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Chapter 9

Innovation in Limited Markets: Managing PCP Projects in the UK Defence Industry

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Abstract

This chapter will outline guidelines developed to both support and enhance innovation within the context of procuring complex performance (PCP) contracts. Such contracts are currently being employed across a range of sectors where limited market conditions exist. Such contracts and market conditions are set to remain the dominant form of defence procurement strategy for the foreseeable future. The case of the Typhoon combat aircraft programme is presented as an example of a typical, large-scale, complex procurement programme for the defence industry. The MoD and the UK defence industry have developed new, contractual models for procuring complex equipment, such as aircraft and naval ships. These models involve the contracting for complex performance, which has changed the paradigm in the relationship between the customer(s) (MoD, UK Armed Forces) and the supplier (UK Defence Industry). Outcome-based contracts for procuring complex performance (PCP) have been employed widely by the defence industry and other sectors in limited or oligopolistic markets. Ten theoretical propositions are presented in this chapter, to help us discuss PCP contracts. The literature review will include servitisation, complex performance models and discuss innovation strategies in the context of limited markets. Lessons learnt from the case, and guidelines for enhancing innovation are presented.

Keywords: innovation, projects, procuring, performance, UK defence industry

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1. Introduction

With the national defence budgets reducing over time as a result of environmental changes and continued economic uncertainty [1], the MOD and the UK defence industry have developed new, contractual models for procuring complex, technology-driven equipment, such as aircraft and ships. These models involve contracting for complex performance, which has changed the paradigm in the relationship between the customer(s) (MOD, UK Armed Forces) and the supplier (UK defence industry).

In procuring complex performance (PCP) contracts, a close, long-term relationship is developed that requires all those involved in the value-chain, including the customer and the extensive supply network, to co-operate in an enterprise approach to deliver competitive advantage with no single actor having the internal capability to achieve the totality of the requirement. Incentivising the supplier is key to delivering innovation, both radical and incremental, which requires suitable mechanisms built into the contractual and organisational construct. However, it is suggested that innovation within the defence industry may now be inhibited by the way that these new business and operating models have been implemented [2]. Innovation is a widely explored subject but, currently, no guidelines exist for supporting innovation in PCP contracts for organisations engaged in this type of procurement activity. Therefore, this chapter seeks to identify from the literature a set of *trends*, *success factors and barriers to support and enhance innovation within the context of a PCP contract.* Each of these will be reviewed in the context of the UK Typhoon combat aircraft programme, a major project in the UK Defence industry in order to move towards a set of guidelines that may be of interest to a practicing manager who has responsibility for managing a PCP project. This topic is relevant and of significance as PCP contracts are being employed across a range of sectors where limited market conditions exist and are set to remain the dominant form of defence procurement strategy for the foreseeable future.

Innovation is a feature of all successful enterprises and essential to provide future growth while remaining competitive and adaptable in a dynamic world [3] but setting the right conditions for enabling innovation within companies and organisations is not simple. A taut definition is provided by Tidd and Bessant [4] is '*the successful exploitation of new ideas*' (p. 19) inferring that innovation is a process whereby new ideas are converted into value either monetary or otherwise. Innovation involves integrating technological, market and organisational change. Being innovative is vital to the UK defence industry to ensure that it can meet the MOD's, and, ultimately, the Nation's requirements for continual adaptation of capabilities to meet the challenges of the future which was reinforced by the Secretary of State for Defence [5] in the 2015 UK Strategic Defence and Security Review (SDSR):

> *'Given those challenges, my third and final point is that being efficient would not be enough. We also need to innovate. We are determined to take the opportunity offered by the SDSR to build a culture more ready to take risks and more open to change. We want to do everything we can to augment our force structure, speed up the integration of new technologies, adopt new operating concepts and incentivise modern working practices'.*

The trend towards 'performance-based contracting', such as 'power-by-the-hour' in aviation, 'contracting for availability' (CFA) in defence for air, land and maritime forces and performance-based

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contracts in public-private healthcare is reshaping service support networks in many capital-intensive industries and is part of the wider movement towards integrated 'servitisation' models [6]. Performance-based contracting is designed to replace the traditionally employed fixed-price and cost-plus contracts to improve product availability and reduce the cost of ownership by directly linking a supplier's compensation to the output value of the product generated by the customer. Key features of PCP contracts are the shift in emphasis from output to outcome and the transfer of risk from the customer to the supplier for additional revenue [7, 8]. PCP contracts are an example of servitisation as an innovation strategy.

Drucker [9] suggests that innovation is the *'discipline of the entrepreneur'* and the systematic search for *'windows of opportunity'*, which suggests that innovation is a process that can be learned, managed and influenced and reinforces, Myers and Marquis's [10] conceptualisation of innovation as a non-linear, integrative process. The major choices a company make to influence performance through innovation are defined as innovation strategy [11]. Examining and critically comparing the innovation strategies of the defence companies and agencies involved in the Typhoon combat aircraft programme, which has been procured using the PCP model, will enable an analysis of the challenges of innovation in limited markets and an opportunity to explore how innovation can be enhanced to deliver more value within the context of PCP contracts in the future. The intention is to build on current theory to understand the level of influence that contracting for complex performance has had on the innovation strategies of UK defence companies. These are categorised into *trends*, *success factors* and *barriers to innovation* that influence innovation in complex performance contracts.

To highlight these issues in practice, the case of the *Typhoon Combat Aircraft* is presented that is representative of a typical, large-scale, complex procurement programme for the defence industry. This programme is international, multi-mission, combat aircraft designed and manufactured by companies from four European nations. In this case, we shall draw on fourteen interviews with personnel from three UK defence companies at different levels (e.g. strategic, operational and commercial) and the MoD involved in contracting for complex performance. A number of lessons learnt are drawn on from considering each of the *trends*, *success factors* and *barriers to innovation* in the single case. It is intended that this moves us towards a set of guidelines that will be of interest for private firms and public agencies to enhance innovation capability within the context of programmes that have been procured using the contracting for complex performance model. Further work is suggested to provide a multi-case analysis to enable a critical comparison of the approaches taken and are representative of the agencies that undertake this type of activity.

2. Research issues in contracting for complex performance

The literature review is bounded within the areas of innovation strategy and management within the context of contracting for complex performance in limited markets. First, innovation strategies within limited markets are discussed (Section 2.1), followed by introducing the strategy of servitisation (Section 2.2), concepts and principles in contracting for complex performance (Section 2.3), knowledge management and incentivisation in PCP contracts (Section 2.4) and reviewing timeframe, managing risk and the design of PCP contracts (Section 2.5).

2.1. Innovation strategy within limited markets

Innovation has many facets, but Tidd and Bessant's [4] definition: 'the successful exploitation of new ideas' provides a holistic interpretation and introduces the concept of innovation as a process. The process view of innovation is widely supported [10–13] with process complexity increasing as concepts have developed from relatively simple, linear process models to the integrative and networked fifth generation models of innovation suggested by Rothwell [14]. The concept of open innovation introduced by Chesbrough [15] suggests that innovation activity and knowledge accumulation can take place beyond the boundaries of the firm. To be successful at innovating, firms or organisations should develop routines, which encourage knowledge sharing and absorptive capacity together with a culture that supports innovation and a climate that encourages creativity [16, 17].

