristics of the armed forces paying particular attention to implications for technological developments and innovation.

II. GOVERNMENT AND THE PROVISION OF DEFENCE

At the one extreme, government manufactures, owns and maintains key defence and space assets, while at the other extreme the government contracts-out the necessary defence services to contractors (customer- Figure 1). The customer-extreme regime relates to the government hiring the services of professional firms to the point of non-nationally owned defence forces, but simply contractors. A more realistic approach would be that the government maintains ownership, but rents maintenance and management to private contractors.

Different nations have historically used different industry-government regimes to provide defence services. Following economy-wide differences, countries like the US have opted for privately owned firms acting as contractors and manufacturers of systems requested by the armed forces, while much of the respective Research and Development was conducted by both private and publicly owned establishments. In contrast to that, the Soviet model of design bureaus competing for projects that could be manufactured by unconnected (in terms of management) machine production factories, wholly owned by the state. The end of the Cold War and the subsequent waves of privatisation at a global scale resulted in countries like the U.K largely privatising its defence industry, followed to a lesser degree by France, Germany Italy and Spain (see Hartley, 1998; Mawdsley, 2003), while the U.S. moved further up the pyramid of Figure 1 by fully contracting-out maintenance over major systems, such as the Space Shuttle (to the United Space Alliance a 50-50 joint venture between Lockheed Martin and Boeing) and trying to privatise satellite remote sensing services

(Landsat). The trans-nationality of the European defence industry was thus materialised in aerospace through the creation of EADS and the initiation of a landmark public-private-partnership that would allocate control and management to a commercial entity of the strategically important asset of satellite positioning and navigation services (European Galileo- see Zervos and Siegel, 2005).

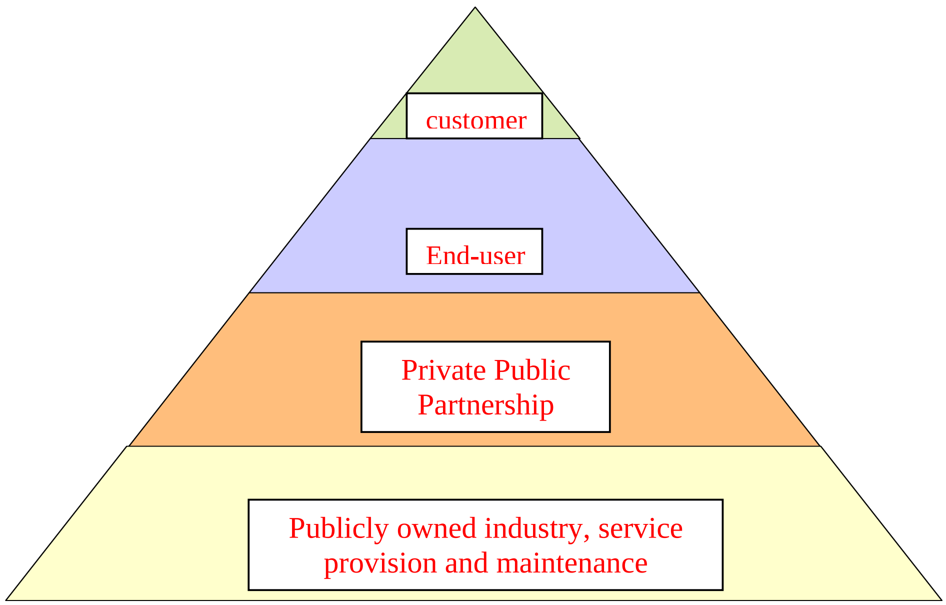


Figure 1

The Role of the Public Sector vis-à-vis the Defence Industry

Throughout these examples a clear movement up the pyramid of Figure 1 is experienced on a global scale. Assuming the presence of economic cost-related advantages in privatising R&D and production and maintenance of defence related services (examined below), the main drawback encountered is the significant increase of the share of defence technologies and know-how to commercial entities. At the extreme case where operations are also turned-over to commercial entities concerns are raised in terms of accountability of operations, as well as profit considerations taking precedence over security. This was illustrated in the case of U.S. expressing its willingness to take direct action against systems such as Galileo if it provided its services to China in case of a future U.S.-Chinese conflict; while arguably concerns have also been raised over the code of conduct of commercial enterprises involved in security operations in Iraq and other points of conflict. The issue of control and code of conduct of commercial defence-related service providers is therefore becoming increasingly important for defence. In this perspective, there are advantages in terms of monitoring costs of having just one, or a limited number of contractors supervising the relevant operations. By the same token, there are advantages in having few (or just one) firm orchestrating R&D for new network based defence systems in terms of gate-keeping the relevant technologies.

