



**How incentive alignment along the supply chain fosters
incremental innovation: Evidence from defence
performance-based contracts**

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Abstract

Purpose: To investigate how providers of product-service bundles design and manage their contracts with upstream suppliers to incentivise incremental innovation for the benefit of their downstream customers, who contract the provider based on performance.

Design/methodology/approach: An embedded multiple-case study was conducted to examine elements of a European jet fighter's manufacturing and after-sales supply chain. The embedded cases concern provider contracts with first-tier suppliers of product and service offerings. Data collection involved 21 semi-structured interviews, documents, and other secondary data sources. Data analysis was informed by agency theory to assess the effectiveness of contract design and management in delivering incremental innovation and to identify related contracting strategies.

Findings: We identify four strategies for fostering incremental innovation in contracts between providers and their first-tier suppliers. These include two contract design strategies, i.e., reducing goal incongruence and addressing information asymmetry; and two contract management strategies, i.e., reducing outcome uncertainty and promoting inter-firm integration between providers and sub-suppliers.

Originality: The research shows the contingent effect during contract design and management of a sub-supplier's product vs. service offering, which, in turn, impacts incremental innovation. We also find that using focused key performance indicators in sub-supplier contracts can be effective in improving product and service quality.

Practical implications: The research offers managerial guidelines regarding how providers can design and manage their tier-one supplier contracts to achieve incremental innovation. These include encouraging early supplier involvement, using focused KPIs in contracts, and managing product and service-offering suppliers differently.

Keywords: Incentive alignment, Innovation, Performance-based contracting, Supply chain, Agency theory, Case study.

Paper type: Research paper

1. Introduction

Innovation is critical to improving business performance and gaining a competitive edge (Oke, 2007). Focal firms often rely on their supply chain (SC) partners to innovate (Zimmermann et al., 2016), but this is dependent on the alignment of incentives along the SC (Narayanan and Raman, 2004). Alignment refers to supply chain counterparts working towards a common goal and achieving outcomes that ultimately benefit end customers (Selviaridis and Spring, 2018). Incentives can take various forms and may include both financial rewards and penalties as well as time- and scope of work-related inducements (Weber and Mayer, 2011; Sumo et al., 2016c; Randall et al., 2011). Incentive alignment is a key tenet of supply chain management (Norrman and Näslund, 2019). Yet, how the focal firm can successfully align its incentives with upstream suppliers to achieve innovation outcomes for downstream customers is underexplored.

One way of aligning incentives in SCs is through contracting (Selviaridis and Spring, 2018). Contracts serve as a key mechanism for governing customer-supplier relationships (Caldwell and Howard, 2014), encompassing provisions such as payment mechanisms, specifications, and performance obligations, as reflected in key performance indicators (KPIs) (Akkermans et al., 2019). Performance-based contracting (PBC), in particular, facilitates incentive alignment as it links supplier payments to the achievement of customer goals (Kim et al., 2007).

PBC has garnered much research attention in dyadic customer-provider relationships, particularly in contexts where manufacturers (henceforth “providers”) bundle products with after-sales support to ensure performance in terms of product availability (Hypko et al., 2010; Selviaridis and Wynstra, 2015). PBC grants providers greater autonomy as they can determine how to achieve the desired results (Sumo et al., 2016c). Moreover, it incentivises providers to innovate incrementally as they profit from products with fewer

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4 failures (Randall et al., 2010; Sumo et al., 2016a; Sumo et al., 2016b). A reduction in
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6 spare parts consumption via quality re-engineering or maintenance enhancements not
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8 only yields increased profits for providers but also cuts costs and enhances performance
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10 for the customer. Thus, PBC helps to align incentives between providers and customers.
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14 Extant PBC literature has primarily focused on provider-customer relationships, with
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16 only a few studies going beyond the dyad to consider the upstream SC (e.g., Datta and
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18 Roy, 2013; Kleemann and Essig, 2013; Selviaridis and Norrman, 2014). These studies
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20 have enhanced understanding of how a PBC between the provider and its customer affects
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22 the way in which the provider manages its upstream relationships with suppliers
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24 (hereafter “sub-suppliers”). These studies have, however, stopped short of examining
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26 how sub-supplier contracts can be aligned with the provider-customer PBC agreement
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28 when *innovation outcomes* are in focus. Moreover, prior research has largely neglected
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30 *sub-suppliers’* perceptions of the ability to align their incentives with those included in
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32 the downstream PBC. Understanding this is imperative because sub-suppliers control the
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34 quality and availability of the components and services needed to deliver incremental
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36 innovation and improve product availability for end customers.
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41 This paper focuses on incremental innovation (i.e., doing the same thing but better)
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43 rather than radical innovation (i.e., doing something differently) (Tidd, 2013) because, in
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45 manufacturing settings, PBC is concerned with improving existing products gradually.
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47 Doing things better, i.e., incremental innovation, can ultimately lead to improvements in,
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49 for example, quality, productivity, and/or cost performance. Given the above, we ask:
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53 *In the context of a PBC agreement between a provider and downstream*
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55 *customer, how does the provider design and manage its tier-one upstream*
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57 *supplier contracts to align incentives and foster incremental innovation?*
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We draw on agency theory (Eisenhardt, 1989) to analyse incentive alignment between the provider (principal) and its first-tier suppliers (agents). Specifically, our analysis of sub-supplier contract design and management is informed by well-established factors influencing the choice between an outcome- and a behaviour-based contract (Eisenhardt, 1989), as well as the strategies used to govern principal-agent relationships in the supply chain (Matinheikki et al., 2022). We examine two cases of PBC concerning the manufacture and after-sales support of a European jet fighter sold to two different countries. In total, we investigate six embedded cases of sub-supplier contracts, distinguishing between sub-suppliers offering products and services.

We contribute to the PBC literature (e.g. Datta and Roy, 2013; Li and Mishra, 2021; Kleemann and Essig, 2013) by unveiling specific strategies that providers employ to design and manage their supplier contracts to foster incremental innovation. We also reveal the contingent effect of sub-suppliers' product vs. service offerings on the design and management of sub-supplier contracts. Furthermore, we contribute to literature linking PBC to innovation outcomes (e.g., Sumo et al., 2016a; Sumo et al., 2016c) by demonstrating that the use of a small number of focused performance indicators instigates *sub-supplier* innovation. Finally, and more generally, we extend the SC alignment literature (e.g., Selviaridis and Spring, 2018) by identifying contracting strategies for achieving innovation outcomes.

2. Literature review

2.1 Performance-based contracting and innovation outcomes

Prior research has examined the management of customer-provider relationships within the context of PBC (Randall et al., 2010; Nowicki et al., 2018), including with regards to contract design and performance measurement (Doerr et al., 2005; Glas et al., 2013; Sols

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4 et al., 2007; Glas et al., 2018), including the design of KPIs (Akkermans et al., 2019).

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6 This literature has uncovered challenges and risks in relation to PBC design and
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8 implementation and the overall effectiveness of this contracting approach (Glas et al.,
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11 2019; Selvaridis and Norrman, 2015; Ng and Nudurupati, 2010; Randall et al., 2011;
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13 Guajardo et al., 2012; Datta, 2020).

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16 Only a handful of studies have gone beyond the customer-provider dyad to examine
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18 implications for incentive alignment upstream in the supply chain (Essig et al., 2016),
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20 especially when innovation is of critical concern, such as in order to improve product
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22 reliability and maintenance effectiveness (Alqahtani et al., 2023). For example, Datta and
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24 Roy (2013) found that when providers and spare parts suppliers share the costs of
25
26 investment, their profits rise. Similarly, Li and Mishra (2021) found that sharing repair
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28 costs between providers and their suppliers leads to performance improvements.
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30 However, such cost-sharing can incentivise sub-suppliers to under-invest in product
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32 reliability, affecting product availability performance. Kleemann and Essig (2013) found
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34 that collaboration between the provider and its suppliers is critical in the face of high
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36 outcome uncertainty, but such collaboration is lacking due to misaligned incentives
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38 between the provider and its suppliers. Nikulina and Wynstra (2022) identified factors
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40 that explain how sub-suppliers can effectively engage in multi-party PBCs in the
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42 construction industry, building on the work of Selvaridis and Norrman (2014).

