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**A UK Perspective On Defence
Equipment Acquisition**

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ABSTRACT

This paper considers the challenging problems of defence equipment acquisition from a UK perspective. It first reviews the developments in the organisation and procurement strategies of the UK Ministry of Defence since the end of the Second World War, and then presents in more detail the 'Smart Acquisition' initiatives introduced by the Ministry of Defence in 1998 in the hope of making the acquisition process 'faster, cheaper, better'. But despite many improvements in this process, there remain some inherent problems for which there are no ideal solutions. The paper also considers the persistent trends in defence equipment towards higher unit costs and towards higher fixed/variable cost ratios, both within projects and within force structures. It then outlines some of the effects of these trends on the development of national acquisition policies.

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#A UK PERSPECTIVE ON DEFENCE EQUIPMENT ACQUISITION

Introduction

This paper reviews the development since World War II of the United Kingdom's (UK) organization and strategy for the acquisition of defence equipment, where the term 'acquisition' covers all procurement and support activities through the life cycle of an equipment project from concept to disposal. It then presents in more detail the 'Smart Acquisition' initiatives which were promulgated, to improve the efficiency of acquisition, as part of the UK's Strategic Defence Review of 1998. Finally the paper discusses some of the issues in defence equipment acquisition which remain at present unresolved, as well as two particular problems which will influence defence planning for the 21st century in UK and in other nations.

Characteristic Problems of Defence Acquisition

There are many problems affecting the acquisition of defence equipment. Some of these problems are similar to those encountered in large complex projects in the commercial sector, and others match those involved in the provision of other public services, but major defence projects face an exceptionally extensive and difficult array of problems. Some of these problems are new, but others have bedevilled defence acquisition since time immemorial.

It is evident that the market for defence equipment is, in economic terms, 'imperfect' since it has relatively few buyers and few sellers. In such a market, simplistic economic theories are invalid, and both buyers and sellers must formulate their policies with reference to the special features of the relevant part of the defence market.

Large defence projects demand a considerable investment of public funds, and therefore attract keen attention from the taxpaying public and from their elected

[#]**Acknowledgements:** The author is grateful to his colleagues in the Defence Engineering Group for their advice, but accepts full responsibility for any remaining deficiencies.

representatives in Parliament. Both are quick to condemn any perceived error in the management of defence projects. However, while the budgets of defence projects are closely scrutinized, the security benefits which their deployment will provide cannot easily be illuminated and therefore these benefits are often not clearly appreciated or understood by the general public. This problem of public ignorance is not easily remedied because many aspects of the changing threat which lead to the requirement for a new project, and of the advancing technologies which might be exploited in the project's design, cannot be presented in the public domain. These problems are particularly acute for any project which requires major design and development work, and hence will not enter service until many years after the key decisions to commit public funds.

Defence equipment acquisition is also difficult because many items of equipment (such as warships and combat aircraft) are too expensive to be replaced frequently, and so are expected to remain in service for many years. The specifications of such projects must therefore be carefully considered to ensure, as far as possible, that their designs are robust and will remain effective despite potential changes in technology and geopolitics. The development of new equipment involves the supplementary problem that at the start of development the project characteristics cannot be predicted with precision, since to match the anticipated threat the new equipment's design must exploit the latest technology and thus will inevitably involve some risks. The outcome of these risks during development can affect the performance, cost and timescale of the project.

Decisions on defence equipment acquisition must also take account of the twin goals (often conflicting) that the new equipment must be safe and economical to operate and support in peacetime and must also be effective in war, if and when it is deployed in action. It is a unique characteristic of defence equipment that it is (providentially) only rarely used for its intended lethal purposes. Ironically, the best equipment is used most rarely, since its reputation encourages rival nations to seek peaceful means of resolving disputes.

Finally, defence equipment acquisition is closely scrutinized because it is vitally important to national security and because many stakeholders have legitimate interests in ensuring that acquisition decisions are made correctly. Such stakeholders include the Armed Services who will operate the equipment in peace and war, the Treasury which

must raise funds to pay for it, rival commercial contractors who hope to manufacture the equipment and thereby raise their own profit and prestige, politicians concerned for the prosperity of particular regions or of sectors within the national defence industrial base, authorities responsible for airworthiness and for the safety of explosives, and allied nations concerned about the future military strength of the alliance. These stakeholders (and many others) will inevitably seek to influence equipment acquisition decisions to match their own individual perceptions of what is best for the UK.

