Contracting for Complex Performance in Markets of Few Buyers and Sellers: The Case of Military Procurement

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Abstract

Purpose - The objective of the paper is to identify and review the impact and challenges of new contractual arrangements on UK military procurement and other limited or oligopolistic markets.

Design/methodology/approach – The unit of analysis is the large-scale procurement programme. Two cases of major military platforms (naval and air defence) examine through-life maintenance or 'contracting for availability' and build theory on Procuring Complex Performance (PCP). Propositions are developed from the literature then tested and extended from the case analysis, supported by 35 interviews from buyer and supplier representatives.

Findings – Examining UK Military platform procurement reveals a perspective not present in fast moving high volume supply chains. In oligopolistic markets such as defence, the Ministry of Defence (MOD) represents a market of one, seeking ambitious and non-incremental innovation from the Prime Contractor during the procurement process. The new contractual arrangements show an increasing shift in responsibility to the Prime Contractor who coordinates service support and supply chain incentivisation over extended, often multi-decade platform lifecycles.

Research limitations/implications - The cases were conducted separately and later compared. Whilst based on defence sources, the paper concludes with general recommendations for all public-private complex procurements and seeks to explore other industry sectors as part of further research into PCP.

Originality/value - Examined from a theoretical and practical perspective, the cases reveal the challenges facing procurement in major public-private projects. The changing role identified reflects extended timescales and the quasi-market military procurement environment, compounded by current economic and politically charged conditions. Procurement by *default* increasingly plays a new shaping role in large-scale programme management driven by outcome based contracting. Customers such as the MOD must re-evaluate their role under these new contractual arrangements, providing leadership and engaging with future contracting capability and innovation.

Keywords: Outsourcing, supply chains, oligopoly, markets, incentives, silos, innovation.

Paper type: Research paper

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1 Introduction

Like many support services procurement has had to argue over the years for the right to sit at the top table of management (Kraljic, 1983; Cousins et al, 2006). Due to a combination of circumstances, defence procurement will now take a leading role in shaping defence capabilities and platforms in the 2010s. Ironically, this is not a leadership role which has been sought, but is a by-product of new contractual practices in the UK mandated by planned deep cutbacks (Prins and Salisbury, 2008) and compounded by further cuts due to the financial crisis, unprecedented world events and an above average rate of inflation for defence expenditure. Where military procurement was once reactive: servicing and responding to military logistical requirements, current circumstances are running concurrently and making the role of defence procurement more responsive. This paper examines the implications of procurement taking on leadership roles in defence by default. It builds on the concept of Procuring Complex Performance (PCP) by presenting a new perspective not present in high volume supply chains, asking how emerging challenges in the UK military inform procuring complex performance. Private sector firms in limited or oligopolistic markets are free to adopt new contractual arrangements that change the nature of their business. However for a major government department such as defence, such new contractual approaches risk repercussions ranging from potential decline in the nation's industrial infrastructure to market unattractiveness.

Beginning in the 1990s and highly influenced by the received wisdom of Japanese management, procurement has increasingly become a strategic function in the adoption of end-to-end supply chain practices. Yet much of operations and supply chain management research has been in fast moving, high turnover and often consumer facing markets (Womack et al 1990; van Weele, 2005; Monczka et al, 2010). In business-to-business (B2B) and business-to-government (B2G) markets, large-scale and long-term projects spanning multiple decades such as civil engineering or defence have received less attention from the supply chain and procurement communities (Davis and Hobday, 2005; van Marrewijk et al 2008). Recent work tends to dismiss applying practice from one area of procurement e.g. high volume manufacturing environments, to another as 'best practice' based on one-size-fits-all (Todtling and Trippi, 2005). In seeking to delineate the procurement of complex performance from supply chain procurement and the large-scale projects of Complex Product-Systems (CoPS) (Davies and Brady, 1998; 2000; 2005), this paper adopts the UK defence sector as an example of specific contractual arrangements which have emerged from limited market or oligopolistic conditions (Sherer and Ross, 1970).

Beyond being B2B rather than consumer facing, large-scale 'one off' procurements create different challenges to most supply chain research which focuses on sourcing and replenishment decisions. In large-scale procurements such as a new hospital, highway or airport terminal, the service lifecycle of the infrastructure far exceeds the life of individual parts, components and assemblies of which the infrastructure is composed (Armistead and Clark, 1991; Hartmann et al, 2011). This mismatch between the lifecycle of the components and lifecycle of the system, which could be a building, platform, complex object or software, creates fundamentally different procurement challenges to typical product centric supply chains. New business models are emerging using terminology such as service innovation, service science, product-service and servitization which spans the interface between Engineering, Operations and Marketing (Vandermerwe and Rada, 1988; Potts 1988; Quinn et al, 1990; Olivia and Kallenberg, 2003; Vargo and Lusch, 2004; Baines et al, 2009). While interest in service-dominant logic is increasing (Araujo and Spring, 2009), specific issues for procurement are not being addressed. Thus, a warship might be procured with a contract that included maintenance, upgrades and disposal: what might be termed 'services' where the offering becomes a product-service bundle (Stremersch et al, 2001). Increasingly providers of large-scale programmes are obtaining high revenue percentages from non-product offerings. A lifecycle perspective no longer refers simply to the revenue gained by transferring an asset to a customer, where a growing proportion of revenue comes from services (Neely, 2008; Cusumano, 2008; Wise and Baumgartner, 1999). Such repetitive, 'drum beat' income is a welcome complement to the often cyclical or lumpy nature of demand in industries such as construction and aerospace. However, in industries dependent on public spending this move to increased revenue from support services is more than matched by the concomitant decline in revenue from product or platform sales, due to government cutbacks and increases in platform life. Managing the shift to new business models reliant on service and support income at the expense of capital income is a major challenge to traditional models based on manufacturing and selling platforms and associated spares. How much risk there is for platform contractors, where such risk resides, and what risks this trend means for buyers is little explored.

New contractual forms are emerging that emphasise the performance outcomes required from the contract rather than tight specification of how the outcome is to be achieved (Davies and Brady, 2000; Melnyk et al., 2010). Examples include power-by-the-hour in aviation, contracting for availability in maritime defence, and performance-based contracts in public-private healthcare. A popular view of these new contractual forms is that they reflect the increasing co-creation of value between customer and supplier (Vargo et al., 2008), work that seeks to understand the implications of product-service bundles and value co-creation from the perspective of the supplier or contractor i.e. how can manufacturing adopt a more service-based approach? (Potts, 1998; Stremersch et al 2001; Olivia and Kallenberg, 2003). Yet examples that consider procurement and the customer-buyer perspective are much rarer (Lindberg and Nordin, 2008; van der Valk, 2008) and not related to

instances where, for the buyer, the cost of the infrastructure or hardware will be far outweighed by the cost of operations and support over an extended lifecycle.