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45 The above studies have enhanced our understanding of the implications of PBC for SC
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47 incentive alignment, but they did not empirically examine how a provider can design and
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49 manage its first-tier supplier contracts to foster incremental innovation (i.e., improve
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51 product reliability and maintenance), thereby helping to achieve availability outcomes for
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53 the end customer. Prior research has also neglected the sub-supplier's perspective on what
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55 type of governance mechanisms would incentivise them to innovate.
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4 PBC, as a contracting strategy, can facilitate incremental innovation (Randall et al.,
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6 2010) because manufacturers inherently benefit from higher product quality. Beyond the
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8 manufacturing setting, Sumo et al. (2016a) showed that PBC can foster innovation in IT
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10 service provision due to the autonomy given to the provider to determine the most
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12 effective approach to achieving results. Randall et al. (2011) demonstrated that early
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14 investments in product improvements at the onset of a contract can increase provider
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16 profits and prevent additional costs for the customer. However, the authors did not explore
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18 scenarios where a product is manufactured by an alliance of OEMs, which necessitates
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20 other suppliers to invest in enhancing their products and maintenance processes.
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26 Innovation is usually incremental because continuous, cumulative improvement is
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28 more efficient and effective than occasional, step-change improvements (Tidd, 2013).
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30 This is also largely the case when PBC is used in manufacturing settings (Hypko et al.,
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32 2010) to improve the availability and reliability of products and the effectiveness of
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34 maintenance while simultaneously reducing the cost of support activities (Kim et al.,
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36 2007; Randall et al., 2010; Sols et al., 2007). Improved reliability reduces failure rates,
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38 while improving maintenance turnaround times improves service effectiveness. Taken
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40 together, these improvements reduce costs and increase product availability (Guajardo et
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42 al., 2012; Randall et al., 2010; Sols et al., 2007). PBC therefore fosters incremental
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44 innovation to improve day-to-day maintenance and logistics operations (i.e., incremental
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46 service innovation) and to redesign components to reduce failure rates (i.e., incremental
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48 product innovation). Incremental innovation is also linked to product improvements in
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50 terms of the mean time between failures (MTBF) and service improvements in terms of
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52 the mean time to repair (MTTR).
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57 In summary, the PBC literature has highlighted that incremental innovation is a
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59 significant outcome that the provider seeks to achieve, and that the provider's suppliers
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4 contribute to this outcome. However, prior literature has neglected how providers can
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6 design and manage contracts with their suppliers to achieve incremental innovation. In
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8 this study, we therefore seek to empirically investigate this issue. We use agency theory
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10 as our analytical lens because of its focus on the role of contracts in promoting incentive
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12 alignment in SCs (Fayezi et al., 2012).
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15 16 17 2.2 Agency theory

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19 Agency theory explains the contractual relationship between a principal and an agent
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21 performing work on behalf of the principal (Eisenhardt, 1989). It posits that the principal
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23 strives to minimise the costs associated with managing the agent, such as rewarding,
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25 monitoring, and regulating their behaviour (Fayezi et al., 2012). Concurrently, the agent
26
27 seeks to increase their benefits and minimise the principal's control (Eisenhardt, 1989).
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29 Agency theory addresses problems that arise when there is: (1) asymmetric information
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31 (i.e., adverse selection or moral hazard¹) and potential goal incongruence, and (2) a
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33 different view concerning risk preference between principal and agent (Eisenhardt, 1989).
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38 The theory is based on two streams of enquiry in the management literature: (1)
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40 *principal-agent*, where the focus is on choosing the optimal contract type (outcome-based
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42 vs. behaviour-based); and (2) *positivist*, where the focus is on how to oversee the
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44 principal-agent relationship (Eisenhardt, 1989). Although agency theory has traditionally
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46 focused on dyadic (customer-provider) contractual relationships, more recent research
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48 has used it to study interconnected principal-agent relationships in the extended SC
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50 (Matinheikki et al., 2022; Selvaridis and Norrman, 2015; Selviaridis and Spring, 2018;
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52 Howard et al., 2016).
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¹ *Adverse selection* is when an agent misrepresents their actual ability prior to engaging in a relationship.
Moral hazard is when an agent behaves differently than agreed and in a self-interested manner after
engaging in a relationship.

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4 Research has identified eight factors influencing the principal's contract choice
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6 (Eisenhardt, 1989). More specifically, an outcome-based contract (including a PBC) is
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8 preferred when (1) the customer is risk-averse, (2) there are significant goal conflicts
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10 between principal and agent, or (3) the outcome can be measured. However, a behaviour-
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12 based contract (e.g., labour-time and material-cost (T&M)) works better when (4) the
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14 agent performs a well-known task (e.g., logistics), (5) outcome uncertainty is high, (6)
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16 the agent's behaviour can be monitored, (7) the provider is risk-averse, and/or (8) the
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18 principal and agent are involved in a long-term relationship that allows the principal to
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20 evaluate the agent's behaviour history.
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25 More recent research has highlighted four strategies for governing agency
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27 relationships in SCs (Matinheikki et al., 2022). First, *information transfer strategies*
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29 involve transferring information between customers and providers to curb adverse
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31 selection and moral hazard problems. Second, *goal alignment strategies* intend to reduce
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33 the agent's (provider's) self-interestedness and, therefore, reduce misalignment between
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35 the provider and customer. Third, *integration strategies* integrate customer-provider
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37 operations to overcome information asymmetry and goal incongruence problems. Finally,
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39 *psychological influence strategies* refer to trust and credible threats, which can reduce
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41 moral hazard in SC relationships.
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46 In the context of PBC, the provider firm needs to understand both contract choices and
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48 strategies to govern supplier relationships in order to align incentives across the SC and
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50 achieve incremental innovation. The selection of contract types and appropriate strategies
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52 is context dependent. For instance, complex products with high outcome uncertainty
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54 (such as engine maintenance) might benefit from a PBC together with goal alignment
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56 strategies that reduce outcome uncertainty. In contrast, a well-defined, routine task, such
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58 as logistics, might be best managed with a time and materials contract and information
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4 transfer strategies that ensure clarity around goals and progress. It is thus important to
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6 choose suitable contract types and strategies to address the unique challenges of each
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8 supply chain relationship. In this study, the aforementioned eight factors and four
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10 strategies inform our analysis of the governance of the provider's relationships with their
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12 suppliers, and how contracting in this context can influence incremental innovation.
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18 **3. Methodology**

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20 Given the limited amount of prior empirical research on how the provider designs
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22 upstream sub-supplier contracts to foster incremental innovation and improve equipment
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24 availability, we adopt a case-based research design. Case study research provides depth
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26 and insight into a little-known phenomenon (Yin, 2018). It allows operations and SC
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28 phenomena to be explored and understood in a particular context (Yin, 2018). We have
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30 chosen to study incentive alignment in SCs within the defence sector due to the prevalent
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32 role of sub-suppliers (an alliance of OEMs) in the manufacture and support of weapon
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34 systems, and due to the prominent use of PBC as a contracting strategy. We investigate
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36 how the provider aligns its incentives with sub-suppliers and the resulting impact of this
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38 alignment on innovation outcomes downstream in the SC.
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46 *3.1 Case study design*

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48 An embedded, multiple-case study strategy was adopted (Yin, 2018). We investigated the
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50 alignment of incentives in the supply chain, i.e., among the provider, its first-tier
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52 suppliers, and the provider's customers. This alignment includes synchronising financial
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54 penalties and rewards, contract duration, and the scope of work. The provider may pass
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56 these incentives on to ensure that its first-tier suppliers are aligned with the provider to
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58 achieve innovation outcomes for the benefit of the end customer. We investigated two
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4 cases of PBC contracts with six embedded cases of sub-supplier contracts: four sub-
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cases of PBC contracts with six embedded cases of sub-supplier contracts: four sub-supplier contracts in Case A, and two in Case B. The cases concern part of the SC for the manufacture and after-sales service support of a European jet fighter sold to two different countries (see Figure 1). In each case, the downstream contract is a PBC between the provider and the customer (national defence department). Each country and the associated buying defence department has its own requirements, which likely influences both the design and management of contracts between the provider and its first-tier suppliers.

The jet fighter is built by an alliance of four countries (i.e., four domestic defence companies), with the provider (in both cases) being a large company listed on the stock exchange and one of four OEMs producing the weapon system. The primary unit of analysis is the SC and the associated incentives of firms (i.e., customers, the provider, and first-tier suppliers of the provider) therein. The sub-units of analysis (embedded cases) are the incentives in the six contractual relationships between the provider and its first-tier suppliers. Accordingly, the units of observation are the interconnected contracts in the supply chain, which largely reflect incentives and incentive alignment in terms of, for instance, the payment mechanism, KPIs, and contract duration provisions.