Knowledge creation is an essential part of successful innovation practice, which involves creating and sharing knowledge throughout the organisation which can then be embodied in new technology or products [18]. Smith and Reinertsen [19] build on this idea, identifying that resources and organisational capabilities are the ingredients of successful innovation with repeatable, codified innovation routines being the fundamental building blocks of an innovative company. Building capabilities can be achieved through organisational learning by various methods including working closely with customers and suppliers, joint ventures and alliances. Pursuing incremental innovation is a strategy for many firms but Strecker [11] asserts that focusing purely on incremental innovation can harm firm performance in the long-term and does not prepare a firm for discontinuous or radical innovation where the 'rules of the game' may change. Radical innovation can lead to a greater return on investment as well as superior competitive advantage [20]; however, radical innovation is inherently risky and does not always lead to success for pioneers of new products [4, 21]. Henderson and Clark [22] suggest that firms, which have an incremental or radical orientation, will require quite different organisational capabilities. Therefore, a tension exists in configuring for incremental or radical innovation. Many firms or organisations would still potentially seek to achieve both attributes.

In limited markets, like the defence or the rail industry, this tension will be particularly acute due to the characteristics of specialised markets with limited buyers and sellers. Limited or restricted market structures dominated by a few sellers are defined as an oligopoly. The theory of an open market structure suggests where competition between sellers is not restricted, this should generate low prices and high productivity whereas oligopolistic power can lead to imperfect outcomes and behaviours which can generate high prices and low productivity [2, 23, 24]. Imperfect markets are a challenge; further to this governments have pursued greater efficiency and effectiveness demanding greater innovation from industry, this has, in part, initiated adoption of strategies like 'servitisation' and the shift to new operating models, like PCP contracts. In the context of a PCP contract within a limited market structure, Caldwell and Howard (2014) indicate that firms will particularly struggle to configure to address the challenges of continual incremental innovation whilst also seeking to provide a radical innovation capability.

The extension of new concepts, like servitisation, through various sectors is indicative of more open forms of innovation. With the spread of technologies and methodologies across sectors

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due to the effects of globalisation, particularly the rapid development of information technologies, the influence of technology on the changes to institutions and vice versa is clear. Spin-offs or concepts of 'dual use' across sectors of technology and methodologies are commonplace [25]. It can be argued that national, sectoral and technological innovation systems play a part in driving change. National innovation systems are assessed as the totality of institutions and practices that interact to produce and diffuse new technology whereas sectoral and technological innovation systems are concerned with adoption of certain technologies in or across sectoral boundaries [26]. It is suggested that it is the co-evolution of national, sectoral and technological systems that has shaped specialised industries, like defence, and that innovation is driven or stifled by the interactions, inter-linking processes and changes in technology and institutions [27–29].

2.2. Servitisation strategies in the context of defence projects

As industries evolve, new strategies like servitisation are developed. Baines et al., [30] define the concept of 'servitisation' as the innovation of an organisation's capabilities and processes to shift from selling products to selling integrated products and services that deliver value-in-use with manufacturers becoming 'service-manufacturers'. Servitisation has become a key source of growth for many industries, including defence, with integrated solutions being developed, which generate greater customer value. Long-term relationships are emphasised with a shift towards organisational innovations, such as PCP contracts, to create new opportunities and gain a competitive advantage. In the context of servitisation, Gallego et al., [31] suggest that innovation needs to be progressively understood as an open and interactive process, which requires efforts, capabilities, and competences from various sources. This fits with Chesbrough's [15] concept of open innovation where incoming information and knowledge from outside the firm's boundaries is useful to the innovation processes.

New models of operation, such as servitisation, have challenged the traditional hierarchical architecture among the state, firms as systems integrators and subcontractors within the industry and the management of complex programmes. With knowledge and capabilities becoming more widely distributed, the design and development of complex programmes require new interactions between the public and private sector, which implies new knowledge combinations and capabilities between these parties. To integrate and manage the system effectively will require architectural knowledge as well as technological and organisational competence [29, 32, 33]. To be effective systems, integrators will require that current processes and functions are re-evaluated to develop new forms of exchange between the customer's, the firm's and, most likely, the array of sub-contractors' processes, behaviours and systems. Success in this area requires a true understanding of the meaning of value as it can be argued that a constant focus on 'value-for-money' by the state could undermine UK industrial capabilities. Many authors such as James [27] have argued that the creation of value should be a co-creation activity. The instigation of organisational routines and processes that support learning will enable designers, integrators and suppliers of complex product systems to build capabilities based on previous activity which, in turn, may develop 'repeatable solutions' or enhanced solutions based on experience [2].

In limited markets, like the defence industry, a close relationship between customers and suppliers is inevitable. As there are clear dependencies then a relationship between the organisations built on trust, vision, effective communication, collaboration and teamwork is an enabler for success [34–37]. To provide effective support and enable joint innovation, the firm requires intimate knowledge of the customer's operations. However, close co-operation between suppliers also requires appropriate protection of intellectual property (IP) to encourage and sustain innovation [38, 39].

By developing customised solutions for the customer alongside the physical product, the firm can reduce the overall costs associated with owning and using the product [40]. With a service-based approach, a firm can improve its capability to deliver higher value which has been regarded as a strategy of innovation for firms to remain commercially competitive [41, 42]. Focusing on benefits and value in totality by not separating products from service, firms will be able to innovate for better outcomes in product design or enable better human processes. Vargo and Lusch [43] propose service as 'the application of specialised competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself' (p. 2). Success in the development of services will be largely determined by the innovation culture, which should encourage and support openness, creativity and going outside of the norm [44].

Transforming a firm towards being service-orientated from a production-orientated entity requires an innovative, integrative approach, which combines traditionally separate aspects of a firm. Areas such as manufacturing, engineering, operations, marketing, business management, strategy and HR will have to work in an integrated fashion to co-create value with the customer to deliver an effective and efficient service [45]. Service development process, organisation and culture are all elements of a new service-orientated structure combined with measurement and rewards, suggested by Neu and Brown [46] as the five factors that enable successful service development. A service-based structure would have a customer-orientated, value-in-use based approach focused on outcomes provided by products or actions [47].

2.3. Contracting for complex performance

PCP contracts are a manifestation of the servitisation approach, which emphasise performance outcomes rather than how the outcome is to be achieved. Contracting for complex performance requires the service performance to be defined and linked to payment with an implicit transfer of risk to the supplier. Service performance is tied to financial penalties for poor performance and incentives for exceeding performance or innovating. PCP contracts are designed to be 'through-life' solutions to complex projects providing sustainable support, maintenance and upgrade over extended periods, often decades.

PCP contracting is 'outcome' focused. Customers only pay when outcomes have been delivered rather than for completed activities and tasks. This holds implications to the established architecture of 'production' and 'manufacturing' driving firms to be more innovative in the co-creation of service value, such as reducing costs, implementing new customer-focused processes and re-engineering of business processes [48]. A focus on customer outcomes means that PCP contracts encourage collaboration and co-ordination along the supply chain through

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the alignment of incentives [39, 49, 50]. In turn, it is suggested that this combination supports innovation in the long term as suppliers may have an interest to invest in designing more reliable products, with more efficient repair and logistics capabilities to increase profitability [51]. Through an examination of organisational control in terms of agency theory and socialisation models, Johnson and Medcof [52] demonstrated that PCP contracts support long-term, proactive innovation. PCP contracts, vis-à-vis behaviour-based contracts, engender self-initiated agent innovation as outcomes are specified but not the means to achieve the objectives of the contract leaving space for innovation. The incentives for achieving the outcome with fewer resources are increased profits through the reward scheme built into the contract. It is argued that the literature currently underplays the challenges associated with supplier-led innovation in product, process and working methods and that the empirical evidence is limited [53, 54, 79]. However, there is a generally accepted view that PCP [54] contracts do engender incremental innovation by the supplier [2, 8].