There is a final and fundamental characteristic of procuring complex performance that differentiates it from supply chain procurement. The more comprehensive the complex performance procurement, the fewer the sellers and even rarer are buyers: often one per nation. In areas such as defence, highways, health, power stations, airports, docks, transport and advanced software systems, there may often be only one buyer. The public sector is a key buyer of complex procurements, one recent driver being the outsourcing of formerly public sector responsibilities e.g. maintenance contracts in defence and public private partnerships in areas from road building to prison management. This paper focuses on how these new contractual arrangements shape and support such models. Given its scale and centrality to public sector procurement, the defence industry is at the forefront of these developments. Yet the traditional procurement capabilities defence buyers use to manage multiple short-term tendering processes, evaluate suppliers, and manage capacity through dual sourcing arrangements are not the capabilities needed for markets of 'one-to-one', contributing to soaring cost overruns and delay (Gray, 2009; Haynes, 2012).

The paper is structured as follows: the literature review uses propositions to define procuring complex performance in terms of new contractual arrangements in limited markets. After the research methods, the findings from 2 defence cases are compared and then discussed in the analysis which revisits and extends the propositions. The contribution to theory and recommendations for practitioners are presented in the conclusions.

2 Literature review

The study of oligopoly as a form of restricted, limited or 'quasi' market structure dominated by a small number of sellers is an enduring theme in management and economics research (Shubrick 1959; Sherer and Ross 1970; Appelbaum 1982; Venebles, 1990). Imperfectly competitive markets such as those involving few sellers means participants are likely to be aware of the actions of others, requiring strategic planning in price, organizational structure and public-private investment with implications for aspects of social welfare such as employment (Cremer et al, 1989). As a relatively common form of market, oligopoly can give rise to a range of behaviours or outcomes involving restrictive trade practices by firms, such as collusion, creation of cartels, price raising and restricted production. While open forms of market competition between sellers lead to low prices and high productivity i.e. an efficient outcome, in an imperfect market the opportunity for non-competitive behaviour increases with oligopolistic power, often leading to high prices and low productivity (Appelbaum, 1982; Sherer and Ross, 1970). Less common is the industrial organization typically found in sectors such as defence or railway equipment, where as the result of privatisation followed by mergers and

acquisition activity there are few sellers and *fewer* buyers with only central government performing the role of chief procurer and project commissioner. Such situations give rise not only to the possibility of price escalation and stagnant productivity, but also concerns over infrequent or lumpy demand patterns leading to inability to meet future production requirements through the depletion of national industrial infrastructure and loss of skills and capabilities:

Proposition 1: *Contracting for complex performance in markets of few buyers and few sellers involves volatile or infrequent demand patterns adversely affecting national production capability.*

Most treatments of purchasing and supply describe a large customer buying a stable product that matches a specification from a smaller supplier (e.g. Womack et al, 1990). The purchased product is an asset that, in turn, is incorporated into a larger asset and transferred along a supply chain for delivery to an end customer (Lamming, 1993: 215); the critical activity is replenishment. Contrast this account with the growing number of contracts that combine the tangible and measurable (products, categories, temperatures, deadlines) and intangible and harder to measure outcomes, critically innovation, but also risk management, environmental sustainability and minimisation of through-life costs over an extended lifetime. In complex procurements the ease of transferability of replenishment and asset-based purchasing is missing, product and service are bundled together and 'inseparable' under the contract, often termed a full-service contract (Stremersch et al, 2001). It is the bundling of different purchasing logics over time (Penrose, 1959; Araujo and Spring, 2009) encompassing design, build, operate and maintain that creates complexity. The view that '*...resources consist of a bundling of potential services*' (Penrose, 1959: 22) not only establishes the connection between service bundling and Resource-Based Theory (RBT), but raises questions over defining the firm's distinctive competitive advantage. Multi procurement logic contracts mandate broad capabilities, one of which is the ability to enter new markets or transfer capabilities from one market to another. This is the case where the contract involves creating a marketplace for a product-service that is not currently supplied, for example encouraging private industry to contract in an area previously performed within the public sector:

Proposition 2: *Complex product-services that are sold to markets-of-one require multiple procurement logics bundled into one contract;*

Proposition 3: *Procuring complex performance will often involve 'market making' where there is no existing supply market for the combination of product and service.*

The governance literature has already reached a degree of agreement that a contract cannot, even in simpler contractual arrangements, hope to cover all eventualities and circumstances (Dyer and Singh, 1998; Poppo and Zenger, 2002). Given the necessity of a contract, therefore, under PCP it is likely that there will be a combination of relational and contractual approaches, varying in proportion

over time but dominated by relational approaches (Roehrich, 2009). There is also a growing need to understand how the customer looks beyond output as a consequence of the purchasing decision, to buying an outcome that includes predefined performance measures (Davies and Brady, 2000; Melnyk et al, 2010; Ng et al, 2009). The putting in place of organisational routines and learning processes (Davies and Brady (2000: 931) explains how suppliers of complex product systems build capabilities based on past performance to develop new lines of business or 'repeatable solutions'. There is a parallel between solutions and the outcome-based approach proposed by Melnyk et al (2010: 34) where "*supply chains...deliver one or more outcomes*" for example: cost, responsiveness, security, sustainability, resilience and innovation, as opposed to task-based piecework. Once an outcome or blend of outcomes has been selected it influences critical characteristics and design traits across the supply chain and becomes a major management undertaking.

Drawing on a recent example from the UK, the customer has to transition from buying an asset such as a purpose built facility for researching national standards, to buying complex performance i.e. the set-up and maintenance of a laboratory able to supply internationally respected national standards research for 25 years. Managing a supplier for performance is a different set of capabilities to that required for purchasing and supply, which conventionally is presented as a large customer buying a stable, tangible product from a smaller supplier, and involves outsourcing control and the transfer of risk in exchange for revenue. Core to traditional purchasing and supply is the understanding of specifications which can be codified and therefore consulted and complied with (Lindberg and Nordin, 2008). Procuring complex performance means in effect buying a succession of 'one-offs', a series of make-to-order buys, where the ambiguity of future requirements means contract design will be less prescriptive and more outcome driven:

Proposition 4: *Procuring complex performance contracts emphasize outcome over output and transfer control from the buyer to the contractor who gains support revenue in exchange for risk.*

Adding time as a constraint; either that there is no time, for example to plan as in urgent requirements e.g. disaster relief, or that there is in effect a surfeit of time where the horizon spans multiple decades. Both extremes defeat detailed ex ante specification. In the national standards laboratory neither the UK government nor contractor can know what standards or materials will be involved from even 4-5 years out from the contract's signing. Hence, it is not the contract length, but the degree of variability or 'full-service offering' contained within the contract that necessitates the client having advanced and contingent purchasing capabilities (Stremersch et al, 2001: 5). Note that what is complex in year 1, using the standards laboratory example, the investigation of a new composite material, may, by year 5 have been standardised. Similarly, contracting out accountancy work to a centre in an emerging country may be an extremely complex procurement in the first few years, but may standardise over time. Critically, this challenge of managing contractor inputs that may

commoditise over time is set in the context of managing what are effectively monopoly suppliers. These are not contracts that can be easily re-let, where managing being 'locked in' (Lonsdale, 2005) to one supplier over decades is not addressed in the replenishment-based supply literature.