[Insert Figure 1]

Case A's PBC specifies that the provider is responsible for delivering support (maintenance and logistics) to the jet fighter customer A (see Figure 1 for the KPIs). The PBC has lasted for more than 15 years and is renegotiated every five years. The agreed payment mechanism is fixed price plus incentive fee, with penalties incorporated should the provider fail to deliver on any KPIs. The upstream contracts studied include four sub-suppliers: sub-suppliers A1 (engine), A2 (avionics), A3 (general maintenance, e.g., hydraulic maintenance), and A4 (logistics and warehousing). Sub-supplier A1 had a five-year availability-based contract with the provider, while all other sub-suppliers had

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4 labour-time and material-cost (T&M) contracts, with durations varying between three and
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6 five years. A3 and A4 were owned by the provider at the time of the contract design;
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8 however, A3 was sold in 2020 (prior to data collection).
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11 In Case B, the provider is responsible for delivering maintenance and logistics support
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13 to the jet fighter customer B (see Figure 1 for the KPIs). The PBC between the customer
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15 and provider has lasted for more than 15 years, based on a 10-year business agreement
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17 (five years fixed and five years indicative). The payment mechanism is pain-and-gain
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19 sharing based on an agreed target cost. Any cost savings that the provider makes are
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21 shared 60:40, with the customer recycling their gain into the weapon system (for
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23 improvement purposes). Upstream in the SC, we studied two sub-supplier contracts: sub-
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25 suppliers B1 (avionics) and B2 (general maintenance). Sub-supplier B1 had a five-year
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27 availability-based contract based on pain-and-gain sharing, while sub-supplier B2 had a
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29 5-year T&M contract. B2 is owned by the provider, including at the time of the contract
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31 design.
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37 We used theoretical sampling (Barratt et al., 2011) to select the two cases. Our sample
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39 included two distinct payment mechanisms (performance-based vs. T&M) to explore the
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41 influence of varying contract designs on incremental innovation. Additionally, we
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43 selected cases from two different customers (i.e., two defence departments in two
44
45 different countries) to observe how these differing contexts and end-customer
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47 procurement approaches affect incremental innovation. The uptake of PBC around the
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49 world in the defence industry is limited (Hunter, 2015). This influenced our focus on
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51 conducting in-depth analyses of two cases in specific countries that have adopted PBC.
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56 We distinguish between product- and service-offering suppliers when examining
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58 innovation in PBC. This is important due to the differing consequences of incentive
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60 misalignment with the provider for product- and service-offering suppliers. Specifically,

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4 product suppliers often face greater goal conflict compared to service suppliers because
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6 product-offering suppliers profit from a high failure rate while the provider profits from
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8 a low failure rate. We adopted Sampson and Froehle's (2006) definition of a service,
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10 which involves the customer (i.e., provider) providing input into service delivery. For
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12 example, the provider shares timely information with service suppliers to ensure efficient
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14 service delivery or coordinates the timely delivery of materials necessary for repair or
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16 transport. In contrast, sub-supplier products or components refers to physical items
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18 delivered to the provider, e.g., engine spare parts delivered to the provider's warehouse
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20 for installation (Hu et al., 2018).
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25 Given the above, both product-offering and service-offering sub-suppliers were
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27 selected as embedded cases. An example of incremental innovation within product-
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29 offering sub-suppliers is the re-engineering of a sub-component with a high failure rate,
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31 resulting in a 50% reduction in failures. In the case of service-offering sub-suppliers,
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33 incremental innovation may entail improving repair capacity by 20% through
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35 implementing new repair processes or optimising forecasting techniques. In Case B, we
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37 studied two sub-supplier contracts, as compared to Case A where we studied four. This
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39 is because of the influence of the host country in Case A, which prompted the provider to
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41 engage local sub-suppliers in addition to OEMs, resulting in a greater number of sub-
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43 suppliers.
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50 3.2 Data collection

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52 We collected data through multiple sources: semi-structured interviews, field
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54 observations, documents such as contracts², and other secondary data (e.g., shareholder
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59 ² We studied in detail contract clauses related to the payment mechanism, scope of work, and performance
60 requirements. Additionally, we examined KPI reports that were filled out in the context of contract management, and presentations explaining the contracts under investigation (e.g., the history of the contract).

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4 reports, annual reports, and newspaper articles). We conducted 21 semi-structured
5
6 interviews with managers from all of the actors involved (see Table I), covering two main
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8 themes: (1) how sub-supplier contract design (outcome-based vs. behaviour-based) can
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10 induce sub-suppliers to innovate, leading to improved performance, and (2) how PBC
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12 contracts can be aligned with upstream supply contracts to foster innovation. Seven
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14 interviewees did not permit voice recording, so we took detailed notes and wrote them up
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16 after each interview to maximise recall and enable follow-up questions (Yin, 2018). The
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18 other interviews were recorded and transcribed. The interviews lasted between 43 and
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20 133 minutes. In Case B, we compensated for the lack of a customer perspective by using
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22 relevant documents and other secondary data sources (e.g., the customer-provider
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24 contract).

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29 Follow-up interviews were conducted if any discrepancies were identified between
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31 interviews or between interviews and documentary sources (e.g., contracts). This allowed
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33 us to clarify our interpretations and validate our findings. For instance, an additional
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35 senior manager from sub-supplier C and a representative from the provider that interacted
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37 with sub-supplier C were interviewed to resolve discrepancies with regards to sub-
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39 supplier C's failure to incrementally innovate. A copy of the interview protocol used to
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41 capture the customer, provider, and sub-supplier perspectives is available in a
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43 supplementary file that accompanies this manuscript.

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48 [Insert Table I]

49 50 51 *3.3 Data analysis*

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53 Data were coded and analysed using *NVivo*. Agency theory informed the data analysis in
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55 two ways. First, to analyse suitable sub-supplier contract types for delivering an improved
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57 product or service. Second, to understand how to govern sub-supplier relationships in
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59 order to deliver these improvements. As a first step, we analysed each case study (i.e.,
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4 within-case analysis) in terms of *contract effectiveness*, i.e., the ability of the sub-supplier
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within-case analysis) in terms of *contract effectiveness*, i.e., the ability of the sub-supplier to deliver incremental innovations for the benefit of the provider and its customers. For example, the provider reported that sub-supplier B1 was able to improve their product quality, which helped them achieve a better outcome from the downstream contract (PBC). Sub-supplier B1 reported that these improvements were as a result of their freedom in the contract, the payment mechanism (i.e., pain-and-gain), the provider's maturity, and the contract duration.

Subsequently, we analysed the embedded cases collectively (i.e., cross-case analysis) in terms of the sub-supplier *contract design* and *contract management* strategies. Contract design includes drafting the contract (often based on tailoring a standard template), negotiating payment mechanisms, determining the scope of work and contract duration, whereas contract management was operationalised both in terms of managing contractual KPIs as well as managing sub-supplier relationships more broadly. We used open coding procedures for each embedded case (Corbin and Strauss, 1990). Codes were then grouped by construct categories, linking back to the strategies used to govern principal-agent relationships in supply chains (Matinheikki et al., 2022). Table II displays the resulting coding structure, including the agency-theory informed aggregate dimensions we derived. Throughout this entire process, the author team worked together to discuss and iteratively refine the coding process to arrive at robust conclusions.

[Insert Table II]

During the cross-case analysis we grouped codes as “product offering” and “service offering” before combining them in an Excel spreadsheet to improve the audit trail (see cross-case analysis in the next section). During this step, we linked contract effectiveness with the embedded case codes in the cross-case analysis. For example, we related the success of sub-supplier B1's contract to deliver incremental innovation to the payment

mechanism, time-based incentives, statement of work (SOW), collaboration, and transparency.

4. Analysis and findings

4.1 Within-case analysis

4.1.1 Analysis of Case A contract effectiveness for incremental innovation

Consistent with agency theory, sub-supplier A1 was contracted on an outcome basis for two main reasons. The first is high goal incongruence. The provider's contract with the customer is based on availability, meaning they profit from a long mean time between failures (MTBF), which ensures the weapon system is available at a certain level. However, sub-supplier A1, as a product-offering sub-supplier, profits from a short MTBF, as any reduction in spare parts consumption affects their income. The second is low task programmability. Sub-supplier A1 is the engine OEM, and the provider has difficulty in evaluating what the sub-supplier is doing due to technical confidentiality.