Evolution of Acquisition Organization and Strategy in the UK

In the decades following the end of World War II, the organization of the UK's Ministry of Defence (MoD) for defence acquisition changed considerably, as did its acquisition strategies, in an ongoing quest to get better value for money from the defence budget. These changes were implemented against a background of decreasing numbers of Service personnel; the strength of UK forces fell from about 700,000 in 1950 to about 210,000 in 2000. The scope of the changes in organization is illustrated by the examples below

At the beginning of the period, each of the three Armed Services (Royal Navy, Army and Royal Air Force) specified and procured equipment for their own use. But in 1959 the Ministry of Aviation was created to take responsibility for the procurement of aircraft, guided weapons and electronic systems (these being high-technology high-cost areas in which parallel development projects for different Services was seen as extravagant). In 1971 a new branch of the MoD, the Procurement Executive (PE) with a mixture of Service and civilian personnel, was established to procure all defence equipment. The MoD(PE) was divided into branches procuring land, sea, air and electronic equipment (such that the air branch, for example, procured the aircraft required for all three Services) in order to concentrate the technical and financial expertise relevant to equipment for each environment, and to obtain economies of scale in the procurement of equipment (such as cars and trucks) used by more than one of the three Services.

In 1945 some defence equipment (such as aircraft) were designed, developed and manufactured by private sector contractors in accordance with MoD specifications. However many other types of equipment were designed, developed and manufactured

within the public sector – for example, much of the equipment for the Army was produced in public sector Royal Ordnance Factories (ROF). Ships for the Royal Navy were designed by the MoD's own naval architects, built in private-sector shipyards and refitted as necessary in public-sector Royal Dockyards (RD). The authority to design some classes of equipment was assigned to the relevant MoD research establishments. In the intervening period, these heterogeneous arrangements have been progressively rationalized. Today, almost all design, development and manufacturing work is done by private sector contractors (including the new owners of the privatised ROF and RD); the exception is that warship design remains the responsibility of the MoD.

A new MoD Central (tri-Service) Staff was created in 1985 to plan future policy on equipment, operations and logistics for all three Services. It had become apparent that the Services' operations were interdependent, and that any future conflict would demand close co-ordination between them. Hence their respective doctrines and requirements for equipment must be mutually compatible. In the Central Staff, ambitious officers should now be judged by their ability to work harmoniously with those from other Services, rather than by their zeal in pursuing nugatory inter-Service rivalries.

After 1979, the UK government sought greater efficiency in the provision of public services by forming Executive Agencies to undertake discrete tasks. Each Agency had an assigned budget, or an agreed price per unit of service provided, and had some freedom to reform its organization and procedures (though an Agency's staff remained civil servants and its budget was subject to the rules of public accountability). In accordance with this overall policy, the MoD now has nearly 40 Agencies of widely varying sizes responsible for equipment procurement, equipment support, training, personnel, logistics, communications, medical services, etc.

Concurrently, the MoD's procurement strategies were evolving in response to changes in Government policy, and to its own experience on particular projects. During the Cold War, when the threat from the Warsaw Pact appeared to be overwhelming and urgent, the Service staffs formulated ambitious requirements for high-performance equipment to be developed within demanding timescales. This policy often led to

escalating project costs. The Downey Report¹ insisted in 1969 that the development of future new projects should be managed in phases, with the work in each phase being satisfactorily completed before funding for the next phase was approved. This staged approach controlled the risks and reduced cost overruns, but the introduction of multiple pauses for decision-making extended the project timescales. Twenty years later, the 'Learning from Experience' Report² argued that MoD projects were making insufficient investment in the early stages of a development project to assess and manage its risks, and that projects managers needed more delegated authority.

For many years after World War II, MoD maintained a close, symbiotic relationship with the UK defence industry which was then regarded as an essential component of national security. At one stage, the Procurement Executive had specific responsibility for 'promoting the welfare' of the defence-related sectors of UK industry. Accordingly, it ensured the industry made a profit on defence contracts by giving cost-plus contracts, which guaranteed payment of the industry's costs plus a (limited) profit, and sought where practicable to maintain adequate levels of workload on the industry's various design and manufacturing facilities. This policy was drastically altered by Mr. Peter (later Lord) Levene after his appointment as Chief of Defence Procurement in 1985. He decided that the 'special' nature of the defence market had been much exaggerated, and that defence equipment acquisition would benefit from a more commercial approach featuring both open competitions for equipment contracts and fixed price contracts which transferred some of the project's financial risks from MoD to its chosen contractor. He also insisted that future projects should be entrusted to prime contractors who could manage them as they judged best, without MoD interference.