2.4. Knowledge management and incentivation in PCP contracts

Innovation, to a large extent, derives from the knowledge exchange between organisations [56, 57]. In terms of seeking to set the right conditions for innovation, Avadikyan and Cohendet [58] state that the central and challenging issue faced by the buyer is effective governance mechanisms which can deal with the trade-off between short-term efficiency and the long-term, relational aspect of knowledge economics. Furthermore, strategic knowledge management is a fundamental element of innovation processes with inter-organisational arrangements such as networks, long-term partnerships, communities and knowledge platforms recognised as important features. Long-term, partnered PCP contracts in the defence industry are an example of evolving knowledge management networks with management practices aimed at collective learning and co-construction of competencies between the public and private sector. Swart and Harvey [59] build on this idea suggesting that the key knowledge within projects exists across the boundaries between organisations, such as the customer-supplier boundary, and that this area is one of the most fertile regions for innovation. Utilising a knowledge-based view provides a mechanism for knowledge creation and structuring organisations or processes. Routines which encourage knowledge sharing and absorptive capacity are important to organisations that wish to be successful at innovating [16]. Ng and Nudurupati [47] suggest that, in the PCP context, sharing knowledge reduces uncertainty and unpredictability which would support innovation.

Incentives are a critical factor in supporting mechanisms for innovation in any context [60]. There is plenty of historical evidence of investigating methods to enhance innovation within defence contracts with Sumner [61] examining incentive mechanisms *'apart from profits to induce innovation'* looking at ways of jointly engaging parties in government contracts. Link [62] suggests that public/private activity is part of the national innovation system as efficiencies from R&D can be leveraged. Thereby, PCP contracts can be a mechanism for supporting innovation where new technology is being developed for reliability improvement or capability upgrades.

Agency theory views 'contracts' as instruments for aligning incentives and sharing risks especially in the context of environmental uncertainty and lack of information [63, 64]. For

example, long-term contracting within the defence sector has many uncertainty issues. On the supply side, there is technology obsolescence and on the demand side, variation in the employment of defence forces [65]. Selviaridis and Wynstra [54] conceptualised performance-based contracts along three key dimensions, as shown in **Figure 1**. Within a PCP contract, incentives are a fundamental aspect and the structure of financial and non-financial incentives will, therefore, have a major impact on supplier behaviour. The package of financial rewards or penalties within the contract can encourage suppliers to innovate or create negative consequences, such as opportunism [66, 67]. Rather than traditional fixed-cost or cost-plus, PCP contracts utilise target cost, incentive fee contracts which provide a mechanism to share profits between the customer and the suppliers [8]. However, Behn and Kant [68] highlight that experimentation, innovation and continuous improvement will be inhibited if exceeding higher performance targets is not appropriately rewarded.

As manufacturing firms move to a servitisation approach, delivering value takes a different form with many of the activities performed by customers through the lifecycle of the product [40]. The supply chain relationships are 'bi-directional' where customers also act as suppliers [69, 70]. Within the PCP context, this bi-directionality of supply chains is emphasised with the customer having clear roles in achieving desired performance or co-production of outcomes. Although this complicates service supply chain innovation, it also offers plenty of opportunity for innovation in design, or where capabilities should be placed or how value is delivered [35, 71]. It is particularly important that PCP contracts align the goals of the customer and the supplier through behavioural incentives. For instance, Ng et al., [45] and Caldwell and Howard [2] emphasise how the customer utilises the equipment over the life of the product and its impact on the way the supplier delivers the service.

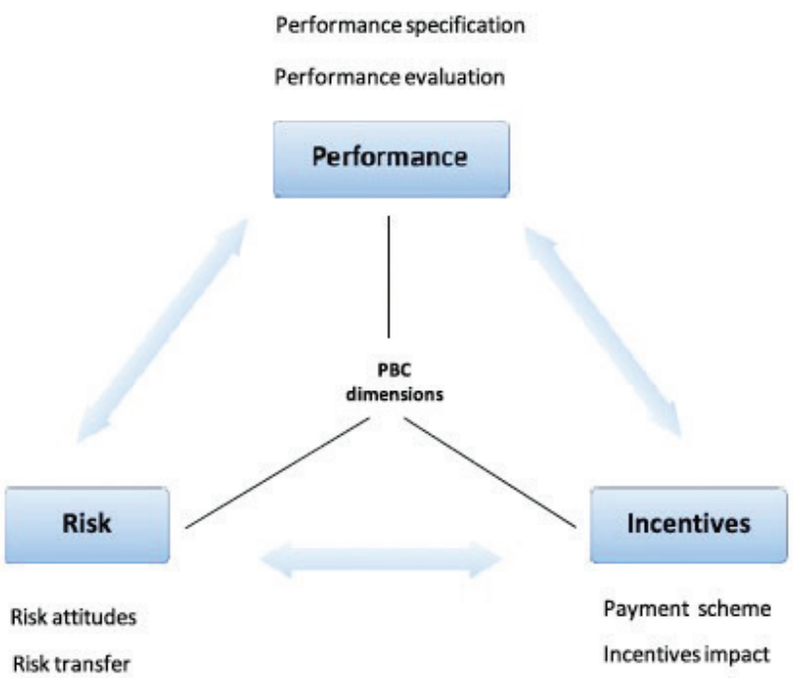


Figure 1. Stylised model of PCP contracts (as presented in Selviaridis and Wynstra [54]).

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Kostas and Andreas [72] indicate that PCP studies stress that incentive systems should reflect a good balance of risks and rewards for customers and suppliers. As well as the alignment of goals with the customer, the prime contractor must also focus on the relationship with the extensive network of sub-contractors. Opportunity for innovation exists within this network but as Spring and Araujo [73] indicate, sub-contractors are not compliant bundles of supplementary resources, they are *'innovating, multi-product, 'flesh-and-blood' organisations*' (p. 154), in their own right. Sharing the cost of uncertainty, but also the rewards for innovation with sub-suppliers, will potentially enable a prime contractor to achieve sustainable success on PCP contracts.

2.5. Timeframe, managing risk and the design of PCP contracts

The financial drivers for firms to move to service strategies are higher profit margins and stability of income [38, 40]. With the lifecycle of complex equipment, like fighter aircraft often being decades, the costs of support are approximately seven times the manufacturing costs [74, 77]. Regular income from PCP contracts is attractive to firms as it balances unfavourable economic cycles and the effects of mature markets [30, 75, 76]. For the customer, PCP contracts can elicit desired behaviours arising from the incentives within the contract, thus reducing the cost of contract and the more expensive through-life costs of the equipment over the longer term. Over time, by understanding the use and outcomes required by the customer from complex equipment, firms are able to change business models shifting customer interaction from purely transactional (i.e. selling products) to a relationship basis [77].

Hooper [78] suggests that to make performance improvement focused investments, suppliers require incentives, which are often long-term agreements which enable amortisation of the investment and profit for the firm [79], whereas Eldridge and Palmer [80] propose that short-term contracts do little to promote investment in innovation. As performance incentives need to be sustainable through-life, Lane [81] also indicates that PCP contracts are not appropriate for a short timeframe. However, an optimum period exists for the length of the PCP contract or contract review. This is because it is difficult to judge, over time, how sustainable performance-based incentives in long-term contractual relationships are as supplier learning occurs and service improvements become marginal [54].

A key element of a PCP contract is the transfer of risk to the supplier as benefits are now tied to the achievement of performance outcomes [82]. Therefore, risk appetite and the process for managing risks through the contract are fundamental issues in contract design and management. The level of risk that a supplier will accept will be contingent on how comfortable the supplier feels and risk appetite may be low where the supplier perceives a lack of control or limited ability to manage the risk [47, 53]. Where customers are risk averse and are willing to transfer financial and operational risk to suppliers, then PCP contracts provide a suitable vehicle. Even with significant risk transfer in regulated sectors like defence, the buyer is still accountable for service failure [83]. The supplier's risk appetite can be a key limiter to successful PCP contracts and innovation within this context with some of the literature contending that a reticence from the supplier to accept risks related to service failures due to untested technologies or failed experimentation with working methodologies will inhibit innovation [53, 54, 78]. Therefore, risk management is key to successful innovation within a PCP contract.