Agency theory would also suggest an outcome-based contract would be suitable for product sub-supplier A2 due to goal incongruence. However, high outcome uncertainty led the provider to contract A2 on a time and materials basis (i.e., behaviour-based contract). This outcome uncertainty stems from localisation and SC complexity. The buying government wishes to build local manufacturing capability and gain as much control as needed over critical products in the national interest. This pressurises the provider into engaging with local sub-suppliers and increases outcome uncertainty as the capabilities of local sub-suppliers like A2 are still being developed. As the provider's Head of Contract Delivery explained: "*It is an emerging industry, it's new.*" Moreover, sub-supplier A2 relies on a very complex SC, being situated between four nations and an end-user country. As the provider's Procurement Director said: "*It has dependencies on*

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4 *the supplier in Europe who has dependencies on the logistics provider, and not one of*
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6 *them is willing to carry the risk of the other”.*
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9 Sub-suppliers A3 and A4 were also contracted on a T&M basis, as both have a long-
10 term relationship with the provider. The provider acquired these two companies in the
11 1980s because of the buying government’s requirement to support local companies.
12
13 During the contract design phase, both sub-suppliers were owned by the provider who
14 had very high visibility and control over their operations. The contract type is consistent
15 with agency theory, which posits that when the agent and principal have a long-term
16 relationship, the principal will prioritise a behaviour-based contract. However, in 2020,
17 the provider sold sub-supplier A3, which resulted in the provider losing control over it.
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27 Meanwhile, the relationship between customer A and the provider has lasted for more
28 than 15 years, enabling them to learn from experience. This has been reflected in the PBC
29 contract at the point of contract renegotiation, which takes place every five years. Even
30 though the contract remains availability-based, customer A has learned from previous
31 mistakes, leading them to incorporate a stipulation that constrains the provider's ability to
32 have decision-making freedom. Therefore, even though payment is still based on results,
33 the provider is evaluated based on its ability to conduct certain tasks (e.g., have a certain
34 number of engineers in the workshop or maintain certain spare parts levels) rather than
35 on the contracted outcome only (jet availability). For example, during COVID-19, the
36 provider was unable to secure several spare parts. To avoid being penalised, they
37 cannibalised other jets that were not in use as they were undergoing maintenance. Even
38 though the provider delivered the available target jet to customer A, the customer
39 penalised them because they did not have the number of available spare parts stipulated
40 in the contract. These stipulations affect the sub-suppliers’ contract design since the
41 provider passes these restrictions onto sub-suppliers. For example, in addition to engine
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4 availability, sub-supplier A1 must always have a certain number of engineers available at
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6 the end-user base and spare parts available at the provider's warehouse. This eventually
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8 affects sub-suppliers' freedom to innovate, as their focus is on fulfilling extra tasks
9
10 required to protect customer A. As the provider's VP explained: "*The more constraints*
11
12 *you put around the contract [i.e., PBC] terms, the more difficult it is [and] ultimately the*
13
14 *more difficult it becomes to innovate because you remove all of the levers of the supply*
15
16 *chain, and you're forcing them down certain routes.*" Moreover, having penalty-only
17
18 incentives negatively affects the provider's willingness to innovate since their focus is on
19
20 avoiding mistakes. This also affected the provider's upstream supply contracts because
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22 they passed these penalties on to their suppliers.
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27 **Nonetheless, we observed that contracting sub-supplier A1 for a long duration**
28
29 **based on engine availability incentivised them to innovate and improve product**
30
31 **quality.** The availability contract created a certain degree of freedom (despite the
32
33 provider's extra stipulations) that helped A1 improve their product. As A1's Programme
34
35 Executive stated: "[due to their contract type] *We're able to find some kinds of innovation,*
36
37 *reduce our arisings [i.e., increase the engine uptime via MTBF improvement], as a result*
38
39 *of that, we are able to take advantage of fewer arisings that happen in the contract*
40
41 *period.*"
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45
46 **Sub-suppliers A2 and A4, even though contracted based on T&M, were also able**
47
48 **to improve their services.** This was mainly due to *funding and support* they received
49
50 from the provider to buy intellectual property (IP) related to avionics and a *collaborative*
51
52 *relationship* with the provider. A2 was able to re-engineer some critical components (i.e.,
53
54 avionics) because they were supported by customer A and the provider to own the
55
56 required IP rights. Sub-supplier A4 was able to improve their forecasting models and
57
58 forecasting accuracy by sustaining a *good relationship* with the provider. As A4's CEO
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4 put it: *“Personal relationships are really important, without a shadow of a doubt [...] I*
5
6 *know quite a lot of people, so even when people rotate out, I tend to know the new people*
7
8 *coming in [this helps] produce a forward forecast as well as where we think things are*
9
10 *going to, very quickly.”*

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12
13 In contrast, **sub-supplier A3 has a challenging relationship with the provider,**
14 **affecting its business and willingness to make service improvements.** According to
15
16 A3’s Engineer Executive: *“The learning curve plummeted massively because of [the*
17
18 *provider’s] way of working, we work one month, then we wait four months doing nothing.”*
19
20 The provider still perceives A3 as an organisation that is not mature enough to be relied
21
22 upon and A3 has been unable to improve its services due to a *lack of collaboration* with
23
24 the provider.
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30 4.1.2 Analysis of Case B contract effectiveness for incremental innovation

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32 Sub-supplier B1 was contracted on an outcome basis for the same reasons as sub-supplier
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34 A1: high goal incongruence and low task programmability. Meanwhile, sub-supplier B2
35
36 has a long-term relationship with the provider as a subsidiary, meaning they have good
37
38 visibility and control over B2. Therefore, the contract is based on T&M, a type of
39
40 behaviour-based contract.
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44 In terms of contract effectiveness in Case B, the customer awarded the provider with
45
46 a 10-year business agreement, enabling it to invest funds and improve the weapon system.
47
48 This also allowed the provider to grant longer-term contracts to sub-suppliers, helping
49
50 them allocate funds to improvements. The provider’s Head of Business Management
51
52 explained: *“The advantage of [Case B] type contracts is [...] they’re 10-year contracts.*
53
54 *So, they allow the provider to contact each of the vendors with a reasonably long-term*
55
56 *solution and give them a long-term funding stream.”*
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4 The payment mechanism between the provider and customer B is a pain-and-gain
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6 mechanism, meaning that if the provider saves money, the customer will invest this in the
7
8 weapon system. This has fostered innovation in the PBC contract as the provider is
9
10 incentivised to make consistent savings. In addition, since the PBC contract is focused on
11
12 a single KPI (flying hours), the provider reflected the pain-and-gain mechanism (with
13
14 minor differences) in B1's contract. **This motivated sub-supplier B1 to innovate and**
15
16 **improve the product.** As B1's Service Solutions Manager explained: *"From a*
17
18 *commercial perspective, [pain-and-gain mechanism] is the most effective commercial*
19
20 *arrangement. It's the simplest. It's the most honest. It's the most effective."*
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25 Furthermore, a single KPI and a set of key resilience indicators (KRIs) (e.g., inventory
26
27 health) granted the provider more freedom to do things differently while still delivering
28
29 the required flying hours. For example, during COVID-19, the provider cannibalised
30
31 other jets without upsetting the customer because the KPI focused on flying hours only,
32
33 and the customer was protected by a "bank of hours" KRI. **This decision-making**
34
35 **freedom also allowed the provider to grant B1 and B2 more autonomy, thus enabling**
36
37 **them to innovate.** The provider's Executive Manager stated: *"...you've got 20 spares in*
38
39 *the repair pool [...] We'd helped the vendor compress that lead time so that they could*
40
41 *cannibalise three of the items, and we could run the port with seventeen."*
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46 4.2 Cross-case analysis

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48 The cross-case analysis shows that the provider uses four strategies to design and manage
49
50 sub-supplier contracts to achieve incremental innovation outcomes (see Table III).
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54 [Insert Table III]
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4.2.1 Contract design strategies to reduce goal incongruence

The *payment mechanism* is an important aspect of sub-supplier contract design. The provider has trialled many different payment mechanisms over the years, resulting in service improvements. However, there is no silver bullet or one-size-fits-all solution. Each sub-supplier needs a payment mechanism tailored to their specific organisation and objectives if they are to be motivated to innovate.