During the 1980s, MoD demanded that its managers should give greater attention to their projects' future levels of reliability and maintainability in service (and to improve these qualities where practicable) and in the 1990s demanded that they should adopt Integrated Logistic Support (ILS) procedures to coordinate and streamline arrangements for supporting projects in service. In addition, the UK Government insisted that MoD should participate in two other national policy initiatives. The first of these was the

¹ W. G. Downey *et al*, "Report of the Steering Group on Development Cost Estimating" (HMSO, London, 1969).

² Graham Jordan *et al*, "Learning from Experience" (HMSO, London, 1988).

introduction into public sector accounts of Resource Accounting and Budgeting (RAB), a commercial accounting system which takes explicit account of equipment depreciation and requires MoD branches to pay annually to the Treasury a return on their capital employed. The second was the Private Finance Initiative (PFI) which plans to apply private sector capital and expertise in the provision of many public services, by contracting for the provision of services (of an agreed volume and quality) from a commercial contractor who would fund, own, operate and support the necessary equipment.

Smart Acquisition

Despite all the reforms and recommendations described above, the new Labour government elected in the UK in 1997 perceived several problems in defence acquisition. On many projects the timescale from concept to entry into service was unduly protracted; a few were so delayed that their technology became obsolete soon after (or even before) they entered service. Many projects substantially exceeded the predicted values of their procurement cost and timescale, though it is fair to note that such overruns are also common among the defence projects of other nations and indeed among civilian projects of comparable scale and complexity. MoD project managers often failed to trade off equipment performance, cost and timescale to obtain best value for money over the equipment's life cycle. Finally MoD processes were perceived to be unduly bureaucratic and cumbersome; they required project managers to adopt the same procurement procedure for projects of very different scale and risk, they encouraged excessive transfer of risk to contractors, and they failed to give the project managers sufficient delegated authority or incentives to seek the most cost-effective strategies.

To overcome these problems, Chapter 8 and Supporting Essay 10 of the 1998 Strategic Defence Review³ proposed a series of reforms and reorganizations, which are collectively known as the Smart Procurement (later Smart Acquisition) Initiatives. Part of the Chapter restated and reinforced existing MoD policies favouring

international competition for contracts to supply equipment to MoD,

³ *Strategic Defence Review, Cm 3999* (The Stationery Office, London, July 1998).

- €# collaboration on procurement with allies, where practicable,
- €# rigorous planning and risk reduction early in any equipment project,
- €# a through-life approach to project management,
- €# project integration facilitated by systems engineering,
- €# accurate cost and timescale forecasting, and
- €# delegation of authority to project leaders.

All of these policies are excellent in theory but some at least have proved difficult to implement. The ever-changing technologies and the diverse organizational structures of defence equipment projects always make it difficult to interpret the results on past projects on a consistent basis and hence difficult to make accurate cost and timescale forecasts for future projects; a through-life approach can be impractical when different components of a project's through-life cost are controlled by different budget holders; MoD project managers have been repeatedly urged, in earlier reforms, to invest sufficient resources in project definition and risk reduction early in the project life cycle, but these recommendations have never been effectively applied.

The Smart Acquisition Initiatives include three changes in MoD organization. The three Service branches formerly responsible for equipment support have been combined to form a united Defence Logistics Organisation (DLO) to obtain economies of scale and to ensure cohesive logistic support to tri-Service expeditionary forces. The Procurement Executive has been changed into the Defence Procurement Agency (DPA) with a formal customer-supplier relationship with the MoD for the procurement of defence equipment. The Defence Evaluation and Research Agency (DERA) including the UK government's research establishments has been split into two separate organizations. One is QinetiQ which will enter a Public Private Partnership (having both government and private sector shareholders) and will seek to win business from the commercial sector as well as from MoD. The other is the Defence Science and Technology Laboratory (Dstl) which will be an integral part of MoD and will undertake those sensitive areas of defence research which need to remain under government control. These areas include operational analysis to plan the future UK force structure required for potential military operations, and research on countermeasures against chemical and biological weapons.