The literature most relevant to the make or buy decision is Transaction Cost Economics (TCE) (Williamson, 2008; Stratman, 2008; Grover and Malhotra, 2003). In TCE the transaction cost refers to the cost of providing for a good or service through the market rather than having it provided from within the firm (Coase, 1937). Transaction costs are those other than price that are incurred in trading goods or services, the three critical drivers being uncertainty, frequency and asset-specificity. PCP contracts with their focus on extended lifecycles and value co-creation fulfil all three aspects, with all activities involving opportunity costs. Firms are rarely able to calculate real transaction costs to compare in a 'make vs. buy' decision (Ghoshal and Moran, 1996). The concern with transaction costs is that they act as a proxy for the overall ease or difficulty of managing the activity in-house. So, for example, in contracting out the support of fighter jets there is a high degree of asset specificity as equipment and infrastructure are unlikely to have alternative uses, lack of reliable maintenance data makes costing support problematic creating uncertainty, and the one-off nature prohibits either party building up relevant commercial expertise. In such a case TCE would suggest keeping such activity in-house (i.e. hierarchy) to minimize transactions costs and opportunism.

In order to understand PCP it is necessary to combine TCE analysis with another theoretical perspective, that of RBT, as many have suggested (Jacobides and Winter, 2005; Holcomb and Hitt, 2007; Ellram et al, 2008). A common view of RBT based competitive advantage is that it exists at the level of the organization, based on unique skills and capabilities that are difficult for rival firms to copy (Penrose, 1959; Wernerfelt, 1984). As globalisation increasingly exposes markets to the possibilities of collaborative alliances and extended supply chains, this goes hand in hand with the need for a greater understanding of the division of assets and knowledge between firms. The commercial realities of the 21st century combined with the stability and forced intimacy of the ties that bind buyer and seller in long-term PCP type contracts, means that each has to cooperate by combining resources, leveraging supply skills and achieving competitive advantage in projects demanding complex products and services. Hence competitive advantage can no longer be ascribed to one firm's internal resources alone, but is embedded within an interlinked supply network dependent on inter-firm cooperation (Lavie, 2006).

Where the customer is demanding product-service bundles from the contractor often the offering will be critical to the customer's own delivery processes. For example: availability of aircraft is central to a defence customer, a baggage handling system is essential to an airport operator. In PCP contracts, the co-creation of value between firms is led by mechanisms such as risk and reward share agreements that reflect the customer's dependence on the prime contractor above that of a traditional

contract. Such contracts require mechanisms to align the interests of the customer in terms of innovation and the interests of the supplier with the minimum outlay of resources:

Proposition 5: *In markets-of-one customer and supplier are 'locked in' where contractual and relational mechanisms must combat opportunism and ensure a steady stream of innovation from an incumbent and monopolistic supplier with a significant contractual incentive.*

The procuring complex performance approach draws on the work known as Complex Product-Systems (CoPS) (Hobday, 1998; Brady and Davies 2000; Davies and Hobday, 2005). CoPS involve engineering-intensive products or systems supplied in units of one or small batches, usually tailored to meet the precise requirements of each customer. The creation of CoPS often involves extreme production and innovation complexity. Davies and Brady (1998) further identified that industries supplying CoPs are usually restricted markets with a few large suppliers facing a few large customers in each country. However, PCP differs from CoPS in four aspects:

- the focus on procurement and supply;
- customer value is delivered as an integrated product-service (not a product system) where a significant proportion of value is delivered as support services located up and downstream from manufacture/construction;
- the process of co-creation of value between partners involves a greater emphasis on the interplay between inter-firm relationships and contractual governance;
- CoPS are concerned first and foremost with technological progress, while PCP is focused on the sum of performance outcome and economic efficiency.

Where CoPS can be viewed as *'…a subset of projects concerned with the development, manufacture and delivery of complex capital goods'* (Davies and Hobday, 2005 p22), PCP speaks to the whole-life issues of complex projects, concerned as much with the performance capability to supply sustainable support and maintenance over extended periods, as the initial phases of design and build. There is more resonance between PCP and CoPS in the need for strong co-ordinating roles for the purpose of linking various stages of the project together (Davies and Brady, 1998; Davies and Hobday, 2005), leading Hobday (1998) to see project management and systems integration as the core capability for successful CoPS involving temporary structures consisting of many firms.

The extended timeframe of PCPs maximises the opportunities for political interference (Mayer and Khademian, 1996) and the waxing and waning of policy drivers, see for example the concern with political inspired interference in mega projects (van Marrewijk et al, 2008). We suggest that the 'static world' of matrix-based procurement models such as Kraljic (1983) are not suitable for such dynamic and political environments, and require further consideration around co-creation of value and extended lifecycle. The extended timeframe has a number of knock-on effects. Partners have to be chosen from among the few that have the necessary financial, professional and commercial

capabilities to contract over decades. Few organisations could compete for a multi-decade contract to maintain and upgrade a jet designed and built by another firm. In parallel, there are few professionals with a skill set that includes contracting for multi-billion, multi-decade fighter jet support, including large elements of unknown risks and costs. Conversely, there is a very small supply base to choose from and this has the advantages of stability:

Proposition 6: *Building on insights from CoPS, the co-creation of value in PCP contracts necessitates one party having a systems integration role and suggests leadership by the buyer;*

Proposition 7: *Complex procurement in oligopolistic markets is likely to feature political interference.*

Linked to the discussion around CoPs is that PCP means a shift away from procurement as an upstream, manufacturing orientated activity associated with economies of scale, towards markets of 'one customer and one buyer' undertakings. In such undertakings, markets are often subsumed by the issues of outsourcing and supplier relationships concerned with maintaining levels of customer support and product development (Goffin and New, 2001; Stuart, 1996). What becomes apparent in these cases is often the 'triadic' rather than dyadic nature of the relationship (Choi and Wu, 2009; Li and Choi 2009). In a PCP scenario triadic means the involvement in a procurement relationship of three significant players: a buyer who is the source of funding such as the UK Treasury, an organisation who receives the product-service such as a government department or the armed forces, and a lead contractor or Prime who delivers the service. This may lead to unanticipated forms of co-operation between customer and suppliers, such as joint lobbying against cutbacks, and even co-operation in drafting contracts to suit both parties at the expense of a third party such as the UK Treasury:

Proposition 8: *PCP contracts in oligopolistic markets often involve triadic relationships resulting in coalitions of interest and joint lobbying by two parties against the other.*

3. Method

Theory building from case research is a consistently powerful tool in Operations Management research (Handfield and Melnyk, 1998; Meredith, 1998; Voss et al, 2002). Case research offers flexibility for theory building, enabling the investigator to follow emergent themes which are explored using complementary data sources to facilitate the research objectives (Voss et al., 2002). Building theory from one or more case studies is a research strategy which creates constructs and propositions from empirical evidence where the central notion is to develop theory inductively (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). A common issue for case researchers immersed in the phenomenon of interest is to balance persuasive rhetoric on one hand with "*convincing the reader of the writer's*

disengagement" on the other (Firestone, 1987: 17). This means overcoming the desire to emphasise the rich descriptions of narrative, towards generating rigorous and testable theoretical concepts which draw generalizable conclusions (Melnyk and Handfield, 1998; Voss et al, 2002; Stuart et al, 2002; Eisenhardt and Graebner, 2007). This paper uses propositions as an instrument to connect with and refine theory while incorporating 'interesting empirical observations' as a means to better understanding problems in real world contexts (Siggelkow, 2007).