We found that sub-suppliers prefer a per-use payment mechanism in a long-term contract (e.g., in the later years of a weapon system's life cycle), while they prefer a fixed price contract in a short-term contract (e.g., in the early years). A per-use payment mechanism can align the interests of the customer, provider, and sub-suppliers. For example, if the end-user (customer) chooses not to use the products, they will pay less, while the provider's and sub-suppliers' cost base will decrease as the products are not in use.

Moreover, a cost-plus³ contract is not preferable for A1, A2, or A3 as they are unwilling to open their financial books to the provider for confidentiality reasons. However, this contract type was acceptable to A4, B1 (due to the pain-and-gain payment mechanism), and B2 (owned by the provider). Furthermore, pain-and-gain was preferred by all sub-suppliers as an incentive for investing in innovation except A1 (as a result of the financial benefits of A1's current availability contract). A pain-and-gain mechanism applies pressure on product-offering sub-suppliers to improve their products. If a product keeps failing, the sub-supplier will share in the loss; and if they improve the product, they will share in the profits. However, pain-and-gain needs to be aligned with strategic sub-suppliers, and it requires the provider to be transparent with regards to PBC incentives

³ Under cost plus, the provider reports its cost to the customer and then adds a fixed percentage as profit.

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4 and KPIs. Nevertheless, pain-and-gain was seen by A3 as a means of avoiding the
5
6 provider's opportunistic behaviour, which might otherwise harm relationships.
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9 It is crucial for the customer to guarantee that, by opening up their financial records to
10
11 enable a pain-and-gain mechanism to be implemented, the sub-supplier's profits will not
12
13 be adversely affected. In Case B, when the provider attempted to transfer the pain-and-
14
15 gain mechanism to B1, the sub-supplier hesitated due to the customer's previous
16
17 behaviour when inspecting their financial records (to make sure public spending is fair).
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19 This scrutiny had an effect on the sub-supplier's decision-making process.
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23 In Case B, the provider used a fixed-price, guaranteed turnaround time (FPGT)
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25 contract with sub-supplier B2 to align both parties' goals. This also involved biannual
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27 joint reviews with B2, which improved the sub-supplier's forecasting. Nevertheless, while
28
29 turnaround time is an important metric, it may not be the primary driver of innovation for
30
31 sub-suppliers. Instead, an incentive mechanism, such as a reward/penalty, is needed. Sub-
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33 supplier B2's Senior Manager reported that they have a turnaround time, but still have a
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35 problem with aircraft because this contract type drives money without actually improving
36
37 service availability.
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41 We also found that incentives are crucial to fostering innovation. *Financial incentives*
42
43 refer to rewards and/or penalties. The provider's experience helps to design effective
44
45 incentive mechanisms, but sub-suppliers raise several issues that need to be considered
46
47 when setting up incentives. For example, A1 and A2 prefer incentives that cover their
48
49 risks so they have the confidence to invest. They also stressed that incentives must be
50
51 achievable since targets that are too ambitious can discourage sub-suppliers from
52
53 investing in improvements. The provider in Case A designed incentives (in the form of
54
55 penalties) to reward A1 for sustained achievement, not just a one-off success (i.e., a 'lucky
56
57 hit'). Thus, the sub-supplier's incentives were linked to average quarterly targets.
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4 Although this motivated A1 to keep achieving the targets, the firm's managers stressed
5 that penalties alone are not a motivational tool to improve the service and products.
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9 Having only penalties disincentivises sub-suppliers to improve their service. In fact,
10 imposing a penalty will increase the cost (due to increased risk) without the sub-supplier
11 seeking creative ways of improving the service. In Case B, the provider's Head of Supply
12 explained: "*Putting penalties in means they can put more risk in their price, which just*
13 *means that the price is bigger to start with [...] when you do the maths, you can't afford*
14 *it. You can't afford to buy the risk because, really, they're just putting in the risk that they*
15 *could get penalties.*"

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25 Nevertheless, most sub-supplier contracts are developed in peacetime. Sub-supplier
26 A1 argues that incentives during wars that hinge on missions flown (i.e., mission success)
27 as a KPI would motivate them to improve their products. Moreover, A3 and A4
28 highlighted that *payment in advance* helps them commit to making upfront investments
29 in the absence of financial incentives.

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37 *Time-based incentives*, which refer to the contract length, offer another way to
38 motivate a sub-supplier to improve their products and services. The provider and sub-
39 suppliers agreed that the longer the contract, the greater the incentive for upfront
40 investment to improve the service and products. For A1, contract duration needs to match
41 the life cycle of the engine and overhaul maintenance scheduling if the sub-supplier is to
42 invest in reliability. In addition, during the early product life cycle of the engine, a short
43 contract is more suitable because, in the initial period, maintenance and risk will be low.
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60 This helps A1 secure income while they understand how the weapon operates and identify
any challenges and costs involved in improving it. In later years, a longer contract will
help to make investment decisions in advance by improving MTBF, which in turn helps
to reduce unscheduled maintenance and annual costs. Moreover, the longer the contract

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4 under a pain-and-gain mechanism, the more money can be recycled into the weapon
5 system, leading to further improvements.
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9 10 4.2.2 Contract design strategies to reduce information asymmetry

11 The weapon system we studied was made by four countries. The product design took
12 decades to finalise. The provider's interviewees stressed that the multi-national
13 partnership and sub-supplier contracts needed to be formed very early so that sub-
14 suppliers can have full visibility of the customer requirements. The provider reported that
15 having a customer with two 'faces' (commercial and operational) increases contracting
16 layers, affecting the speed at which requirements are passed on to sub-suppliers. Sub-
17 suppliers A1 and A4 indeed highlighted that involvement during the PBC contract-
18 drafting phase *improves visibility* and helps them better understand end-user requirements
19 and, thus, plan their improvements more efficiently. Moreover, shaping the mindset of
20 the sub-suppliers for a win-win approach is important for improving transparency and
21 reducing information asymmetry. The provider's Head of SC in Case B commented that
22 incorporating after-sales services into the acquisition process is crucial to improving the
23 weapon system, as the after-sales support will have better visibility of the weapon system.
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41 *Reducing adverse selection* also helps to reduce information asymmetry. The provider
42 uses a sub-supplier segmentation approach to reduce adverse selection. This is helpful in
43 distinguishing between sub-suppliers who are able to improve their services and those
44 who must be closely scrutinised. In both cases, we found that the provider used various
45 approaches to reduce adverse selection. One approach is to contract with highly reputed
46 sub-suppliers that are more likely to improve their service because they know their
47 reputation and sales results are at stake. Another approach is to contract with sub-
48 suppliers that have a variety of components in the market. These sub-suppliers are more
49 motivated to improve their services than sub-suppliers that have only one product. The
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4 provider can leverage this diversity to improve the service. It can also use its prior
5
6 experience in contracting with a sub-supplier to better understand the sub-supplier's
7
8 capabilities. Moreover, Case A highlights the importance of shortening the SC as much
9
10 as possible when selecting sub-suppliers. In Case A, the provider contracted with a local
11
12 OEM (A2) instead of a major OEM (B1), and this affected service improvements.
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14 According to the provider's Vice President, the company will, in the near future, need to
15
16 bypass A2 and contract directly with B1 instead.
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21 *A statement of work (SOW) can also lead to reduced information asymmetry, thereby*
22
23 *affecting innovation outcomes. The provider and sub-suppliers in both cases stressed that*
24
25 *it is important to take their time when designing the SOW in order to get it right.*
26
27 *Misalignment between the KPIs in the PBC and those in the sub-supplier contracts was*
28
29 *reported by A1 as an issue affecting the provider's performance. As A1's Programme*
30
31 *Executive explained: "In this contract, we are in a situation of we don't have a back-to-*
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33 *back contract. So, my KPI, I can achieve it, but [the provider] will be failing in theirs [...]*
34
35 *I think. Because we're relying on engine numbers [...] They've agreed a serviceability*
36
37 *number."*
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41 In Case A, the provider does not intend to align the downstream with the upstream
42
43 supply contracts because they are willing to take some risks (that they can handle) in order
44
45 to increase their profits. In contrast, Case B demonstrates the importance of aligning
46
47 downstream and upstream contracts, ensuring that sub-suppliers are profitable. This has
48
49 helped sub-supplier B1 to maintain its improvement efforts.
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53 In addition, the provider believes that aligning incentives with immature local partners
54
55 (i.e., A2 and A3) can have a negative impact on that industry, as imposing KPIs may harm
56
57 local companies leading to their bankruptcy. Moreover, service-offering sub-suppliers,
58
59 A3, A4 and B2, stressed that it is difficult to align downstream and upstream contracts
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4 because the provider's KPIs are concerned with overall availability (of the jet fighter),
5
6 while, for sub-suppliers, KPIs concern a specific task that contributes to overall
7
8 performance. Additionally, fewer contract stipulations can help sub-suppliers to innovate.
9
10 For example, A1 reported that decision-making freedom in their outcome-based contract
11
12 is very important for fostering innovation. In Case B, the provider's autonomy in the PBC
13
14 allows them to pass this freedom on to their sub-suppliers, which in turn helps sub-
15
16 suppliers make fast adjustments and avoid losses. In Case A, the provider lacks this
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18 autonomy, which affects the willingness of the provider and sub-supplier to innovate.
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23 Despite the above, the provider and sub-suppliers agree that there is a need for the
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25 SOW to be very clear in terms of the specified KPIs. All sub-suppliers seek precise KPIs
26
27 that allow them to focus on what is important and that give them some room for
28
29 improvement. The fewer the KPIs, the better the outcomes that the sub-suppliers can
30
31 deliver. As A4's CEO stated: *"...at the top level, we have [...] quite a small number [of*
32
33 *KPIs], and it [...] helps me when I go into my monthly performance reviews. We can see*
34
35 *very quickly whether things are where they should be, whether there's a deterioration in*
36
37 *performance, whether there's an improvement in performance."*
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41
42 Case B demonstrated some lessons learned from contract design mistakes and
43
44 highlighted that, due to the military environment, sub-supplier contracts need to be
45
46 flexible enough to allow for changes; otherwise, achieving alignment between sub-
47
48 suppliers and the provider is challenging. In Case B, a flexible SOW also helped the
49
50 provider and sub-suppliers reduce the risk of obsolescence by allowing sub-suppliers to
51
52 use previous spare parts innovatively.
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55 56 4.2.3 Contract management strategies to reduce outcome uncertainty