III. THE IMPACT OF SPACE AND NETWORKS ON PRODUCT CHRACTERISTICS

The use of network-intensive defence technologies and dogmas follows from perceptions of cost advantages from increased use of technology and interoperability of different armed services through network multiplier effects. This puts increasing emphasis on the interconnectivity, or the network-specific characteristics, as opposed to the value of the assets seen in isolation from each other:

'Just 20 or 30 years ago, the airplane was the thing, or the ship was the thing, now those things are just nodes in the network and the network is the thing' (Stuart McCutchan in Merle, 2003).

The use of space-based assets is of strategic importance ever since the Cold War, but unlike other strategic weapons like intercontinental ballistic missiles (ICBMs) can be used not just as a deterrent, but much more flexibly to provide long-range communication and remote sensing (RS) capabilities (a use emerging primarily from the U.S. Vietnam war). Space allows long-range networking capabilities and has been used extensively to multiply the effectiveness of high-technology assets[2]:

'Space power has become as important to the nation as land, sea, and air power. The evolution toward a global economy will depend as much upon the information lines of communication through space as it will on the transportation lines of communication across the sea. Space forces will support the realization of Joint Vision 2010 by dominating the collection and dissemination of information in support of military operations. Consistent with National Space Policy, DoD is committed to utilizing and, if required, controlling space to assist in the successful execution of the National Security Strategy and the National Military Strategy' (Cohen, 1998: Chapter 7).

'Technological advances create the potential for new forms of competition in space and cyberspace. Space and information operations have become the backbone of networked, highly distributed commercial civilian and military capabilities' (Rumsfeld, 2003: 15).

The strategic use of assets such as space navigation services and e-networks for a wide range of 'conventional' weapons has essentially the same impact on them as process innovation. Figure 2 applies Lancaster's exposition of new products and old products as merely different fixed combinations of their respective characteristics (see Baldwin and Scott, 1987) to defence goods.

[2] The best known example is the pathway and target identification dependence of cruise missiles like Tomahawk; without space-based services the ownership of the relevant missile technology would be of limited use to any owner for targeting and navigation purposes.

In this framework, a movement farther out along the rays correspond to the capability of the given asset to produce more of the relevant characteristics (Z1, Z2) and is attributed to process innovation. In contrast, product innovation would have the effect of the creation of a new ray corresponding to different combinations of the two characteristics (Z1 and Z2). Assume target accuracy and close-infantry support[3] as the respective characteristics (Z1, Z2) of attacking aircraft and artillery assets, the use of space based assets such as e-networking (telecommunications), RS and navigation can extend the relevant rays along a two-characteristics diagram (Figure 2) at a low marginal cost (as satellites are essentially sunk costs – see Neven et al, 1997 and Snow, 1987).

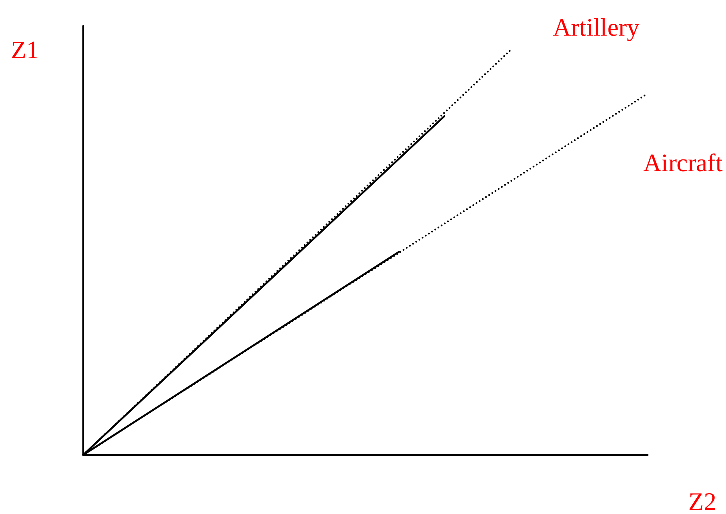


Figure 2

Network Effects on the Characteristics of Conventional Defence Goods

[3] Another well-suited characteristic that can be used is reliability.