The research strategy adopts 2 cases of military platforms to examine the proposed management of through-life maintenance solutions and develop theory on procuring complex performance. Major defence programmes involve the interplay of complex phenomena including unique product configurations, firm interactions and wider national socio-political influences over extended time periods, suggesting a case-orientated approach. The research design incorporates the use of a case protocol (see Table 2, Appendix) comprising 12 questions derived from the literature and developed for use in an interview setting. As PCP is an emergent theme in operations and supply chain literature, the research draws on established fields such as industrial markets, CoPS and outsourcing. The case protocol enables data collection by improving rigor and consistency of the investigation particularly where multiple sites are involved (Eisenhardt, 1989; Yin, 1994; Stuart et al, 2002). The questions are designed as semi-structured, serving both to anchor the research within predefined fields of literature whilst providing flexibility to explore emergent, less known or previously unrecognised phenomena as they occur during fieldwork (Dubois and Gadde, 2002). Sources of data included the response to the interviews, provision of company documents and public reports (Yin, 1994). Different internal and external stakeholders were interviewed (see Table 3, Appendix) to generate multiple perspectives and as an aid to triangulation (Voss et al, 2002). Interviews were of typically 90mins duration and focused on platform performance, events covering the programme, and overall impact on respective parties. Interview formats sought to accommodate the role, position and expertise of the different respondent groups. All interviews were conducted on location and initially included a site tour that built a picture of the working environment. Interviewees were asked if they had any objection to being taped and the majority of interviews were recorded and transcribed. The names 'Jet fighter' and 'Aircraft Carrier' were used for anonymity and because the emphasis of the research is on the complexity of the strategic issues facing defence procurement not the idiosyncrasies of the organisations.

The cases were studied independently and compared collaboratively (Brax and Jonsson, 2009). The data sets provided a comparable analysis as both studies began by studying the Prime contractor and proceeded to broader buyer-customer perspectives. Analysis of the data involved examining the similarities and differences of the challenges encountered in the cases using pattern matching or replication logic to identify and explain re-occurring themes (Yin, 1994; Miles and Huberman, 1994; Eisenhardt, 1989). Both cases typify the process of involving prime contractors

more closely in the UK military through contracting for outcome-based solutions, with the issues they faced often generalisable to other examples of oligopolistic markets e.g. public transport, and where the researchers were invited to offer their own insights. Participating organizations received preliminary versions of the research reports and oral presentations, but only minor corrections were suggested, indicating a level of credibility, validity or 'authenticity' of the investigation (Miles and Huberman, 1994: 278).

4. Findings: UK military

The UK military is divided between three forces: air, land and sea. This paper covers two of these areas, air and sea, containing the most technically advanced equipment. In 2012, £39 billion was committed by the government to defence spending, representing 2 per cent of GDP (HM Treasury, 2012). While the army receives the largest proportion of annual operational spend because of the high personnel count, the navy and air force receive around 80 per cent of new equipment spend for ships and planes. Major platforms such as capital ships and fighter jets are significant examples of markets with few buyers and fewer suppliers. The power of the buyer in the defence sector has long been recognised in the US (Apgar and Keane, 2004; Lundquist, 1992) whereas in the UK, Humphries and Wilding (2003) explicitly refer to business-to-business relationships in military procurement as 'sustained monopolies'. They cite the Ministry of Defence (MOD) as the largest single customer of British industry, but its 'immense power' is compromised as the major defence companies are 'virtual domestic monopolies'. Sharp (2005) also refers to these military supply relationships as 'discriminating monopolies', where how to manage such mammoth public defence procurements appears an endemic international problem. In a review of post Cold War procurement, Anthony (1998: 880) concludes "*...it has emerged clearly from this review that all countries find it difficult to design effective and accountable arms procurement mechanisms*". In short, all these factors play out both ways: in the concentrated defence sector suppliers and prime manufacturers may be as locked-in as customers.

4.1 Jet fighter

Until the end of the twentieth century, the western approach to maintaining fighter jets was that the armed forces, overseen by the relevant Ministry of Defence (in the UK, the MOD) between them carried out the required maintenance in-house. In the UK, Royal Air Force (RAF) personnel would service the aircraft and MOD staff would externally purchase the necessary equipments, and technical services support externally on a piecemeal basis from many contractors. In the Jet fighter aircraft studied here, as an example, there were 350 separate contracts for the MOD team to manage. To add to this supply complexity, the maintenance requirements are dynamic and escalating. The capabilities of the aircraft need to be improved constantly as new technology becomes available and the

capabilities of potential enemies also improve. A key feature of the new Contracting for Availability (CFA) model of procurement, which first emerged in military aircraft in the mid 1990's is that, both to keep costs down and to keep aircraft availability up, such capability improvements must be embodied at the same time as routine servicing work: a considerable improvement on the old system.

Post financial-crisis austerity programmes are compounding already announced plans to cut defence spending. Principally in the last decade, budget pressures have meant that the traditional in-house approach (i.e. servicing and separate upgrading) is unaffordable, mandating a new approach; partnering with industry on long-term, output-based incentivised contracts as the only way to achieve projected cost savings. Various forms of contracting for availability have now been contracted for across the RAF fast-jet fighter fleets, covering the Tornado, Harrier (now obsolete) and most recently, Typhoon jets. These contracts transfer the bulk of the servicing work (i.e. planned periodic servicing and capability embodiments) to industry, though a Prime Contractor promising guaranteed outputs (e.g. aircraft availability, flying hour levels, etc). Put another way: 350 contracts can be merged into one contract, with the key feature that output is guaranteed to certain levels by the Prime Contractor.

A new pricing method has been developed to introduce an incentivisation framework and attendant behavioural changes necessary to motivate all parties to take part in the drive to cut costs. Referred to as Target Performance Price Incentive (TPPI), this method links technical maintenance data and individual prices on specific equipment (e.g. repairs, spares) with an incentivised gainshare which rewards the parties in accordance with the effort they have put in to achieve savings through reliability improvements or servicing periodicity changes. For example, if the Prime Contractor can reduce the break downs on the aircraft which leads to 'repair arising' at the supplier company on a particular component, then the TPPI gainshare mechanism allows for the reduction in through-life cost to be shared between customer, prime contractor and equipment supplier on an agreed preset basis. What is new is that TPPI can track savings on each equipment item, whereas in the past only total contract cost reductions would be known, with no audit trail as to why costs had come down.