Theoretical propositions identified in the literature review			Key contributions
Trends	*TP.1:* In a limited market, PCP contracting may inhibit radical innovation capability.	Incremental innovation is a strategy for many firms but focusing purely on incremental innovation can harm firm performance in the long-term. Firms which have an incremental or radical orientation will require quite different organisational capabilities which will be an issue for firms in limited markets involved in PCP contracts.	[2, 11, 19, 22]
	TP.2: Innovation is driven by a co-evolution of the technologies and the institutions.	Industry dynamics are driven by the interactions between technology and institutions, and their interlocking elements and processes are a potential source of inertia or transformative pressure. Clear connections exist between innovation systems and the rest of the economy.	[25, 28, 29]
	TP.3: Managing complex programmes in the servitisation context requires new capabilities and knowledge combinations.	Servitisation has become a key source of growth for many industries. Longer-term relationships are emphasised with a shift towards organisational innovations, such as PCP contracts. Complex programmes require new interactions between the public and private sector which implies new knowledge combinations and capabilities between these parties. Organisational routines and process that support learning enable designers, integrators and suppliers of complex product systems to build capabilities based on previous activity.	[2, 29, 30–33]
Success factors	*TP.4:* A shared, strategic vision between customers and suppliers combined with a service-based approach integrated across the whole enterprise supports innovation in PCP contracts.	In limited markets, close integration between customers and suppliers is inevitable. Innovation is supported by a shared strategic vision together with effective communication, collaboration and intimate knowledge of the customer's operations. A service-based approach focused on outcomes provided by products and actions can be a strategy for innovation.	[35–38, 41, 42, 44, 46, 47]
	TP.5: PCP contracting can engender long term, proactive agent incremental innovation.	PCP contracting being outcome focussed with the customer only paying for delivered outcomes rather than activities and tasks implies changes to the established architecture of 'production' and 'manufacturing' driving firms to be more innovative in the co-creation of service value. PCP contracting supports innovation in the long-term as suppliers may have an interest to invest in designing more reliable products or improved processes.	[37, 39, 48–52]
	TP.6: Systems for knowledge sharing should be built into the enterprise.	Innovation, to a large extent, derives from the knowledge exchange between organisations. Key knowledge within projects exists across the boundaries between organisations, such as the customer-supplier boundary, and this area is one of the most fertile regions for innovation.	[16, 47, 56–59]
	TP.7: Appropriate incentive structures are key to promoting innovation in PCP contracts.	Incentives are a critical factor in supporting mechanisms for innovation. The package of financial rewards or penalties within a PCP contract can encourage suppliers to innovate or create negative consequences. PCP studies stress that incentive systems should reflect a good balance of risks and rewards for customers and all suppliers.	[8, 35, 40, 45, 60, 62, 66, 67, 71]

Theoretical propositions identified in the literature review			Key contributions
Barriers	*TP.8:* Short-term contracts do not support innovation within the PCP context.	To deliver complex equipment programmes where through life-costs are high, regular income for firms and cost reduction for the customer supports the PCP approach. Long-term contracts provide a key incentive to promote innovation.	[30, 38, 40, 47, 54, 79–81]
	TP.9: Inappropriate risk management will inhibit innovation.	A key element of a PCP contract is the transfer of risk to the supplier with the process for managing risks being a fundamental issue in contract design and management. The supplier's risk appetite can be a key limiter to successful PCP contracts and innovation within this context.	[47, 54, 78, 82]
	TP.10: Service-design boundaries can inhibit innovation.	Success within PCP contracts begins with the design of the contract including definable, measurable outcomes, appropriate incentive structures and the right governance. Barriers to innovation could come from restricting the supplier's freedom to service design and a rigid specification may inhibit a supplier's willingness to bear risk and be innovative.	[8, 54, 84, 85, 87–90, 99]

Table 1. Theoretical propositions grouped into trends, success factors and barriers to innovation within PCP contracts.

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In pursuing success within PCP contracts, the design of the contract provides the fundamental building blocks, which are clearly definable, measurable outcomes, appropriate incentive structures as well as the right mix of contractual and relational governance mechanisms [54, 83, 85]. This idea is supported by Olsen et al., [86] who concluded that trust, authority and appropriate incentives are key factors, in governance of complex outsourcing contracts. Moreover, the contract must also be flexible as a rigid specification may inhibit a supplier's willingness to bear risk and be innovative [8, 87]. Contract design sets the conditions for innovation over the life of the contract and the types of governance mechanism will play a key part in enhancing or restricting success [88–90]. Barriers to innovation could come from restricting the supplier's freedom to service design. This is highlighted by Axelsson and Wynstra [91] who indicate that there is a link between contract specification methods and the design of incentives for supplier-led innovation [54].

2.6. Summary of theoretical propositions for innovation within PCP contracts

The preceding literature review provided the foundations to arrive at a set of theoretical propositions, summarised in **Table 1**. These theoretical propositions are suggested in terms of *trends*, *success factors* and *barriers* to be used to analyse innovation within the context of PCP contracts in a limited, specialised markets. The following section will explore each of these propositions in the context of the case of the Typhoon project in Section 3.

3. The case of the defence industry and the Typhoon project

In this section, the UK defence industry and the Typhoon project are presented drawing on fourteen interviews with key personnel in three UK defence companies and the MoD. These individuals are involved in contracting for complex performance at the strategic, operational and commercial levels. Each of the theoretical propositions presented in **Table 1**, is reviewed in the context of the Typhoon project to offer some lessons learnt in the context of the case, before moving towards some guidelines that may be applicable to other practicing managers in this area.

3.1. UK defence industry

The defence industry is a specialised market with some unique characteristics that influence the business strategies adopted. Blom et al., [92] provide a number of factors, which explain the idiosyncrasies of the market: firm heterogeneity, stable structure, high innovativeness, high export propensity and active public involvement. Defence firms are highly heterogeneous with a varied array of technical competencies and product portfolios operating in a stable oligopolistic market structure that has a low exit and entry rate. High innovativeness is a feature of most defence firms with respect to technological innovation with collaboration between private and public organisations being commonplace. Additionally, defence is a monolithic customer which will buy major equipment, like fighter aircraft, in batches or tranches from a single manufacturer under a prime contract that it will likely keep for up to

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30 years or more [93]. The industry has a high export propensity with a large proportion of firms, which sell products; is of strategic importance from a military and national security perspective; it is heavily regulated and there is extensive, active public involvement with the public sector providing a key, stable source of income.

Maintaining defence capabilities is expensive with the UK committing £46Bn in 2016 which is 2% of GDP as required by NATO [94]. Governments have realised that it is unaffordable to have national capabilities in every area; therefore, governments have addressed the issue by reducing the costs of maintaining a domestic industry through privatisation, engaging in the export market which reduces unit cost through scale, and engaging collaboratively with other nations [92]. In turn, this explains why defence trade is a facet of national security strategy as it enables a balancing between spending and security. **Figure 2** shows how the network functions.

Changes in the approach to procurement from the MOD, which began to apply a more commercial mind-set as a result of the Levene reforms in the 1980s and, more recently, the Grey review [96], introduced competitive tendering processes as well as more stringent contracts which transferred risks for development, production and support of equipment from the MOD to industry. These reforms had a fundamental impact on the strategies for defence companies as traditional cost-plus contracts were replaced by target-cost, incentivised contracts together with a partnered approach to procurement.