The use of this example for the widest possible set of ‘conventional’ weapons results in more effective use of sunk costs and multiplier effects from networking with such strategic systems (in contrast to the aforementioned inability of ICBMs to have such multiplier effects).

Again, the presence of a limited (or just one) agent that links those assets and provides the network is seen as beneficial, given the presence of transaction costs and the need for common standards. This is a role traditionally reserved for the armed forces themselves, but the increasing complexity and use of civilian-developed technology on such networks invites increasingly closer partnerships between commercial providers and the armed forces.

In terms, therefore of both monitoring and transaction costs, the concepts of integrators in defence is seen as advantageous given the new technological and networking developments. The implications of this for the traditional dilemma of competition versus consolidation in defence is that it appears to tilt the balance in favour of consolidation of the defence industrial base and the creation of mega-firms that provide integrated solutions.

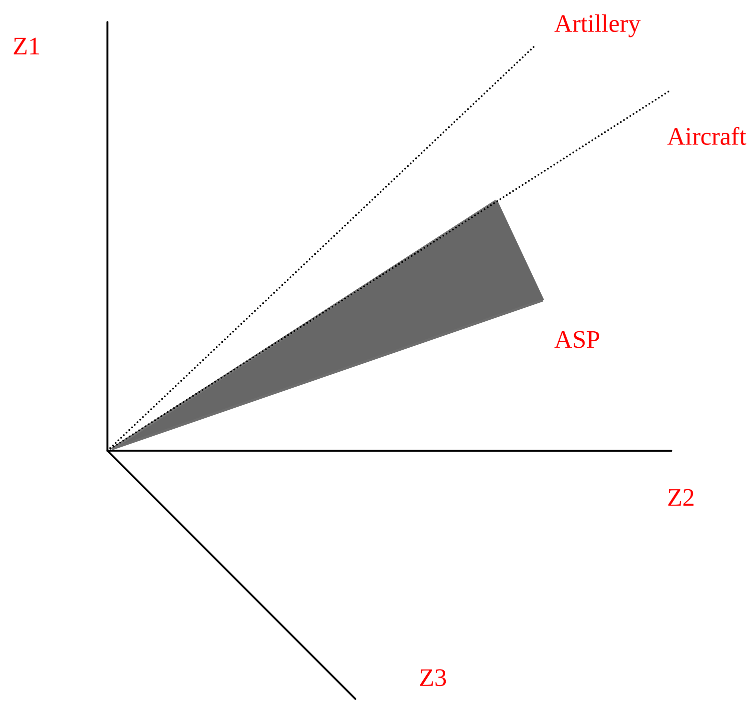
IV. IMPLICATIONS FOR INNOVATION

For space, if system integrators, rather than space agencies like NASA, or the DoD assume responsibility for manufacturing and maintaining space habitats and military purpose built aerospace-planes then the respective technologies might take longer to mature and become operational, as those integrators will be able to define the envelope of technological feasibility for such systems, while being subject to X-inefficiencies from the absence of competitors due to security and protocol-related barriers to entry:

"Consolidation carries the risk that DOD will no longer benefit from the competition that encourages defense suppliers to reduce costs, improve quality, and stimulate innovation" (U.S. General Accounting Office, 1997, p. 21, quoted in Lorell et al, 2002: 6)

The military applications of aerospace-planes (ASP) researched by a number of countries, including the U.S., Japan and several European nations (U.K., Germany, France) are quite promising and can revolutionise warfare capabilities (see Vick et al, 1999 for X-40 and other relevant programs). A military version of ASP can perform both the role of RS and telecommunication satellites, as well as, having the striking capabilities for close air support of surface targets. In essence, in the previous two dimensional setting, where the two axis measure target accuracy and close-infantry support, a third element is added –of strategic nature- remote sensing capabilities. Thus, the ASP is qualitatively different to the 'aircraft' in our previous example in terms of its characteristics.