Another of the Initiatives is the creation of Integrated Project Teams (IPT) to manage individual defence equipment projects (or clusters of related smaller projects). Each IPT includes personnel drawn from all of the MoD branches involved, and from the principal industrial contractors with relevant expertise; it therefore contains virtually all the knowledge and skills necessary to manage the project, but the IPT leader can also call on the services of specialist staff (for example, contracts officers) who are required temporarily. The balance of skills within an IPT varies to match the project's needs at different stages in its life cycle. The industrial members of an IPT must withdraw during periods in which competitions are held to choose between alternative industrial suppliers. However, after a competition, representatives of the chosen contractor(s) rejoin the IPT and participate fully in its management of the project. This arrangement signifies a new 'partnering' relationship between the MoD and the defence industry, forming one of the key features of Smart Acquisition. Partnering is intended to be a cooperative and supportive relationship in which the parties share information, work jointly to manage the project's risks, and adopt strategies which provide mutual benefits; it should provide a more constructive environment for acquisition than the policies used by MoD in former times. However it must be remembered that conflicts of interest between customer and supplier are still inevitable, and must be recognized and managed effectively.

Smart Acquisition recommends using an incremental acquisition strategy, where practicable. Formerly, most major projects were expected to remain in service for many years, perhaps with a mid-life update in response to changes in the threat or developments in the relevant technologies. In an incremental acquisition strategy, the initial performance for a new equipment project is set at a relatively-unambitious level, which allows an economical and low-risk development and rapid entry into service. The equipment is then improved by a planned series of enhancements, integrating new subsystems as their technology matures to improve or extend the equipment's functionalities. By this 'technology insertion', the equipment's contribution to military capability can be increased far beyond that set by the initial requirement, without incurring the risks and expenditure peaks associated with a traditional development. Furthermore, although the enhancements are in theory preplanned, they can in practice take constructive account of the feedback from Service users, following deployment in the field of the initial version of the equipment.

In the Downey procedure cited above, a major project required at least four approvals from a committee of the most senior MoD officers and officials before manufacturing could be started. Any project which, between regular approvals, encountered technical or management problems having a significant effect on its performance, cost and timescale forecasts was required to seek an additional approval based on the new forecasts. Under Smart Acquisition, the life cycle of a defence equipment project has been reorganized into six phases – Concept, Assessment, Demonstration, Manufacture, In-service and Disposal with the collective acronym CADMID – and has two regular approvals, the first at an ‘initial gate’ before the Assessment phase begins, and the more-rigorous second approval at the ‘main gate’ before the start of Demonstration. Additional approvals are required as before if the projects have serious difficulties. However, the Smart policy should reduce project timescales by eliminating two regular approvals and the consequent delays.

An important element of Smart Acquisition is the MoD’s Combined Operational Effectiveness and Investment Appraisal (COEIA) procedure⁴ which assists the process of equipment selection. COEIA uses both military operational analysis and discounted cash flow methodologies to provide a structured, rigorous and traceable comparison of the military and financial aspects of alternative equipment proposals being considered for procurement, and of their associated risks. COEIA has largely replaced earlier procedures of tender assessment which used multi-criteria decision theory, featuring scoring and weighting of the multitude of features in contractors’ proposals. Any decision on the procurement of a major project takes separate account of the decision’s effects on the UK defence industrial base and on any relevant Government macroeconomic and foreign policy objectives.

Finally, one of the most important features of Smart Acquisition is the identification of a designated Service customer to direct each equipment project. In the project’s initial stages the Service customer is one of the Capability Managers on the MoD Central Staff; in the later stages, after the project enters service, the relevant Service commander of the relevant front-line or training units takes over as the Service customer. Each Service customer is a budget holder and each successively reaches an agreement

⁴ David Kirkpatrick, “Choose your Weapon – Combined Operational Effectiveness and Investment Appraisal and its role in UK defence procurement”, Whitehall Paper 36, RUSI, London 1996.

with the IPT on the quantity and quality of the goods and services it must provide. Under Smart Acquisition procedures, a new project is initiated by a Capability Manager whenever analyses of the future capability of the UK's Armed Forces predict a shortfall in one of the Capability areas, such as control of the underwater battle space. This predicted shortfall stimulates the formation of an IPT which in the Concept phase assists the Capability Manager to formulate a User Requirement Document (URD). The URD defines the customer's requirement for additional capability, without specifying which class of equipment (such as aircraft, surface ships or submarines) might best provide that capability. The conclusions of the Concept phase are presented at the initial gate, seeking approval for the Assessment phase to compare alternative projects. When the Assessment phase has identified the equipment option offering best value for money, the IPT defines in a System Requirements Document (SRD) the performance, cost and timescale targets which can form the basis of a contract with a chosen supplier. Throughout the initial CADM phases the URD is maintained, and updated as necessary, to form the Service customer's definition of the capability required; this document can guide later project management decisions trading off equipment performance, cost and timescale as the design evolves.