3.2. The Typhoon programme

The Eurofighter Typhoon programme was established in the 1980s to design, develop, and support a new European fighter aircraft. Britain, Germany, Italy and Spain formally agreed to start development of the aircraft in 1988 under a complex, collaborative arrangement designed to share the huge costs of the programme with the UK eventually purchasing over 100+ aircraft in a number of staged buys or tranches. The European dimension created a significant



Figure 2. The defence industry and national security network (reproduced from PWC [95]).

complexity within the organisation and design in addition to the complex nature of the technology being developed and supported. Each partner nation was awarded a work share under the principle of *juste retour*[1] with the aim of the programme to share work, technologies and develop national capabilities. Programme management is led by an agency, which represents the four countries, and the Eurofighter consortia provides the industrial construct representing the prime contractors involved in the programme. A schematic of the programme management is provided at **Figure 3**:

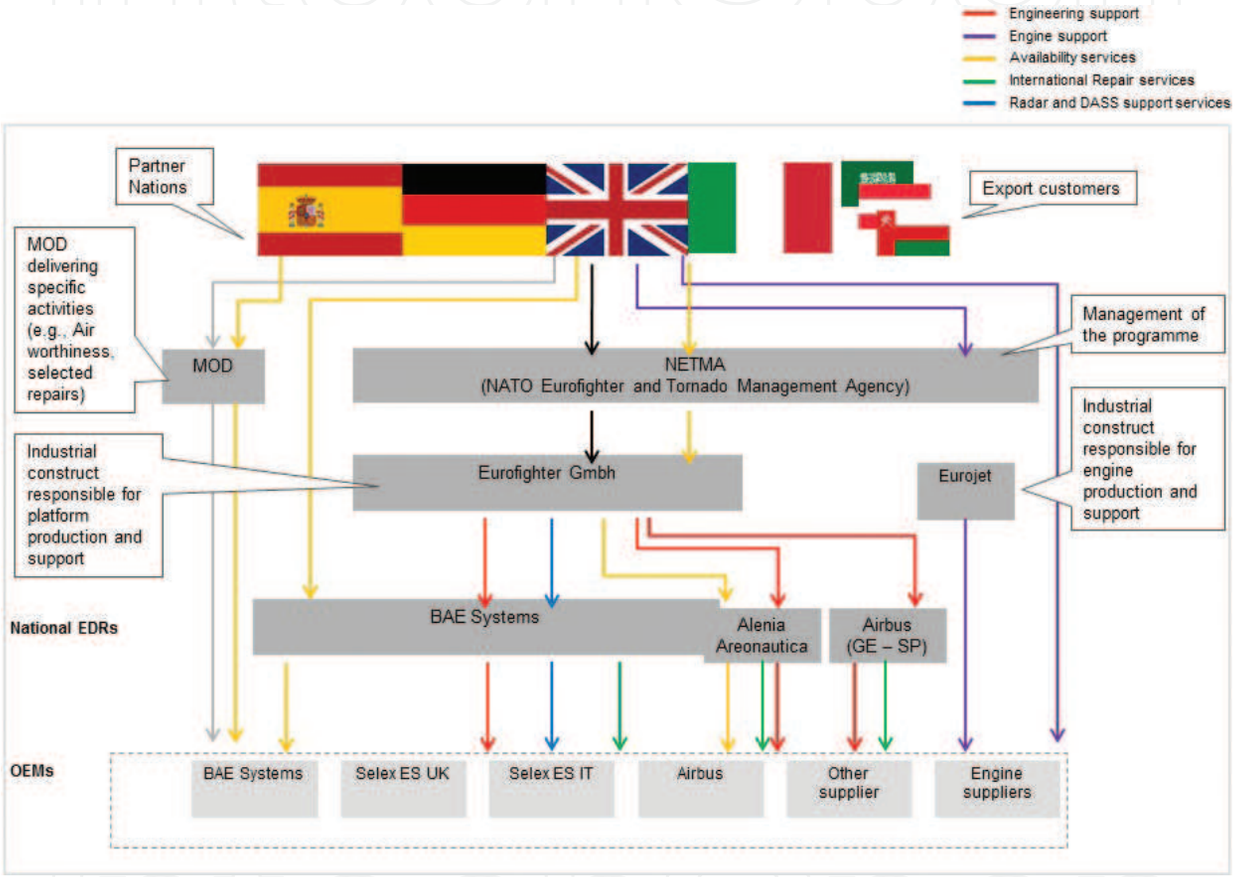


Figure 3. Typhoon programme management construct (reproduced from MOD [97]).

The differing requirements, influences, and aims of all the agencies all contribute to creating significant issues in managing the programme or striving to create an environment for innovation. In the case of Typhoon programme the decision-making cycle is measured in years of the programme, neither weeks nor months. This creates issues in getting everyone harmonised around a particular course of action, particularly as many agencies are involved, in four partner nations and companies and two management agencies. Within the supply chain, there a host of other agenda's—physical, economic and industrial.

[1]Principle that the funding granted to project participants from a given country/region under a joint call is in proportion to the budget contributed to the joint call by that country/region.

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3.3. The UK support construct

The programme is designed to maintain alignment across all of the partner nations but permissions are built into the construct to enable individual nations to develop the capability of their aircraft using different approaches especially in the support construct with an expectation of potential convergence and reintegration at a later date. Over the last 10 years, this has enabled the UK to develop a service-based, availability solution for the Typhoon aircraft support which will become truly outcome-based with the latest iteration of the contract, the future state operating model (FSOM), worth £2.1Bn over 10 years, although the engine remains a separate availability contract.

An outcome-based solution enables the MOD to address the key issue of affordability, reduce complexity and transfer risk to the provider [8]. Prior to availability contracting, Royal Air Force (RAF) personnel carried out maintenance and upgrade of aircraft in-house with spares, equipment and technical support purchased from a range of contractors on a piecemeal basis by MOD staff; this model became unaffordable and did not exploit the capabilities of industry. Aligned with the governmental drive for more outsourcing under the MOD's SMART procurement initiatives [89, 96], moving to a service-based, PCP contract enables a prime contractor to take on the responsibility for a defined output, such as available flying hours, in exchange for a fee [45]. Adopting this strategy provided industry the opportunity to reap the benefits of servitisation, such as higher profit margins, stability of income and protection from economic cycles [38, 40] at a period when the outlook for the number of large-scale production programmes has reduced. The risks and rewards are co-shared appropriately through the creation of painshare and gainshare mechanisms within the contract, which are common on one-off, complicated programmes [8] with long-term partnering relationships being emphasised between the MOD and industry.

For military aircraft, there is a requirement to constantly upgrade as new technology becomes available to defeat potential threats and contracting for availability (CFA), which first appeared in the mid-90s, enables upgrades to be achieved at the point of routine servicing which keeps costs down and availability up. CFA is a form of PCP contract where equipment, such as aircraft, are made available for tasks normally measured in flying hours. There have been various CFA for combat aircraft including Tornado, Harrier and Typhoon. In addition to the UK, armed forces from across the globe are moving to this form of delivering defence capabilities [98].