In Figure 3, the ASP is perhaps less capable than an aircraft in terms of close support, but much of the network augmented characteristics are endogenous, as the ASP has its own satellite-like capabilities (remote sensing – Z3). Space based stand-off weapons like ICBMs need not rely on e-based networks for accurately and timely performing their missions, as space and air capabilities are combined in one platform.



<u>Figure 3</u>

Two in One = Three

Following Swann (1990), innovative entry that increases dimensionality of product characteristics (Z3) takes place following congestion in the existing characteristics space (Z1 and Z2 from Figure 2). The presence of four generations of fighter aircraft can be easily interpreted as pushing the envelope of technical advancements within platforms that are reaching their boundaries in terms of technical improvements. The e-network developments despite their ability to push the envelope and improve on existing characteristics through multiplier effects, still do not increase dimensionality as the introduction of new concepts like the ASP does in Figure 3. The question then is how is this innovative entry going to materialize in terms of cost efficiency for the military and what are the institutional developments necessary for the adoption of the new technology. This raises two questions, the first relating to the developments within the branches and operations of the armed forces and the other on the defence industry. This paper focuses primarily on the industry, while leaving questions of armed forces restructuring and inter-operability with allied forces for future research.

The defence industry has lost much of its cutting technological edge-status following the RMA and the increasing significance of electronics as e-commercial systems are a bigger and technically equally demanding market (see Dowdall et al, 2004). The armed forces find themselves increasingly using technologies developed under civilian electronic products and programs (ibid). This is also true for the reusable-launching technologies field (ASP) as the relative weight of the defence industry and the armed forces is not what it used to be before the end of the cold war.

Commercial launching companies have spun-out and projects like the X-prize foundation[4] have shown that the level of technological development and innovation in the private sector can potentially overshadow military technological developments, if the relevant civil markets for space travel develop (see FAA, 2005 for suborbital projects assessment). Nevertheless, the armed forces technical requirements are very different to comparable civilian product requirements and though possible in the future, it is unlikely that defence project development will become like any another segment of custom-made civilian products.

[4] Since the inception of the X-prize Foundation to develop a competition for promoting technological innovations in space in 1996 over 20 teams registered for the U.S. $10 million ANSARI X PRIZE, which was won in 2004, by the developers of the reusable, spacecraft, "SpaceShipOne", which managed to fly twice into space (above 100 Km) within a two-week period (Diamantis, 2004).

The formation of aerospace and defence integrators ensures the adaptability of advanced civilian technologies to meaningful products for the armed forces, but the cost of the military becoming an end-user is that it is faced with an uncontested monopoly, that as an expert can determine the technically and operationally feasible, unlike the civil sector, where a company can get a second quote on its system requirements. The bidding contest is run by the integrator that decides on the winning project, while the armed force is limited in choice and knowledge of technical feasibility.

In summary, the customer-oriented role of the government is partly the result of the reverse of the traditional view that military programs create technological spin-offs to civilian sectors. The armed forces, thus increasingly become another customer of commercially developed technologies. This approach though economically attractive results in the armed forces losing control of their systems technological developments and perceptions of cost-efficiency, with armed forces maintaining sizeable provision of relevant services by firms.

V. CONCLUSIONS AND FURTHER RESEARCH PROPOSALS

The paper presents the key implications from the formation of defence integrators and the transfer of technological knowledge to the respective firms for newly developed defence assets, as opposed to the relevant government agencies maintaining major own-technological capabilities. The drawback of such transfer of technology and use of defence firms for designing, providing and maintaining defence systems is that the firm can decide on technical feasibility, while monitoring costs for the government can increase at the expense of defence-specific innovation (or its relevant cost) and extensive use of off-the shelf technology by the contractor.

For newly developed technologies with key innovative requirements that further revolutionise defence and warfare capabilities through the use of space-based assets, despite advantages in using industrial integrators to develop such purpose-built ASPs the extend to which private firms will be involved in manufacturing, maintaining and even operating such assets for the military will require considerations of long-term potential losses of innovation incentives.

Further research is required to examine how public-private partnerships can evolve in different developments of defence that will allow efficient use of private services without compromising security, accountability, or incentives to innovate.

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