Critically, the 'Prime' has to ensure their supply chain is engaged with reducing failure rates which often means reduced volumes for them. Financially motivating the supply chain to contribute their intellectual effort is major hurdle. A 3-way split of savings to include the supply base is much harder to achieve equitably than a 2-way split. A further issue is that the true end-to-end savings from any initiatives may be hard to determine, as the MOD budget process separates industrial spend controlled by MOD's Defence Equipment and Support (DE&S) headquarters from other spend within the wider MOD. For example, the cost of providing an output from an RAF base will consist largely of three different budget centres. RAF personnel, fuel and infrastructure services on an RAF budget centre; a prime supplier and its supply chain paid out of a DE&S budget; and finally a third budget centre for buildings coming out of the Defence Estates budget. It is extremely difficult to assess the effect on all 3 military budgets without a long and cumbersome exercise. The current challenge is now

to construct such end-to-end cost models to establish the true cost of individual military platform outputs relative to their perceived military benefit.

Finally, the possibility of cost overruns is always a threat for one party, leading to a heavy emphasis on risk assessment within the contract price. In terms of drafting the contract the issue is firstly determining who is best placed to hold the risk (risk being built into the price in such contracts) and secondly, how does the contract motivate *both* parties to work together to mitigate risk? Using 'painshare' or 'gainshare' mechanisms has been common on large one-off development contracts as methods to share the risk of cost overruns or the rewards of cost. Their use in CFA contracting is based on thinking that the customer will accept a share of the pain if that means the basic price of the contract price is lower, and thus more affordable. What is seen in the Jet fighter contract and others let by the RAF, is a growing emphasis on incentives that unite the goals of the Prime and the user, to create behavioural incentives to work together to take cost out.

4.2 Aircraft carrier

The MOD began planning replacement aircraft carriers as early as 1988, the first of which is due to complete sea trials by 2018. The current class was originally designed for cold war anti-submarine warfare, but has been regularly used in the support of recent operations in the Middle East. In 1998 initial approval was given for the new carrier project involving the formation of an integrated project team consisting of Royal Navy and MOD personnel. This was followed by an initial tendering exercise where independent bids to design and build the carrier were submitted by two competing Prime Contractors. The project team decided in 2002 that delivery was beyond the scope of any one organization, so the two Primes agreed to work together with £300 million provided upfront by the MOD to fund a computer-generated test model of the proposed design. At the end of the demonstration phase in 2005, the MOD participated in a joint signing of the '5 Partner Alliance' charter consisting of the Primes and major manufacturers engaged in the programme.

Important milestones in UK warship construction in the decades leading up to the new carrier programme contract in 2008, point to the realisation by the MOD of the need to drastically cut costs in naval procurement. As early as the 1970s, cost-cutting was achieved initially by outsourcing design and build of warships to privately owned shipyards, who experimented with the use of aluminium alloy as a cheaper alternative to steel. In the 1990s, the first class of ship or 'platform' was built to commercial Lloyds A1 standard *not* the prized Admiralty standard. Despite the early onset of pipe work corrosion and occasional breakdown of ancillary equipment such as hoists and cranes, the assault ship remains in service today. It was not until 2003, a decade after similar contractual arrangements were introduced to the RAF, that the navy received its first wholly commercial design for a platform designed and built with in-service support in mind to provide high levels of availability. Only 3 River class offshore patrol vessels were built to replace 5 older vessels and provided

considerably more availability days. The deal between the Prime and the MOD was particularly attractive on account of the Prime agreeing to lease the ships, requiring no significant outlay upfront by the MOD and only a monthly payment which included a pre-agreed operational rate based on performance cost targets and actual days spent at sea.

As estimates over cost of the new carrier began to rise, a memorandum of understanding was passed between the British and France governments in 2006 to explore the possibility of sharing the aircraft carrier's design, construction and eventually operational use. However, the intention to share risk and cost did not materialise during the carrier's development due to France delaying its procurement decision because of the perceived high costs of the programme, the need to preserve key industries, and a review of its position in NATO. The UK government decided to go ahead with the order for 2 aircraft carriers, with the keel for the first vessel laid in 2009 at Rosyth. The carrier alliance adopted a contractual arrangement of profit and loss via a fixed ratio, based on the proportion of work undertaken and level of risk accepted by participating firms, with the intention of driving the partners together whenever a problem arose during construction. Such forms of performance measure helped to deliver clear targets yet maintain project momentum and encourage to firms to innovate not 'play it safe'. The MOD used a Target Cost Incentive Fee scheme, similar to the construction industry, where firms benefit collectively from their efforts to reduce costs using innovation throughout the project to ensure platform specifications are met.

The complexity of the new aircraft carrier is perceived less in terms of size and functionality (e.g. 3 times the size of its predecessor at 65,000 tonnes, 90 per cent of on-board functionality driven by electronics), but by a planned lifecycle of 50 years and adaptable design approach to on-board aircraft operations. Originally intended to be launched with jump jet capability and later to be replaced with short take-off vertical landing aircraft, the vessel uses platform architecture design with interconnecting modules (e.g. hull, forward island, propulsion units), and systems (e.g. weapons, navigation, safety, communications, waste) which make the task of the alliance assigning work packages clear to suppliers. Ironically, due to cut-backs from the 2010 Strategic Defence Review, an early withdrawal of the Harrier jump jet, and several U-turns by government over choice of navy jet, it is likely that only one aircraft carrier will be launched as a British warship which will have to wait until 2023 for compatible aircraft to become available (Haynes, 2012). Talks of plans to share operational use of the vessels between the UK and France briefly resumed at around the time of the Arab Spring uprisings and following jointly coordinated maritime operations off the coast of Libya by the two nations, but did not materialise for practical and political reasons, principally because of differences in national interest i.e. production infrastructure.

As the carrier programme shifts from build phase, to testing and sea trials, a new challenge for alliance partners is the introduction of service performance indicators which govern the available sea days of the vessel at full operational capability before requiring dockside maintenance.

Contracting for Availability was originally conceived by the air world but adopted by the navy initially as Contracting for Logistics Support (CLS), and is generally perceived by industry and MOD as the future standard for through-life management of all British warships. Although such arrangements have worked well in patrol ships, achieving over 300 operational days per year, questions remain over the evolution of CFA to larger vessels such as the new destroyer, which at present only achieves around 140 days and requires constant attention to maintain its complex electronic ship's systems. As the new carrier is considerably larger and more complex due to the requirement to maintain and launch multiple types of aircraft, questions remain over what are the optimal levels of operational performance and availability for such vessels. The linear model of performance maturity for in-service support developed by one Prime Contractor, presented as a four-stage transformation staircase from basic logistics support to full availability contracting, does not reflect the dynamic and rapidly shifting peacetime/wartime conditions likely to be encountered by the navy in 21st century world politics. When at war naval ships create supply conditions where the imperative for replenishment are the *opposite* of best practice in peacetime i.e. Lean and Just-in-time, meaning higher inventories of spares are required to be held by the Prime and its suppliers to replace lost or damaged parts, including high cost items such as engines.