Due to the political, organisational and technical complexities involved with the Typhoon programme, the steps towards an outcome-based contract have been evolutionary. The first Typhoon availability service contract signed in 2009 was in reality four outputs: aircraft, spares, technical information and training rather than a single outcome: flying hours. Because the construct did not focus solely on the real value to the customer, which was flying hours, there were significant issues with the initial contract with apparently little co-creation of service value [48] or collaboration and co-ordination along the supply chain due to misalignment of incentives [36, 39, 49]. The issues are exemplified by a number of respondents:

> *'That's what the output was, you then had the frontline squadrons integrating it and turning it into flying hours and we spent our lives fighting over moderation of why our aircraft were delivered late'.*

> *'…because it was a claims culture, we had a room of people to work out where we were failing in our commitments so they could put a claim in. We had a room of people claiming against [Contractor X] lack of output performance and it was a battle…it definitely did not stimulate innovation. It might have stimulated innovation within our own organisations to win those battles but it did not actually stimulate innovation across the organisational boundaries'.*

Over the last few years, the programme has been in the midst of re-negotiation of a new contract, which is reaching culmination. The FSOM contract is structured so that the supplier effectively only gets paid for the number of hours flown by the customer. The catalyst for the new contract was a review which demonstrated that the funds to support the platform could potentially run out before the end of the programme. Neither the MOD nor industry could countenance the aircraft not being in service as the Typhoon provides a key defence capability which could not be replicated and being without UK Typhoons would seriously inhibit the potential for future export sales of the platform. The difficult question for the MOD is how to incentivise the suppliers, who are still heavily orientated towards a manufacturing/production culture, in the conditions that prevail within the oligopolistic market structure of the defence industry [92, 93] to enter into a more challenging contract that potentially reduces further the revenues from support? A key element of the solution was the principle of 'recycling' savings from support into funding equipment capability (i.e. product) development programmes which would benefit industry by guaranteeing opportunity for revenue and providing work for engineers and benefit the customer by reducing support costs while generating more defence capability. By introducing the recycling principle, there is a better alignment of the goals of all parties within the enterprise, which has the potential to stimulate further innovation beyond what has already been baked into the contract [2, 45].

3.4. Review of key propositions in the case of the Typhoon programme

The theoretical propositions' combining *trends* (discussed in Section 3.4.1), *success factors* (discussed in Section 3.4.2) and *barriers* (discussed in section 3.4.3) to innovation within PCP contracts are discussed in relation to the Typhoon programme in this section. Lessons learnt are offered for the Typhoon programme that have implications for a set of guidelines that will be useful to the practising manager involved in PCP in the future, either as buyers or suppliers.

3.4.1. Innovation trends

3.4.1.1. Radical innovation capability (TP.1)

Innovation is about managing the process of turning uncertainty into knowledge. Incremental innovation, although not risk-free, is a strategy focused on developing improvements from a position of some certainty whereas radical innovation involves starting at the limits of knowledge [4, 22]. In a limited market such as the defence industry, political constraints and government regulation, both nationally and internationally, and a lack of investment inhibit manufacturers going it alone on large-scale or high-risk programmes which reduces the propensity for radical innovation. The ability to link advanced technologies to market opportunities is a crucial aspect of radical innovation. When markets do not yet exist, it is difficult to persevere when there are organisational pressures for immediate profit [20]. A respondent

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commented that *'regulation is great … as it provides government security but does limit the ability of anyone to invest in [the defence industry]'* and that the majority of the risk is jointly managed with the customer (The MoD). The respondent suggested that this hinders the *'ability to generate dislocative technologies'* that provide options to both the customer and business as such innovation is often determined by political will to support and sponsor. Safety assurance, governance and the size of market creates difficulties for innovation in this context which is risk averse compared to less constrained, consumer-led markets, such as telecommunications or information technology markets. Moreover, the time to market performance for technology or process development may be too great to match customer need. One of the respondents discussed how contracts can drive the type of innovation and can lock down the opportunity for radical innovation as PCP contracts tend to be structured around removing cost through incremental innovation or optimisation. This suggests a need for a strategic focus by governments and firms on this issue, if the industry is to retain a radical innovation capability.

3.4.1.2. Co-evolution of the technologies and the institutions (TP.2)

Governmental commitment to outsourcing on large programmes has driven innovation in the support market and the development of PCP contracts. As the support market is taking a more dominant or equal position, this is reshaping the strategies of firms. Additionally, the unique nature of the market and the linkages with national security strategies [92] drives the relationship between the organisations, public and private, within the industry. As the industry has tended towards a transnational growth strategy, the dynamics of the relationships are continually evolving with different models of support and more organisations influencing the environment [25]. This view was supported by respondent from a supplier who highlighted the change in nature of their business from *'leading developing in Europe, to one that was a follower in the US*' noting that in 2007 they were 70% dependent on the 'domestic customer' and by 2017, 70% dependent on the export market. The challenges faced by the industry may require taking greater risk to match perceived market needs, such as investment decisions may need to be earlier in the technology readiness cycle. Aligned with the findings of Lazaric et al., [29], exploitation and development of dual-use technology, ranging from drones to data analysis, between the defence and the commercial markets remains important with commercial technology now tending to lead defence technology development (e.g. data analysis and forecasting capability in financial technology industries that can be used to improve spares forecasts).

3.4.1.3. New capabilities and knowledge combinations for managing complex programmes in the servitisation context (TP.3)

Avoiding bespoke solutions where possible, spreading learning back and forth across sectoral boundaries and leveraging the extensive technology base that already exists within defence companies as well as outwith potentially provides a fertile landscape for innovation. However, flexible contracts will be required to enable technology insertion and exploitation. The industry consolidated considerably following the end of the Cold War in the 1980s and

further market-led consolidation is suggested in the future [99]. With high entry barriers and limited competition, the market could evolve through the consolidation of the UK support structure. Potentially, in a limited market, collaboration between some of the lead players could lead to better innovation by focusing on the value chain of the capabilities that each of the firms has to offer. Centres of excellence for particular equipment or technology-types could lead to better solutions. Although this was not a common innovation strategy across the firms researched, some of the new relationships developed between firms for the FSOM contract are indicative of this approach. In this regard, a level of integration should not entirely shut down the competitive landscape to prevent SMEs or new entrants from entering the market in future. Further research could be focussed on the threats and opportunities from further consolidation of the sector.

To better manage complex, product-service programmes within a limited market requires different capabilities [2, 96, 100], such as the ability to analyse enabling processes and lead change. Sophisticated, strategic, enterprise-wide modelling tools and learning processes should be built into contracts to enable value to be co-created between the parties [27, 29]. However, boundaries, regulatory, commercial or otherwise, across the organisation can create significant blockers. To enable models to be developed requires clean data which can be shared which was a challenge for the Typhoon programme and, although full enterprise-wide modelling tools do not yet exist, models and frameworks have been developed which have supported the new contract development. To be truly focused on value generation, innovation needs to be encouraged from across the enterprise from other non-traditional areas, such as commercial and finance not just R&D, engineering or production and in all phases of the lifecycle, as detailed by a number of respondents.

Routines and processes developed across the organisation that support learning enable designers, integrators and suppliers of complex product systems to build capabilities. For example, adjacent industries, such as space or rail for the aerospace industry, can also act as a source of innovation, providing routes to new ideas or markets. Measuring innovation is difficult and can be stifling but benchmarks, internal or external, can provide a useful gauge of innovation to guard against being too self-referenced. Dobni [101] suggests setting up innovation benchmarking within lifecycle management and design review as a method of developing capability. Project learning enables repeatable solutions [2] to be developed which can be used by a range of different customers or markets.

3.4.2. Success factors for innovation

3.4.2.1. Shared strategic vision (TP.4)

A fully, service-orientated organisation with an integrated approach supports innovation, but it is not easy to create this type of organisation for companies originating from a manufacturing or production background which is demonstrated in the case. Abandoning product-centric for customer-centric structures can meet resistance for fear of changes to the structure, missing performance targets and lack of understanding of a service strategy. The transition to services does not necessarily ensure the expected high returns which has been referred to

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as the 'service paradox in manufacturing companies' without overcoming organisational and cultural hurdles [30, 38]. A respondent representing a Senior Director of a supplier pointed out *'Where I believe we have to be is a much more service orientated organisation, where I believe we are DNA-locked into is a much more product orientated organisation'*. Evidence from the case underpins the theory that integrating traditionally separate areas together with leadership to develop a service innovation culture and environment supports the business transformation [46]. It was also recommended by two respondents that creating a separate arm of a business can be an effective strategy.