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58 Contract design is not sufficient on its own to align provider-customer contracts with
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60 provider-sub-supplier contracts in order to drive incremental innovation and

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4 product/service improvement outcomes. Rather, contract management is equally
5
6 important. The Executive Manager of Case B's provider described a previous PBC with
7
8 one of their sub-suppliers and how the lack of proper contract management led them to
9
10 switch the contract type to a case-by-case basis.
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12

13
14 The complexity inherent to the multinational design and production of a weapon
15
16 system raises several obstacles that need to be managed to reduce outcome uncertainty.
17
18 One issue is bureaucracy, which can hinder improvement initiatives from sub-suppliers.
19
20 Sub-supplier B1 reported that there are difficulties in re-engineering spare parts due to
21
22 the complexity of coordination between the four nations. For example, if one sub-supplier
23
24 wants to re-engineer a component, they must go through a long process of approval by
25
26 all OEMs based in the other countries.
27
28

29
30 *Localisation*, which aims to maintain high-failure items locally, can help to reduce
31
32 repair cycle lead times and improve service amidst the four-nation complexity. As sub-
33
34 supplier A2's Programme Manager said: "*The improvement of my service is to repair or*
35
36 *manufacture parts locally.*" However, maintaining the SC locally adds layers; therefore,
37
38 it is imperative, for an availability contract, that there is some *control over the supply*
39
40 *chain*. The VP of Case A's provider suggested that controlling the SC to secure safety
41
42 stock (contractually) and investing in local companies' capabilities is important so that
43
44 the provider can reach a level where they can export their products to other customers.
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49 Nevertheless, when the provider and sub-suppliers *understand the business*
50
51 *environment-related challenges* that exist in the context in which they are operating, such
52
53 as politics, COVID-19, the limited number of sub-suppliers in the market, and the limited
54
55 technological advances, they can effectively manage the contract and deliver the required
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57 improvement outcomes. For example, in both cases the provider faced very difficult
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59 negotiations with sub-suppliers whose commercial business had been negatively affected
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4 by COVID-19. Moreover, the defence and aerospace industries are not very competitive
5
6 due to limited supply options. The VP of Case A's provider stressed that, to increase
7
8 competitiveness, the provider and suppliers (especially the local ones) must produce in
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10 and offer maintenance to nearby countries that use the same weapon system and need
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12 equipment and services.
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15
16 *Transparency and trust* can help suppliers make the provider aware of challenges that
17
18 might inhibit improvements. However, product-offering sub-suppliers report that they
19
20 need transparency to be framed such that it protects their interests and IP. Furthermore,
21
22 sub-suppliers want clear visibility of PBC demands so they can manage their innovation
23
24 decisions accordingly. The VP of Case A's provider suggested that, as a big company,
25
26 they have more resources, technology, and experience than their sub-suppliers; therefore,
27
28 it is the provider's responsibility to share them with sub-suppliers to enable improvements
29
30 in products and services. However, sub-suppliers also need to be willing and open to this.
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35 We also found that difficulties in integrating sub-suppliers' and the provider's
36
37 information systems, such as enterprise resource planning (ERP) systems, can reduce the
38
39 quality of *information sharing* and increase lead times, which has a negative impact on
40
41 improvement efforts. However, it is almost impossible to integrate IT along the entire SC
42
43 (especially among large sub-suppliers). Therefore, it is more about what data the provider
44
45 shares with sub-suppliers. Choosing not to share sensitive data (e.g., flying hours) can
46
47 affect sub-suppliers' services and hinder any improvement decisions.
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51 One issue that the provider reported in both cases is that some sub-suppliers (A1 and
52
53 B1) also operate in the civilian market. In fact, their business in the civilian market
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55 exceeds that in the military market. This issue has impacted on pricing and, therefore, the
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57 business relationship. The provider's interviewees stressed that pricing an item sold to
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4 the military at three times the price it is sold to the civilian market can affect the
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6 relationship and the provider's services.
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10 4.2.4 Contract management strategies to integrate provider and sub-supplier operations

11 *Modifying the relationship structure* can resolve agency problems. We found that when
12
13 sub-supplier A3 was owned by the provider, the latter was in control and tried to increase
14
15 their profits. While under the control of the provider, the sub-supplier was contracted to
16
17 provide maintenance for hundreds of line items; however, in reality, they used to deliver
18
19 only a few line items because they lacked capacity and capabilities. When A3 was sold,
20
21 the provider remained tied to the contract (to maintain hundreds of line items). This
22
23 influenced A3's mindset to improve their services so as to keep the contract alive.
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29 In addition, since the end-user (customer) needs to have critical items made locally,
30
31 sub-suppliers A2 and B1 require *funding and support* from the customer and the provider
32
33 to be able to improve their service or spare parts quality by owning the IP. Sub-supplier
34
35 A2 was unable to re-engineer and improve the quality of some products they make since
36
37 they do not own the product-related IP. As A2's Programme Manager explained:
38
39 "*Exactly, the intellectual property rights. You can't violate the licence that's given to you*
40
41 *by the OEM. So, you stick to this licence. You also don't have the authority to change it*
42
43 *because, if you change it, it will affect the service because the licence will be suspended.*"
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48 *Social interaction* can promote teamworking and collaborative relationships, leading
49
50 to improved service and reliability. We observed that sub-supplier A4 was able to improve
51
52 their service through CEO-level relationships with the provider's executives – A4's CEO
53
54 is a former Executive of the provider. Therefore, these social relationships helped A4 find
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56 ways to improve their business and service. In contrast, the provider's informal two-year
57
58 staff-rotation policy prevented A1, A2, and A3 from sustaining a good relationship with
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4 the provider over a longer period. A *good business relationship* can also motivate sub-
5
6 suppliers to innovate. As A3's Programme Manager explained: "*The contract is strict,*
7
8 *and the only way to innovate, if we can, is through a good relationship with the provider.*"
9
10