5 Analysis and discussion

The focus of this section is on how the empirical work informs and develops the treatment of procuring complex performance by revisiting the propositions. Both cases are compared in light of the 8 original propositions, with a further 2 propositions emerging from the discussion. They present the MOD, a 'market of one', seeking ambitious and non-incremental innovation from the Prime Contractors during the procurement process.

Proposition 1: *Contracting for complex performance in markets of few buyers and few sellers involves volatile or infrequent demand patterns adversely affecting national production capability.*

According to RBT, organisations are unique blends of various resources. For Prime defence contractors such resources are only fully utilised in the design and construction of major platforms. Yet contracts for major platforms only arise every other decade, making each contract fully customised, and for a Prime having a share of such contracts is a prerequisite to retaining core capabilities. Losing out on even one such contract would jeopardise the ability of a national champion to remain in that market until another platform contract eventually emerges. The complex performance required in the contracts studied here aims to prolong the life of existing platforms at the expense of sales of new platforms.

On the customer side the infrequent nature of demand, compounded by the transfer of responsibilities to the private sector means that maintaining sufficient expertise in-house to understand the implications of emerging contractual forms is difficult. The transfer of so much expertise in the Jet fighter case (all maintenance and upgrades except in battlefield conditions) raises the further issue of how much expertise will be lost that is fundamental for good contracting. Serious doubts were expressed in both sets of interviews about the loss of capability in the MOD and how the loss or erosion of that capability would affect future ability to contract. In the Carrier case the MOD retains a central role through being part of the five partner arrangement, but there is still an erosion of capabilities that were formerly located within the MOD and which now pass to the Primes in the supply base. New knowledge monopolies are being created in platform maintenance, but located in the private not public or not-for-profit sectors. Note, whilst the authors acknowledge the limitations of the case study method with regards to evaluating 'national production capability', it is suggested that these two cases combined are of such scale and visibility that there is sufficient replication in the data to infer more general links to an industry-wide perspective.

Proposition 2: *Complex product-services that are sold to markets-of-one require multiple procurement logics bundled into one contract.*

In both cases a huge range of requirements from the very basic to advanced engineering have been bundled into one contract. Elements of the contract that appear challenging at the concept stage may be easily resolved by the design phase, whilst new and unanticipated issues emerge. Previous work has suggested bundled contracts work best in mature markets (Spring and Araujo, 2009; Lonsdale, 2005), yet in the Carrier case much of the challenge lies in solving problems unknown at the outset. In the Jet fighter case the issue of bundling tasks of widely different complexity is repeated, but at the level of maintenance and upgrading. High profile examples of new upgrades being embedded at routine maintenance cycles may mask just how high a proportion of the maintenance is routine, and relatively undemanding. Contracting for availability here may be an expensive option, effectively contracting for specialized engineering skills on a contract that is fundamentally routine. It is not clear how the contractor is incentivized to report that the work is simpler and less time consuming than expected.

Proposition 3: *Procuring complex performance will often involve 'market making' where there is no existing supply market for the combination of product and service.*

The reasoning behind the bundling of procurements is that the customer must create a market where none existed before. In the Jet fighter case such work was formerly done in-house and in the Carrier case, the 5 Primes would not have chosen to work together in an alliance if not for the overwhelming scale of capabilities needed to design and build such a ship. Combined elements of propositions 2 and 3 show up in the cases as the creation of new markets which combine many traditional and routinized

activities with new, highly technical and perhaps high risk activities (e.g. electronics). It is not clear from the cases how the risk reward mechanisms differentiate between these two levels of activity.

Proposition 4: *Procuring complex performance contracts emphasize outcome over output and transfer control from the buyer to the contractor who gains support revenue in exchange for risk.*

In the Jet fighter case, an industry with lumpy revenues rather than regular supply chain sales, drum beat income from regular maintenance activities is undoubtedly attractive. Yet in return for this income the Prime is taking on the risk of fighter planes not being available as required, as yet unknown quantities of repairs, and the prospect of lower platform sales as the existing fighter is maintained and upgraded. In the Carrier case, the extraordinary delayed nature of revenue streams in platform infrastructure is even more highlighted by a gap of over 20 years between the new carrier being conceived and the first stage of the build.

In both cases, the contracts call for availability i.e. flying hours or days at sea, and these are outcome measures as opposed to traditional output (e.g. deliver to quality & specification), to schedule and budget (e.g. the price agreed). This is typical of contracting for performance and shifts tremendous responsibility from the buyer to the contractor, and in doing so shifts the contractors' interest from delivery, repairs and spares when there are breakdowns, to through-life management and costing. Concomitant with the contractor picking up a range of new tasks is that the buyer can lose control: for example, the ability to set Admiralty standards during carrier construction, where the buyer loses the ability to determine how the outcome is to be achieved.

The rhetoric of servitisation would see this transfer as positive. The buyer may have been too detailed, too prescriptive and unwittingly added cost and complexity with unique specifications which has certainly been a criticism of military buyers. An empowered contractor will now have the 'bigger picture' and be able to innovate in design for maintenance as well as manufacture, and focus on total cost of ownership. However, such a perspective does not take into account the role of the public procurer as a dispassionate and theoretically neutral entity among competing technologies and strategies. Allowing the Prime so much of the decision-making space may encourage short-term or opportunistic behavior, for example favouring products, processes and technologies that predetermine other decisions in the Prime's commercial favour (e.g. track & trace technology).

There is also the issue for the customer of whether such high profile performance risk can really be transferred to a contractor. In a crisis, the blame would tend to be heaped on the government and government department, and if that risk cannot be transferred then it should not be paid for as a risk premium in the contract. The contractor simply cannot know all the risks it is taking on such as new military episodes, the environment of such episodes (from polar ice to desert heat), and the care taken by the military of equipment no longer perceived as their own.

In the Jet fighter case the main driver of the new procurement is cost reduction, the availability contract is in effect a way of matching how much budget the customer has, with what a provider will offer: effectively a fixed price contract with some mechanisms to share savings. All the circumstances reflect the position of the defence buyer as a 'constrained monopolist' and the dependency in defence relationships. Yet the moves to procure complex performance rather than platforms from Primes are fundamentally customer driven. It is not certain that Prime's business models can adapt to suit this new environment, including reduced platform and spares sales, driven by reduced budgets coupled with improved maintenance regimes. The scale of such contracts mandates Primes compete and undertake them, yet their commercial viability is still an unknown, and ultimately a risk for the buyer if the supply market were to fail in mid programme.