Current Issues in Defence Equipment Acquisition

There are many unresolved issues in defence acquisition, not least of which is the relationship between governments and contractors, acting as customers and suppliers respectively. In recent decades, MoD has successively tried a cosy supportive relationship and a taut strictly commercial relationship. Under Smart Acquisition, it is now experimenting with a new 'partnering' relationship, but it is not yet clear whether the partnering between MoD and a particular supplier should be short term to maintain the prospect of competition and the stimulus which that prospect provides, or long term to encourage mutually-beneficial investment.

Another issue is the scope of PFI contracts, which MoD is establishing for the provision of non-combat services. The first such contracts were for base-area activities such as the management of housing and of training infrastructure, but later contracts for the transport of Armoured Fighting Vehicles (AFV) and for air-to-air refuelling are closer to the front line. Contractors' staff who may be required to operate in a combat zone are

normally enrolled as reservists, and would in any emergency be embodied within the UK's military forces, subject to military discipline and protected by the Geneva Convention. However, there are doubts about how close to the front line a contractor's staff should operate, how far the MoD should commit itself to long-term contracts in a rapidly-changing world; how a PFI contract might be drastically amended in an urgent crisis, and whether the MoD can safely rely on commercial contracts to exert its control of vital military capabilities in an emergency.

A key issue in any new project is selection of the best acquisition strategy. MoD has in past years used a mix of strategies, suited to the class of equipment being procured. Sometimes it has funded the development of new equipment, either on a national basis or in collaboration with allies, and sometimes it has bought existing equipment off-the-shelf. National development of major projects is now extremely rare, since the fixed costs of design and development of many classes of equipment (though not warship hulls) have escalated to unaffordable levels. On a major project the choice of an acquisition strategy can significantly affect the development of a nation's technology base and/or its industrial base; it is always difficult in such circumstances to identify the acquisition option which (in conjunction with future developments in national macroeconomics, in defence policy and in the contractors' corporate strategies) yields the greatest achievable national benefits.

Another unresolved issue is the delegation of power to IPT leaders. Classic management theory suggests that they should be given power to match their responsibilities, and that they cannot reasonably be held accountable for success or failure if they are subject to multiple constraints and directives. But in practice an IPT leader must be constrained to some extent by the increasing need for his project to interact effectively with other equipment already in service or under development, and by the enduring requirement for accountability of public funds. IPT leaders must also be constrained to promote the use in their projects of standard, approved components /subsystems wherever practicable, to avoid the logistic proliferation which would otherwise arise. Within these constraints, the Smart Acquisition policy gives an IPT leader greater freedom to select the procedures and processes which best suit the characteristics of the particular project considered, rather than conforming to a standardized set of Instructions.

A chronic difficulty of defence acquisition is how to motivate the IPT leaders and other stakeholders to promote the maximum cost effectiveness of a project in the long term. Politicians, government officials and Service officers may be involved with the project for only a few years before they move on to other responsibilities, either to advance their careers or to prevent undue rapport with the contractor(s) involved. Smart Acquisition encourages longer tours of duty, so that the members of the IPT have to endure the later consequences of their decisions, but in practice this goal has been thwarted by the zeal of Service officers to go back to real soldiering, and by the reluctance of officials to uproot their families when an IPT transfers from DPA headquarters to a DLO branch many miles away.

The financial management of the MoD's acquisition budget must ensure that the project funding profiles planned by the various MoD branches involved are consistent and well-synchronised, and that the funding profiles of all current projects combine to give a total budget profile without any large and sharp fluctuations; such variations in the Defence Budget could not easily be accommodated between the government's revenue and its other categories of expenditure, all of which change only slightly from one year to the next. MoD's planning and budgeting staff may have to delay some projects and to accelerate others (which is generally more difficult), or may have to persuade IPT leaders to remould their projects' funding profiles, to ensure that the total acquisition budget remains within acceptable limits. They must also choose an appropriate time horizon for budget management, bearing in mind that there may be a long time lag between action to correct a problem and the resulting response. If the planning horizon is too short, crises may only appear when they are unavoidable, and projects may be started without taking proper account of the likely scale of funding required later in their life cycles. If the planning horizon is too far ahead, the funding forecasts for the later years are unlikely to be accurate and any effort devoted to rescheduling projects would be nugatory. As a compromise, MoD now uses a 10-year horizon.