11 Sub-suppliers seek to secure more market share and future business. Therefore,
12
13 assuring sub-suppliers of future business relationships motivates them to innovate and
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15 improve. *Collaboration and coordination* between sub-suppliers and the provider can
16
17 reduce agency problems and improve service levels. For example, in Case A, the
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19 provider's Head of Contract Delivery stated: "*Lack of collaboration creates major*
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21 *problems, because we can't help them to identify where we can help to make*
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23 *improvements.*" The collaborative relationship includes asking sub-suppliers to move
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25 closer to the weapon system. The provider reported that moving B1 to the base had helped
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27 them understand the issues when a product keeps failing. Moreover, collaboration will
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29 require maturity and trust from the customer, the provider, and the sub-suppliers. The
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31 provider reported that the success of collaboration does not rely on the contract type;
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33 rather, it depends on the maturity of the sub-suppliers.
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39 Customer coordination is also important because, in services, the end user's input is
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41 significant; however, it needs to be done in such a way that it does not affect the service
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43 or hold the provider hostage. Customer engagement needs to be collaborative so that it
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45 can support the provider-sub-suppliers' contracts. Since the provider is both principal
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47 (upstream) and agent (downstream), they engage in dual actions, which may affect
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49 contract alignment. For departments that are customer-facing (contract delivery), their
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51 job is to please customers; however, sub-supplier-facing departments (i.e., procurement
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53 department) appear to prioritise cost savings. Such misalignment affects the business
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55 relationship since sub-suppliers are treated differently to customers, which in turn
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57 influences sub-suppliers' improvement decisions. Additionally, the provider needs to
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4 train their sub-suppliers frequently in order to optimise the services they deliver and foster
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6 teamwork.
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10 11 **5. Discussion**

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13 Prior research has highlighted a range of factors, pertaining both to the customer and the
14 provider side, that influence the choice of contract type (Roels et al., 2010). For example,
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16 Glas and Essig (2013) proposed a framework for military contracts, arguing that supplier
17 risk in particular influences customer decisions on contract types such as PBC.
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19 Furthermore, Ng et al. (2013) argued that firms implementing successful outcome-based
20 contracts can enhance their organisational capabilities. All of the aforementioned studies
21 focused on how customers choose contracts with their direct suppliers (i.e., providers). In
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23 contrast, we know little about how providers can design contracts with their first-tier
24 suppliers when the downstream customer adopts a PBC with the provider. The limited
25 body of prior research that has examined the upstream supply chain (Datta and Roy, 2013;
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27 Kleemann and Essig, 2013; Selviaridis and Norrman, 2014) has focused on how PBC
28 influences sub-supplier relationship management.
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41 Using an agency theory lens, the cross-case analysis identified four distinct strategies
42 for designing and managing contracts with sub-suppliers. Figure 2 synthesises these
43 findings in the form of a research model and a set of propositions, which are discussed in
44 the following paragraphs. The implementation of these strategies varies depending on the
45 sub-supplier's offering (product vs. service).
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52 [Insert Figure 2]
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56 Regarding contract design strategies, our study adds to the limited literature linking
57 PBC to innovation outcomes (e.g., Sumo et al., 2016a; Sumo et al., 2016c) and the design
58 of associated KPIs in PBCs (Akkermans et al., 2019). This literature has largely focused
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on dyadic customer-supplier relationships, whereas our study extends this to include the upstream SC. We have shown that having fewer contractual stipulations (e.g., KPIs) can reduce information asymmetry, thereby influencing the design of sub-supplier contracts and ultimately enhancing sub-supplier innovation. The findings have demonstrated the substantial influence of KPIs on incremental innovation in the SC for the benefit of the end customer. However, we have also observed that the number of KPIs in the PBC has differing impacts on sub-suppliers' contracts and their motivation to innovate. In Case A, the customer identified numerous KPIs in the PBC contract, including jet availability, engine availability, flying hours, and turnaround time, with penalties applied only if these KPIs were not achieved. The provider leaned towards protecting themselves by passing these numerous KPIs (with a penalties-only mechanism) to their first-tier suppliers. The use of multiple KPIs in the sub-supplier contract shifted the sub-suppliers' focus towards meeting these specific metrics rather than driving innovation in their service. In contrast, Case B featured a single KPI in the PBC contract, offering the provider flexibility and freedom to determine how best to achieve the required performance. This flexibility allowed the provider to align their back-to-back payment mechanisms (pain-and-gain) with their first-tier supplier contracts, ultimately aligning these contracts with the PBC in terms of delivering improved products and services. Therefore, we propose:

Proposition 1: *In the context of a PBC between a customer and provider, designing sub-supplier contracts to reduce information asymmetry by incorporating focused KPIs is more likely to enable sub-suppliers to incrementally innovate and improve their products and services.*

The findings are consistent with the PBC literature highlighting that penalties can harm the customer-supplier relationship (Selviaridis and van der Valk, 2019), while time-based

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4 incentives can motivate suppliers to be more innovative (Gardner et al., 2015; Howard et
5 al., 2016; Randall et al., 2011; Randall et al., 2010). However, the orientation of sub-
6 suppliers, particularly the distinction between a product and service offering, has been
7 relatively overlooked in the PBC literature. We thus extend prior PBC research by
8 showing that the offering of sub-suppliers matters when it comes to providers choosing
9 effective contracting strategies to achieve innovation outcomes.
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18 Our findings have demonstrated that product-offering sub-suppliers (A1 and B1) with
19 contracts designed based on outcomes exhibit greater alignment with the PBC contract
20 and are more motivated to innovate. This is because the inherent goal incongruence
21 between the two parties (i.e., the provider profits from low spare parts consumption
22 whereas the sub-supplier profits from higher spare parts consumption) is reduced by using
23 an outcome-based contract. Sub-suppliers become motivated to reduce spare parts
24 consumption and therefore seek to innovate in ways that improves their product quality.
25 Consequently, a PBC emerges as the most suitable contract type, motivating these sub-
26 suppliers to innovate and enhance their products. Additionally, we found that designing
27 service contracts solely based on turnaround times is not a sufficient incentive to drive
28 incremental innovation by sub-suppliers. For example, A4 and B2 operated under
29 turnaround time-based contracts without the inclusion of financial incentives. This led
30 sub-suppliers to prioritise meeting turnaround time metrics over finding innovative ways
31 of enhancing maintenance capacity. Therefore, we propose:
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51 **Proposition 2a:** *Designing contracts with product-offering sub-suppliers based on*
52 *performance is more likely to reduce goal incongruence and align the sub-suppliers'*
53 *incentives with those of the provider, leading to incremental innovation.*
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4 **Proposition 2b:** *Designing contracts with service-offering sub-suppliers based on*
5 *turnaround time is less likely to reduce goal incongruence and align the sub-suppliers'*
6 *incentives with those of the provider, resulting in incremental innovation.*
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12 Regarding contract management strategies, our study adds to prior PBC literature
13 focusing on relational governance mechanisms such as collaboration (e.g., Kleemann and
14 Essig, 2013) by showing that providers mobilise “integration”-type contracting strategies
15 to reinforce collaboration with their first-tier suppliers. The findings suggest that the
16 alignment of goals and incentives for incremental innovation does not necessarily require
17 the alignment of contract types along the SC. Rather, provider initiatives to integrate more
18 closely with sub-suppliers through funding and support provision can compensate for the
19 lack of contract-type alignment or financial incentives to achieve incremental innovation.
20 For example, A2 and A4 were both contracted based on a T&M contract, regardless of
21 required performance outcomes. This contract type can be challenging for sub-suppliers,
22 as they may not be motivated to innovate and improve their products or services if they
23 are not rewarded for doing so. However, we observed that both sub-suppliers did in fact
24 innovate and improve their products (A2) and services (A4). Sub-supplier A2 was able to
25 do this by obtaining funding and support from the provider, which enabled A2 to own the
26 IP for some of their critical components and therefore have greater control over their
27 design and development. Sub-supplier A2 was also able to use such funding to re-
28 engineer some of their critical components, which improved their performance and
29 reliability. Sub-supplier A4 was also able to improve their service by developing a good
30 relationship with the provider. This allowed A4 to receive and act upon feedback on their
31 work. As a result, A4 was able to improve their forecasting models, which made them
32 more accurate and reliable. These findings have shown that it is possible for sub-suppliers
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4 to innovate and improve their products and services even when their (behaviour-based)
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6 contracts are not aligned with the downstream PBC (outcome-based). We thus propose:
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10 **Proposition 3:** *Managing sub-supplier contracts to pursue inter-firm integration by*
11 *providing funding and support to sub-suppliers increases the likelihood of aligning*
12 *incentives along the supply chain to achieve incremental innovation.*
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18 The product vs. service offering orientation of sub-suppliers also has implications for
19 the management of sub-supplier contracts. As shown in Table III, certain provider sub-
20 strategies for managing contracts with first-tier suppliers, namely localisation and the
21 control of a supply chain spanning multiple countries and firms (“SC control”), are more
22 important for product-offering sub-suppliers compared to service-offering sub-suppliers.
23 Product-offering sub-suppliers often prioritise localisation, as being closer to the provider
24 reduces lead times for manufacturing or repairing spare parts, ultimately facilitating
25 incremental innovation and the improvement of the product offering. Product-offering
26 sub-suppliers also put greater emphasis on control to ensure the quality and resilience of
27 their SC. Funding and support become critical for product-offering sub-suppliers, more
28 so than for service-offering sub-suppliers, because they may need to invest in re-
29 engineering their equipment or providing staff training. We thus propose:
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47 **Proposition 4:** *Managing product-offering sub-supplier contracts to reduce outcome*
48 *uncertainty through supply chain localisation and control increases the likelihood of*
49 *incremental innovation and product reliability improvements.*
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55 Overall, our empirical study in the defence context contributes to prior research on
56 incentive alignment in supply chains (e.g. Selviaridis and Spring, 2018; Norrman and
57 Näsrlund, 2019; Narayanan and Raman, 2004) by showing how incentive alignment across
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4 the supply chain, through the four contracting strategies we identified, promotes
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6 incremental innovation – a hitherto overlooked performance aspect in the literature on
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8 supply chain alignment. The study also contributes to PBC research by expanding upon
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10 conceptual PBC studies that examined incentive alignment upstream in the SC (e.g., Li
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12 and Mishra, (2021); Datta and Roy, (2013). We have empirically demonstrated the
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14 strategies that providers use to design sub-supplier contracts and foster incremental
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16 innovation. We have found that, in addition to sharing the cost of investments with sub-
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18 suppliers, providers strive to reduce goal incongruence and information asymmetry. Our
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20 findings have also shown that the provider designs appealing sub-supplier contracts by
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22 not only including pain-and-gain sharing incentives but also by promoting collaboration.
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24 This extends PBC research by providing new insights into how to financially incentivise
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26 the supply base of the provider (Caldwell and Howard, 2014).
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34 **6. Conclusions**