Proposition 5: *In markets-of-one customer and supplier are 'locked in' where contractual and relational mechanisms must combat opportunism and ensure a steady stream of innovation from an incumbent and monopolistic supplier with a significant contractual incentive.*

Incentive schemes are used to align the interests and actions of customers and contractors; they are often used when the performance required is complex. Incentive schemes are also high cost to run, and the issue is not the pain-gain ratio chosen, as much as ensuring that the incentive threshold is set appropriately to ensure from the outset that the incentives drive performance. Given the complexity of the requirements in both cases, and the emphasis placed in the interviews by participants on the distributive aspects of the incentive mechanisms it is unclear how accurately the thresholds have been set.

The issue of incentive thresholds is particularly important given the expectation of innovation from the contractors. The contractor has the unofficial incentive of saving maintenance costs that are now a hit on margins rather than a sales opportunity. Such innovations will likely be incremental, with improvements or 'tweaks' to existing products and processes. The incentive schemes do not appear to be targeted to drive the undefined nature of more impactful or radical innovation. Returning to the theme of loss of expertise in proposition 1, both cases pose an unanswerable question at this stage of their contracts: what long-term impact will CFA contracting have on the innovation capability of contractors and the chain?

Although both cases feature a form of target cost with incentives, they also illustrate a fragmented and divided approach to procurement. Contracts are being let platform by platform, which is itself a barrier to a capabilities-based approach. There is an important question to be answered here over how well this patchwork of contracts (however large individually) will perform under the stresses of combat. In the Carrier case additional potential fault lines may be being created through the complex multi-Prime partnering scheme.

Proposition 6: *Building on insights from CoPS, the co-creation of value in PCP contracts necessitates one party having a systems integration role and suggests leadership by the buyer.*

The cases highlight a shift in responsibilities from the public to the private sector. Yet very little emphasis has been placed on the new leadership responsibilities of the private sector Primes that are implicit in contracts for availability. Perhaps the servitisation literature, grounded in smaller scale private-to-private examples, has not needed to address leadership at the scale required of military procurement. If the management of large-scale projects has taught us anything, it is that the influence of strong leadership in capital projects should never be underestimated in terms of the achievement of a desired outcome (Hobday, 1998; Davies and Hobday, 2005).

CFA puts the customer in the driving seat in terms of shaping platform strategy and yet places the detailed knowledge to support strategic intervention in the hands of the contractor. By conducting discrete CFAs on a piecemeal basis a leadership role is circumscribed. In the interviews some alignment within services was reported, but none across services. This phenomena is termed here 'leadership by default' and contrasts significantly with the systems integration role the CoPS literature would suggest.

Proposition 7: *Complex procurement in oligopolistic markets is likely to feature political interference.*

Our review also suggested that traditional and component-led purchasing could not address the political dimension of complex products and services and their powerful interest groups. Clegg et al's (2002) work on megaprojects characterised megaprojects as uncertain, complex, politically sensitive and with large numbers of partners. Sturgess (2011) perceives political intervention as one of the main drivers for the in-sourcing or state provision of complex performance. He makes the point that in the case of public services, proximity to core functions of the client agency creates complexity at the organisational interface; in other words, politicians want to be able to intervene in the delivery of these services. In the Carrier case there is direct political intervention in shaping and changing the plan for aircraft, and less direct political intervention in the talks with the French government. There is also the example of different lobbying groups pushing for vertical vs. non vertical take-off aircraft.

Proposition 8: *PCP contracts in oligopolistic markets often involve triadic relationships resulting in coalitions of interest and joint lobbying by two parties against the other.*

The CoPS literature identified that politics is a feature of CoPS project. Both the cases of PCP described here feature a triangular relationship between the military user as customer, the Prime and the budget holder (i.e. Treasury). It is a long-term issue as to how the 'golden triangle' of user (i.e. Military), contractor (Prime) and budget holder (Treasury/taxpayer) will play out as the contracts mature. A cynic might view a blossoming relationship between user and contractor where shared

interests appear strong i.e. high volumes. At the very least it appears naïve not to see this triadic arrangement as dynamic, and likely to unfold and evolve over time. The cases do not provide any evidence to-date on the assumption within the contracting for availability model that the needs of the three stakeholders are aligned. From the cross-case analysis two further propositions emerge:

Proposition 9: *The effective management of new contracts for complex performance requires the creation of more sophisticated modeling capabilities*.

Cost modeling seems to be an enhanced contractor capability required by the new contractual forms. It is particularly important to PCPs that transfer responsibilities from the public to the private sector, where the previous public management regimes may have viewed costs as given or relatively fixed e.g. traditional 'cost plus' contracting. In the short-term, modeling capability informs the profitability of each platform contract. Yet as these contracts mature the authors suggest this modeling must play a larger and more strategic role.

It would be naïve in the extreme to see CFA and PCP as redefining working practices including many boundary-related issues created by silos. Note that evidence of inter-service information sharing was not found in the research. In the Jet fighter case, beneath the rhetoric of outcome-based contracting there are still budgetary silos e.g. the triad, as well as additionally *in force* silos, such as planned vs. reactive, contractor, treasury and military, as well as prime vs. supply chain. The Carrier case continues this theme with protracted political wrangling about capabilities required for the aircraft, the divergent national interests between UK and France, and further air force versus naval inter-forces rivalry that was a contributory feature of the 10 year hiatus in development. Contracting for performance implies doing away with intra and inter-organizational silos, creating a new and detached focus on end-to-end value creation. However, the literature provides little guidance in terms of how availability contracting avoids silo-based functional mentalities which have shaped so much of the UK military. The strategic use of sophisticated and mature modeling systems across services is suggested as one approach.

Proposition 10: *Procuring complex performance in oligopolistic markets under CFA necessitates Primes review incentives for the supply market, both for supplier led innovation and to secure continuity of supply of existing product-services.*

A final proposition emerges, which parallels proposition 3 on customer market making, but imposes that responsibility on the Prime. The Prime will have to ensure micro-markets for suppliers including those with low volume or obsolete parts whose business model was based simply on supplying volume under the old model. Suppliers will have to be reassured and incentivized to supply innovations to a Prime without the comfort of visibility from the final customer. This proposition reflects the provider bias in the existing literature and an area under reported to-date. Table 1 below

now summarises the constructs of the cross-case analysis. The conclusion, next, presents the challenges for UK military procurement and the contribution of the paper.