Leadership is required to inculcate the service ethos across all areas of the business from the composition of the board to the servicing bays focused on co-creating value with the customer to deliver an effective and efficient service [45]. Appointing an innovation or service support director together with investment in a distinct business unit identity are all visible statements of intent which can support the cultural change required. Other examples highlighted included not being afraid of failure or experimentation, creating the right environment, use of social media and writing innovation into job descriptions. However, cultural change takes time, as the behaviours are at both the conscious and unconscious level, and all of the organisations were still learning and adapting to the service culture. For effective innovation in a partnered, PCP context, the service-based approach and culture will extend across the customer-supplier boundary with an enterprise approach which should be underpinned by a shared, strategic vision. Setting a transparent, strategic vision between the customer and supplier is always going to be challenging as it involves attempting to align national security goals with the goals of private companies but is key for partnered innovation over the decade-long horizon of PCP contracts to provide reference points. Co-locating those who are designing, delivering or managing the service also positively develops the right culture; the integration between the customer and supplier organisations has already been extensive. Some firms have established service delivery centres on RAF sites and others have formed joint teams separate from firm HQs.

Another key consideration in joint, collaborative working is appropriate protection of intellectual property (IP) [39] and the current MOD rules for IP applied in the PCP context could be stifling innovation. This was exemplified by a Commercial Director from one of the suppliers who indicated *' … the way the contract is set up means that we would have to share all of our background intellectual property with all of those companies for the RAF to benefit'*. Even though many of the boundaries have been eclipsed with the advent of PCP contracts in defence, a fully integrated, enterprise approach does not exist as yet with many silos either across the internal boundaries of firms, such as between production and support, or at the external boundaries of the partnered organisation, such as maintenance on the flying squadrons who deliver the output. In a complex organisational mix like the Typhoon programme, there are various cultures including the military culture of the RAF, the MOD procurement agency and the business units of the private companies. Strong cultures can be a positive, but can also inhibit innovation by potentially being blinkered to different delivery models for the same effect. A value-based, service-orientated approach taken across the enterprise could allow more innovation and create a more cost-efficient or effective solution. The PCP contracts for export customers have different boundaries for similar outcomes and provide a contrasting view to current UK support models.

3.4.2.2. Long term, proactive agent incremental innovation (TP.5)

PCP contracts support the development of innovative ways to reduce cost or improve delivery led by the agent. Directly linking payment to outcomes which provide value to the customer, like delivery of flying hours for the Typhoon, creates collaboration along the supply chain through incentive alignment [50]. The conditions for innovation in the long-term are created as suppliers have an interest to be more efficient in service delivery and make products more reliable to increase profitability [51]. By moving away from traditional cost-plus and fixed cost commercial models to a target cost, incentive-fee (TCIF) model is innovative and provides a framework for further innovation (**Figure 4**) but, unlike traditional models, TCIF requires active management from organisations with the right capabilities.

Building in a continuous improvement approach through the development of the service culture can enable innovation within a contract. As suggested in the literature, the challenges of obtaining supplier-led innovation are evident [53, 54, 78] but the PCP framework can set the conditions. On the Typhoon programme, significant costs have been removed over the life of the current contract and there are many examples of continuous improvement including developing a lean learning academy to improve maintenance efficiency, improving structural health monitoring data to improve engine life, and reducing the repair-loop times in the UK or Europe. However, the learning has taken place iteratively over successive generations of contracts with the next contract planned to drive out almost 40% of the cost.

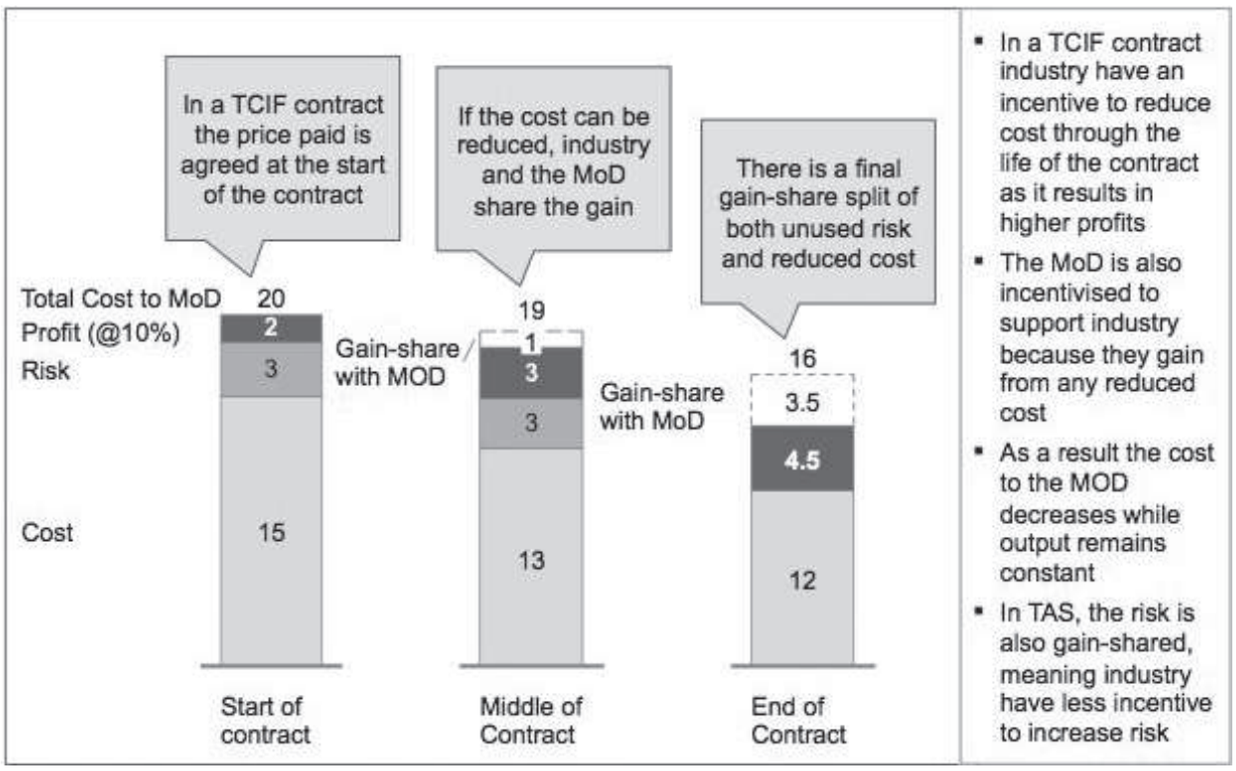


Figure 4. TCIF contract illustration (reproduced from MOD [97]).

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3.4.2.3. Systems for knowledge sharing (TP.6)

Knowledge exchange between organisations is a key factor in innovation [56, 57]. Within partnered programmes, shared data of the right quality is a key enabler to driving innovation. To understand how cost could be removed from PCP contracts required visibility across the partnered community of cost drivers which 'open-book' accounting has gone some way to facilitating. However, in maintenance support contracts, much of the uncertainty comes from how equipment is being used, so getting usage data would provide focus to drive cost reduction or other operational benefits (e.g. sharing data in real time would provide operational benefits over the long term). Setting up appropriate mechanisms for cross-fertilisation of ideas across organisational boundaries can also stimulate innovation. With the development of the partnered approach, knowledge management networks have been set-up, designed around collective learning and co-construction of competencies between the public and private sector [58] which are evident in the Typhoon programme. Involving partners in early stages of product development lifecycle enables potential improvements in design from a supportability or operational perspective but this may involve overcoming difficulties, such as security or competitive rivalry. Due to a silo approach and cultural issues, the MOD has struggled with cross-functional learning across domains and platforms with successful ideas from air not necessarily being transposed to the land or maritime domains or between the various air platform contracts. As Van Baalen et al., [102] suggest that frameworks and tools, such as innovation portals, are proven mechanisms for promoting innovation, providing novel methods for interaction, unblocking innovation ideas and unlocking latent talent within the organisation. Investing in an enterprise-wide toolset could enhance innovation across the partnered community. For instance, the Innovation Manager at a supplier indicated that over 60% of the winning ideas come from an area outside of where the challenge originated.