An enduring issue is the management of support for equipment in service. Arrangements for support must reconcile the need for economy in peacetime operation with robustness against accident and terrorism, plus the occasional demand to provision an expeditionary force and sustain such a force in a remote theatre of operations at any level

of activity from peace-keeping up to full-scale war. Formerly, most support activity, excluding only those major repairs which required the equipment to be returned to the contractor's factory, was done by the support branches of the Service (Royal Navy, Army or Royal Air Force) operating the equipment. Today, it is done partly by the operating Service, partly by the DLO, partly by civilian Agencies and partly by private contractors. Different mixtures are appropriate to different classes of equipment – the repair and maintenance in a nuclear submarine on extended patrol must be done by the crew, but the support of a fleet of logistics vehicles based near the contractor's factory can rely largely on contractor's staff in peacetime (and on civilian sponsored reserves when the vehicles go to war). Some procurement contracts stipulate that for the negotiated price the contractor shall deliver the equipment and also provide any necessary repair and maintenance for an agreed period after entry into service; this device ensures that the contractors will pay particularly-close attention to achieving good reliability and maintainability (R&M) characteristics which have sometimes been neglected in the past through undue emphasis on short-term procurement cost and timescale targets. Increasingly, logistic support is provided to UK Services by contractors who own and operate the aircraft, ships and trucks required, and are permitted to use any capacity which is surplus to MoD's peacetime requirements for trading in the commercial market, provided always that MoD can have exclusive use of the total capacity in a crisis.

Last, but not least important, of the issues presented in this section is the acquisition of research in the defence-related technologies, a category which has grown far beyond its traditional fields of metallurgy and explosives. A national government must have access to sufficient trustworthy expertise to act as an intelligent customer for the equipment it procures for its Armed Services. A national defence industry must have access to more-extensive and more-detailed technological information which it needs to design, develop and manufacture cost-effective equipment for the world market. The problems lie in determining the scale of the research activities required for government and for industry, and in deciding who should fund and manage such activities. In the UK, as in most nations, the government funds most defence research, directly or indirectly, and the conduct of the research is shared between the government's laboratories and those of industrial contractors. In the UK, the share being done in the private sector will increase sharply when QinetiQ enters a Public-Private Partnership.

Two Particular Problems

There are two particular problems in the acquisition of defence equipment which are causing increasing concern in small and medium-sized nations. The first of these is the rapid and sustained rise in the unit cost of successive generations of many classes of equipment. In recent years the unit production cost (UPC) of most classes of equipment has grown at between 5% and 10% per year in real (inflation adjusted) terms.⁵ For a few mature classes of equipment such as rifles and machine-guns the growth rate has been below 5%; for a few classes with rapidly-increasing military effectiveness, such as anti-tank and anti-submarine helicopters, the growth rate has been above 10%. During the Cold War, for example, the real UPC of tactical combat aircraft procured for the UK's forces increased at about 10% per year – equivalent to a tenfold increase in real cost between generations 25 years apart.⁶

These quoted rates of UPC growth have been derived from the cost of first-rate equipment within each generation. At any given time it is possible to design equipment with lower cost and lower effectiveness; such designs can be used for training or in low-intensity conflict, and they may provide security in a region where none of the rival nations deploys first-rate equipment. But it is the first-rate designs which will dominate any major conflict in the future, so the trend in their cost is very significant.

Sometimes the rapid rise in the UPC of defence equipment is contrasted unfavourably with the concurrent decrease in the real unit cost of many consumer goods and services, such as electronic goods and air transport. This comparison is actually spurious and misleading. The trend in the cost of defence goods should be compared instead with trends in the cost of 'tournament' goods, services and personnel which compete for rich or important rewards. This class includes the equipment for professional sportsmen and sportswomen competing for individual titles, the campaign activities by candidates for the Presidency of the US, and the talented footballers or fund managers recruited to rival teams or banks; the unit costs of all these categories are increasing rapidly, just like those of defence equipment.