Table 1 Summary of cross-case analysis

	Jet fighter	***Aircraft carrier***
Contractual measures & incentives	Availability hours (flying hours) Target Performance Price Incentive	Availability days (days at sea) Target Cost Incentive Fee
Quasi-market characteristics	Contract creates new market for new product-service thinking Based on through-life Jet support	Creates a new market for the UK Capability-led naval platforms based on leasing agreements
Procurement logic	Seen as central by the mid 1990s to reducing costs of RAF aircraft servicing, support and maintenance	Traditionally seen as the function to initiate ship design and build. Seen as central from the mid 2000's on to reducing whole-life support costs
Service support	Moved to civilian contractor with some military personnel in support Military retains maintenance responsibility in combat zones	Moved from state-owned shipyard support to civilian contractors Issues over war-peacetime transition of support, such as stocks of spares
Political environment	Jet fighter numbers to be cut in major defence expenditure review Considerable competition for share of defence budget with the navy	Only one vessel to be flagged as British Aircraft will not be on board at launch due to shifting political considerations Collaborative interest with France failed due to differences in interests
Collaborative & boundary issues	Co-location with user in UK bases RAF support personnel work for Prime: blurring of military/civilian boundaries Silo mentality and inter-service rivalry means delays in sharing capability	A consortium or Alliance of UK 'talent' Ownership by Prime of principle naval dockyard New boundaries emerging with other Primes and rival firms after initial bid
Supply chain configuration	CFA is critical for cost savings but the contract is between MOD and Prime Prime must adopt a greater leadership role in extending to the supply chain Contract essentially dyadic but other interested parties may mean triadic	Critical area for savings but availability contract is between the MOD and Prime consortium/Alliance. The Carrier Alliance must extend to supply chain Suppliers to the Alliance required to adopt war-peace service conditions

6. Conclusion

This paper has introduced the phenomenon of Procuring Complex Performance (PCP) in a military procurement setting. While the literature on CoPS and managing large projects provides a foundation, the PCP approach emerges as distinguishable. The two cases highlight the shift towards contracting for availability through increased responsibility and scope for private sector contractors in defence support. We propose such contracts, or coordination mechanisms, are essential for managing all complex public-private undertakings in the 2010s and beyond. They are typified by closed and highly

concentrated industries involving oligopolistic supply markets where a clear need has emerged to identify new business models based on supplying outcomes and ultimately capabilities, not products or services.

While a number of tactical level challenges emerge from the analysis, three core strategic challenges are specifically identified for the UK military. The first is the scale of such procurements, as in how to manage performance and the risk that these are contracts that the Primes cannot afford *not* to compete for, but may struggle to profitably adapt businesses based originally on models of repeat platform sales.

The second challenge is in the outsourcing of capability while retaining sufficient skills to manage existing and new contracts. In this area of public procurement we identify a triad of stakeholders involved in the outsourcing process: User, Prime and Treasury. Critically we also identify a transfer in leadership from the bi-partisan MOD to the private sector. It is not clear how the mechanics of this transfer of leadership will unfold in future and this may be the most complex area of outsourcing complex performance for the military sector.

Third, and following on from the issue of leadership, is how to manage the supply network particularly as an innovation network, for example how to coax more long-term innovation from the supply base. Can Prime contractors with proud histories of radical and incremental innovation adapt to a new and constant focus on incremental improvement and innovation, and maintain or retain the capabilities and unique expertise that has been the core of their market offering for decades? The two contracts studied here are like others the authors have seen that have been set up piecemeal: platform by platform, rather than a more coherent approach such as land, air and sea inclusive, where learning can be exchanged and built up over time within aligned and coordinated units.

There appears to be a danger that the cumulative impact of all the individual availability style contracts may be a loss of radical innovation capability in both the Primes and the national supply base. Is it realistic to expect innovation to permeate through from the supply base to the Prime to the platform, without suppliers having the surety of direct contact (and therefore, in theory, an opportunity to gain full credit for) their innovations? How integrated the response to these three challenges will indicate the connectedness of strategic decision-making by government and dictate the long-term direction of UK military procurement.

In terms of implications for practice, one critical distinction between recent work on supply management and the approach adopted by the authors is that the supply chain is rarely adopted as the unit of analysis. From the evidence emerging from these cases, we suggest that the supply chain may be one of the later and highly contingent parts of a PCP to be configured. This is in contrast to the huge interest in academic work that starts from a supply chain perspective and sees supply chain configuration as the preface to activity. In adopting contracting for availability in major platforms

(military or civilian), three core challenges are proposed for the customer. The customer must understand its own role in terms of how its requirements may evolve over time, including assessing likely political influences. The customer must critically engage with what skills and capabilities it is losing through outsourcing and which skills need to be retained for future contracting (and contract management). Finally, the CFA programmes in the cases may pass additional responsibilities to the Prime, but the need for leadership or a systems integration role in the customer cannot be left to the market. The customer must understand how future capability requirements including radical innovation will be protected and the supplier's contribution rewarded.

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APPENDIX

Table 2 Question protocol

	Question	*Origin / source*
1	Describe the contextual background to the (defence) programme, including national & international politics and world events, up to and during award of the contract.	Mayer and Khademian (1996) van Marrewijk et al, (2008)
2	How was the role of procurement perceived throughout the programme by all parties?	Kraljic (1983) Cousins et al, (2006)
3	How would you describe the market conditions and national infrastructure in UK industry at the time of the programme?	Sherer and Ross (1970) Appelbaum (1982)
4	What arrangements were made to understand overall in-service support issues during the initial stages of platform design and construction?	Penrose (1959); Stremersch et al, (2001); Araujo and Spring (2009)
5	How were specific customer service requirements as part of maintenance, repair & overhaul met by programme contracting?	Potts (1988); Quinn et al, (1990); Olivia and Kallenberg (2003)
6	How was the programme governed in terms of the importance placed on relationship-based versus contract-based styles of management?	Dyer and Singh (1998) Poppo and Zenger (2002)
7	What specific metrics and measures were used to enable decision-making during the programme?	Davies and Brady (2000); Melnyk et al, (2010); Ng et al, 2009)
8	How were suppliers managed in the event of outsourcing over areas such as risk transfer to fulfil order requirements?	Lindberg and Nordin (2008)
9	What degree of collaboration occurred during the programme in terms of inter-firm sharing of skills, capabilities and resources?	Penrose (1959); Wernerfelt (1984); Lavie (2006)
10	How important were co-ordinating or leadership roles such as project management and systems integration to the programme?	Davies and Brady (1998) Davies and Hobday, (2005)
11	What was the nature of the relationship between end consumers, customers and buyers at programme inception, and did any changes occur over time?	Choi and Wu (2009) Li and Choi (2009)
12	What contractual incentives were adopted to foster closer contractor involvement and innovation from the supply chain?	Stuart (1996); Goffin and New (2001); Davies & Hobday, (2005)

Table 3 Case study specifics

	Jet fighter	***Aircraft carrier***
Research period	2008 - 2009	2007 - 2010
Total interviews	20	15
Interview duration	30 - 150 mins (typically 60)	60 - 90 mins (typically 60)
Investigator	First author and colleague	Second author and colleague
Respondents	Prime Group supply chain Prime platform supply chain Platform service managers Prime Business Process Managers Prime co-located site managers Platform users - MOD Procurement - MOD First tier suppliers First tier SC managers and engineers	Carrier Alliance directors Carrier Alliance consultants Prime Engineers Platform users: Royal Navy personnel MOD Procurement First tier supply chain directors First tier supply chain engineer First tier CLS/CFA managers Trade Association CEO
Interviewees	14 Prime manufacturers 4 Customers 2 Suppliers	8 Prime manufacturers 4 Customers 3 Suppliers