3.4.2.4. Incentive structures to promote innovation (TP.7)

Incentivisation is vital to promote innovation, with alignment of goals of the parties involved being a key aspect [55]. In availability contracting, the servicing of equipment and spares is secondary to the provision of the main outcome, which is flying hours for future state operating model (FSOM). Previously, the incentives were wholly misaligned as contractors got paid to repair parts and equipment which had broken so more work meant greater revenues for the suppliers. Under the new model, industry is incentivised to provide reliable and capable equipment, reduce maintenance downtime, improve logistics support as well as provide available aircraft. With the latest contract, the link between outcome, flying hours, and the contract is absolute which truly aligns the goals of the user, the RAF, with the procurement agency, the DE&S, and the industry partners which should drive the behaviours necessary to co-create value. Gainshare arrangements under the TCIF model enable both parties to reduce cost and mitigate risk-providing industry appropriate profit margins which should not limit innovation. Moreover, in the latest contract the MOD has added further incentive by committing to recycling costs saved in support into capability upgrades for the Typhoon aircraft which drives the right behaviours, delivers more defence capability as well as maintains the defence industrial base for potential exports. As one respondent noted FSOM is a model that

drives the right behaviours and highlighted that there is a perceived reward for innovation. This has implications for efficiency as well as better technology that satisfy customer needs. Driving sub-contractor innovation in the supply chain is challenging for the prime contractors as volume remains a key driver lower down the chain and many suppliers are dependent on production rather than support. Less money but greater margins is an obvious incentive but different partnering arrangements or alignment between the various suppliers of the industrial base can provide new dimensions which has occurred within areas of the new contract.

3.4.3. Barriers to innovation

3.4.3.1. Short-term contracts (P8)

Long-term contracts support innovation by promoting investment, and enhancing partnered relationships in the development and support of large, complex programmes like Typhoon which have a lifecycle of up to 30 years. The steady, predictable revenue for industry from PCP contracts is attractive to firms as it balances unfavourable economic cycles and the effects of a mature market [30], enabling an adequate return on investment compared to potentially more lucrative returns elsewhere. Over the lifecycle of the programme, the customer will be able to significantly reduce support costs. Longer contracts create the conditions for industry and the joint enterprise to invest in strategic capabilities. Additionally, in complex programmes, many of the opportunities for innovation, such as equipment reliability modifications, require time to mature. An alternate view could be competition but in the context of PCP, competition may not drive innovation in the long term and could be an expensive method with more risk than the collaborative-partnering model as the national scale of the market is probably insufficient. The Strategic Director of a supplier had indicated that competition can drive short-term benefit but may not be a sustainable position for delivering the capability in the long-term.

An appropriately balanced approach to the overall length and the review points of PCP contracts is suggested as the best approach to support innovation enabling iterative learning through the life cycle of the programme. A long-term approach is required to support investment and develop learning but sustaining incentives for innovation over time becomes difficult as improvements become marginal [54]. An empirical review of various PCP contracts to determine optimum length and review cycle to support innovation could be an avenue of further study. The transfer of risk to the supplier is a key feature of PCP contracts [82] but risk needs to be managed in the right place to enable innovation. Some firms are well placed to manage the level of risk required for the innovation expected of the supply chain by the customer in the new contract, with the right capabilities in place and a good understanding of what is required to deliver the right level of performance. Others do not have the same risk appetite either because the capabilities are not in place or the level of incentives that flow through the contract are perceived to be insufficient as indicated by a number of respondents.

3.4.3.2. Risk management (TP.9)

The corporate processes in place within both the customer and supplier regimes restrict nuanced risk management which inhibits innovation. A highly regulated environment, strict

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approval systems, high-levels of scrutiny rather than autonomy make for risk averse organisational structure which stifles innovation. Some of the processes appear to be still focused on a production mentality rather than the agility required for innovation in support services. The result is an erosion of risk transfer as the contract is developed which will potentially mean less innovation over the lifecycle. Risk management can be improved through better data from greater modelling capabilities, and by having people who have developed the confidence to manage risks through experience in the PCP context which suggests retention of capability, learning and employment across similar projects.

3.4.3.3. Service-design boundaries (TP.10)

Governance mechanisms will play a key part in enhancing or restricting success in innovation for PCP contracts [90]. Bureaucracy during contract development and the service design phase introduces time or inertia implying a tension between an appropriate balance of assurance versus the freedom to innovate. Contract design sets the conditions for innovation over the lifecycle and barriers to innovation could come from restricting the supplier's freedom to service design [91]. The scope of the contract is potentially the limiting factor with clear silos in design remaining. These potentially prevent the enterprise-wide, value driven approach and the current boundaries could be tested for opportunities, including further internationalisation, such as placing repairs in non-traditional locations outside of Europe or the US. However, organisational appetite may be limited by various factors ranging from revenue generation to IP issues so the incentives would have to match. The design start point will also impact the outcome and a 'bottom-up' approach to contract design focused on removing cost from the current state may be a constraint rather than starting with top-level principles which could broaden thinking and approach (i.e. outcomes focused on a shared vision with a understanding of marketing constraints and operating capabilities).

4. Conclusion: towards some guidelines for enhancing innovation in limited markets

This chapter has presented a literature review to identify a set of ten theoretical propositions that have been categorised into *trends*, *success factors* and *barriers* to innovation within PCP contracts. Further to this, each of the propositions have been reviewed in the context of the *MoD Typhoon Programme* in order to arrive at a set of lessons that can be learnt for managing a PCP project in the UK Defence Industry. These lessons learnt are shown in **Table 2** below, it is intended that these lessons learnt will be useful to the practising manager managing PCP projects and that further work is necessary to arrive at a set of guidelines for enhancing innovation in limited markets.

The chapter is limited in terms of generalisability by offering a single case and focusing within the Defence Industry. However, it is argued that the Typhoon Programme is representative of a typical and complex case that will be of interest and relevance to the practising manager. This work is grounded in a strong conceptual base but further empirical work is required to

	Lessons learnt from the Typhoon case	Supporting theoretical proposition
1	For effective innovation in a partnered context, the service-based approach and culture should extend across the whole enterprise underpinned by a shared, strategic vision.	4
2	Building a continuous improvement approach linked to a service culture enables innovation within a contract and over successive generations of contracts through iterative learning.	10
3	Frameworks and tools for promoting innovation (e.g. such as an innovation portal) should be considered to encourage enterprise-wide innovation.	1, 2, 7
4	Partnering arrangements within the supply chain should be examined to exploit different potentially innovative arrangements beyond traditional constructs.	4, 7, 8, 9, 10
5	A balanced approach should be applied to the length and review period of PCP contracts to support innovation through the lifecycle of the programme.	5, 8,
6	Investment is made in modelling capabilities and human capability should be retained within organisations so that learning can be exploited across similar projects.	6
7	The boundaries and scope of a PCP contract should be carefully considered within the service-design phase and at contract review points to ensure that future opportunities for innovation can be exploited.	10

Table 2. Lessons learnt from reviewing the theoretical propositions in the context of the UK MoD Typhoon Programme.

further refine, develop and validate a set of guidelines in different sectors to improve the generalisability of the findings. It is intended that a set of guidelines can be incorporated into a process framework to guide a Capitalise Project Management (PCP) project manager through a large-scale and inherently complex procurement programme. This chapter has also illustrated the challenges of innovation within the PCP context which set to remain the dominant form of defence procurement strategy for the foreseeable future.

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