⁵ Philip Pugh, "Performance Based Cost Estimating", Proceedings of the Association of Cost Engineers 13th International Cost Engineering Congress, London, October 1994, p.5.8.

⁶ David Kirkpatrick, "The affordability of defence equipment", *RUSI Journal*, June 1997, pp.58-63.

Furthermore it has been demonstrated that the observed rise in the UPC of defence equipment is a rational response by the UK MoD, and similar Departments in other nations, to ongoing developments in defence technology and in the threat.⁷ The rise could be arrested only by a global treaty, agreeing to freeze all nations' defence equipment at its current standards of technology. Such a treaty would be virtually impossible to negotiate and even harder to enforce, since many modern defence technologies can be developed covertly. It is therefore prudent to expect UPC growth in each class of defence equipment to continue in future at about the historical rate.

The observed rates of growth in the UPC of many classes of defence equipment are substantially higher than the growth rates of Gross National Product (GDP), and hence of defence budgets, in many nations. Those nations must therefore try to offset the growth in UPC by one or more on the policies given below.

- ## Buying smaller fleets of weapon systems limits the procurement budget but leads ultimately to fragile forces which are vulnerable to accident, attrition or pre-emptive attack, and to the diseconomies of small scale (the smallest practicable fleet of AFV in a national force structure seems to be about 100, and of combat aircraft about 20, but fleets of only a few warships in a class are viable).
- ## Procuring multi-role equipment yields economies of scale and operational flexibility, even though some multi-role equipment may be less effective and/or more expensive than its single-role equivalents
- ## Collaborative procurement shares the fixed costs (such as design and development) with other nations and enhances interoperability within an alliance, but a multi-national project is more vulnerable to dissension and delay.
- ## Longer replacement cycles reduce the frequency of equipment procurement, and the associated need for large volumes of expenditure, but they may cause high support costs and dangerous military impotence as equipment nears the end of a long period of service.

⁷ David Kirkpatrick, "The rising unit cost of defence equipment – the reasons and the results", *Defence & Peace Economics*, 1995, Vol. 6, pp.263-288.

The second particular problem is network-centric (or network-enabled) warfare and the cost now associated with creating an electronic network of sensors, communications and displays which allow combat units to be directed with rapidity and precision. In former times, many combat units operated virtually independently, as there was limited scope for intercommunication and cooperation between them. At that time, a nation's military power increased in proportion (approximately) to the number of combat units deployed with its armies and fleets, and hence in proportion to its expenditure on such units. During the 20th century, radio technology allowed the operations of dispersed and fast-moving forces (such as a carrier task force or an armoured division) to be coordinated effectively. Towards the end of the century, developments in microchip technology enabled electronic systems to collect, transmit, analyse and display prodigious quantities of information, and thus created a Revolution in Military Affairs. Any nation (or integrated alliance) which has the technology and the funds to create an electronic 'knowledge-management' network linking sensors, commanders and shooters in orchestrated cohesion will in future warfare have an enormous superiority over a nation or alliance which remains reliant on traditional methods of reconnaissance, signalling, command and control. It follows that in the 21st century there will be increasing returns to scale from increasing military expenditure.

Henceforth any small nation, threatened by a larger rival which is wealthy enough to afford a knowledge-management network, must ally itself with another nation which has already procured and deployed a network; the small nation can in this way obtain the force-multiplier effect of network-centric warfare. The small nation will have no other realistic option, since in future any forces not connected to a digital network will be virtually useless,⁸ but this policy inevitably involves some loss of national independence and the choice of an ally must be carefully considered.

Conclusions

This paper demonstrates that the management of defence equipment acquisition presents many problems. Some of these problems are perennial, such as the need to

⁸ Tim Robinson, "Network-centric warfare – Frequently Asked Questions", *Aerospace International*, November 2002, pp.14-17.

balance economy in peace against effectiveness in war, and the need to facilitate the complex interfaces between Service customers and their industrial suppliers. Some of the problems change over the decades as the threats to a nation's welfare evolve, as defence technologies develop and as defence industry restructures.

There is no perfect long-term solution to these problems. As circumstances change, a nation's acquisition organization and strategies must be adapted to overcome emergent challenges. Many issues in defence acquisition remain unresolved, with a variety of potential strategies but with no dominant solutions. Two problems in particular – the rapid and persistent growth in the unit cost of defence equipment, and the large fixed cost of a knowledge-management network – seem likely to demand, in the 21st century, significant reappraisal of national policies for defence force development and strategy.

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