35 *6.1 Managerial implications*

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37 Understanding sub-suppliers' perspectives on effective incentive alignment will help
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39 managers of providers and customers to foster innovation in the SC through contract
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41 design and management. Regarding contract design, involving sub-suppliers during the
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43 PBC agreement drafting stage is important to helping them understand PBC requirements
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45 and determine upfront investment. It is also important to be aware that fewer stipulations
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47 in statements of work would enable sub-suppliers to innovate and provide flexibility to
48
49 align KPIs and incentives between the PBC and sub-supplier contracts. Furthermore,
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51 product-offering sub-suppliers are more likely to innovate when they are contracted based
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53 on performance (e.g., availability contracts).
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4 Regarding contract management, when providers' managers are mandated to use local
5 sub-suppliers, they need to invest in developing sub-supplier capabilities. Sub-supplier
6 capability development (e.g., by providing funding to buy critical component IP rights,
7 train sub-supplier staff, and ensure compliance with quality standards) would help sub-
8 suppliers improve and secure future business. Transparency and trust are also essential
9 for identifying SC vulnerabilities and building resilient SCs. Closer integration between
10 the provider and sub-supplier can also help motivate the latter to improve their services
11 and make them more accountable. Such integration can positively affect PBC outcomes,
12 thus demonstrating the importance of effective collaboration and coordination.
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27 *6.2 Limitations and Future Research*

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29 The generalisability of the findings may be limited due to several unique characteristics
30 of the defence setting that serve as "boundary conditions" (Busse et al., 2017). These
31 include local supply requirements, public procurement processes, and the limited number
32 of suppliers in the defence industry (Kress, 2015; Listou, 2013; Smith, 2018; Yoho et al.,
33 2013; Howard et al., 2016; Caldwell and Howard, 2014). Therefore, future research could
34 study industries where these conditions might not be prevalent, such as in the automobile
35 industry, examining the application of the four contracting strategies to build a more
36 nuanced understanding of how incentive alignment along the SC promotes innovation
37 outcomes. In addition, our findings regarding sub-supplier contract design and
38 management are only partly transferable to settings where the provider and customer are
39 tied by a contract type other than PBC. This is because a PBC between the provider and
40 customer is a key source of incentive misalignment along the SC, given that sub-suppliers
41 typically benefit from product failures as they are paid based on their maintenance and
42 repair activity levels. In the case of a behaviour-based contract between the provider and
43 customer, however, such misalignment and goal conflict upstream in the SC tends to
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4 diminish. Having said that, certain elements of the observed contract management
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6 strategies, such as providing funding and support to sub-suppliers and fostering
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8 collaboration along the supply chain, would be applicable to non-PBC settings.
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11 Our study did not explicitly consider the role of relational governance mechanisms
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13 (e.g., trust and relational norms of conduct), or how these might interact with sub-supplier
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15 contract design and management strategies. Future research should examine such
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17 interactions between contractual and relational governance in the context of incentive
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19 alignment in the supply chain (Roehrich et al., 2020). In Case B, we did not interview
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21 representatives of the defence customer; we compensated for this limitation by
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23 complementing interviewee accounts with documents, such as contracts and publicly
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25 available data. Despite these limitations, our study offers novel insights regarding sub-
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27 supplier contract design and management for innovation purposes. Future research could
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29 test and refine our propositions using, for example, large-scale quantitative studies.
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References

- Akkermans, H., Van Oppen, W., Wynstra, F. & Voss, C. (2019) Contracting outsourced services with collaborative key performance indicators. *Journal of Operations Management*, 65(1), 22-47.
- Alqahtani, F., Selviaridis, K. & Stevenson, M. (2023) The effectiveness of performance-based contracting in the defence sector: A systematic literature review. *Journal of Purchasing and Supply Management*, 29(5), 100877.
- Barratt, M., Choi, T. Y. & Li, M. (2011) Qualitative case studies in operations management: Trends, research outcomes, and future research implications. *Journal of operations management*, 29(4), 329-342.
- Busse, C., Kach, A. P. & Wagner, S. M. (2017) Boundary Conditions: What They Are, How to Explore Them, Why We Need Them, and When to Consider Them. *Organizational Research Methods*, 20(4), 574-609.
- Caldwell, N. & Howard, M. (2014) Contracting for complex performance in markets of few buyers and sellers: The case of military procurement. *International Journal of Operations and Production Management*, 34(2), 270-294.
- Corbin, J. & Strauss, A. (1990) Grounded Theory Research : Procedures, Canons, and Evaluative Criteria. *Qualitative sociology*, 13(1), 3-21.
- Datta, P. P. (2020) Hidden costs in different stages of advanced services – A multi-actor perspective of performance based contracts. *Journal of business research*, 121, 667-685.
- Datta, P. P. & Roy, R. (2013) Incentive issues in performance-based outsourcing contracts in the UK defence industry: a simulation study. *Production planning & control*, 24(4-5), 359-374.
- Datta, P. P., Srivastava, A. & Roy, R. (2013) A simulation study on maintainer resource utilization of a fast jet aircraft maintenance line under availability contract. *Computers in industry*, 64(5), 543-555.
- Doerr, K., Lewis, I. & Eaton, D. R. (2005) Measurement issues in performance-based logistics. *Journal of public procurement*, 5(2), 164-186.

- 1
2
3
4 Eisenhardt, K. M. (1989) Agency Theory: An Assessment and Review. *The Academy of Management review*, 14(1), 57.
- 5
6 Essig, M., Glas, A. H., Selviaridis, K. & Roehrich, J. K. (2016) Performance-based contracting in business
7 markets. *Industrial marketing management*, 59, 5-11.
- 8 Fayezi, S., O'loughlin, A. & Zutshi, A. (2012) Agency theory and supply chain management: a structured
9 literature review. *Supply chain management*, 17(5), 556-570.
- 10 Glas, A., Hofmann, E. & Eßig, M. (2013) Performance-based logistics: a portfolio for contracting military
11 supply. *International journal of physical distribution & logistics management*, 43(2), 97-115.
- 12 Glas, A. H., Henne, F. U. & Essig, M. (2018) Missing performance management and measurement aspects
13 in performance-based contracting. *International journal of operations & production management*,
14 38(11), 2062-2095.
- 15 Glas, A. H., Raithel, C. & Essig, M. (2019) Risk perception in performance based contracts and the
16 influence of experience. *International journal of productivity and performance management*,
17 68(6), 1078-1101.
- 18 Guajardo, J. A., Cohen, M. A., Kim, S.-H. & Netessine, S. (2012) Impact of Performance-Based
19 Contracting on Product Reliability: An Empirical Analysis. *Management science*, 58(5), 961-979.
- 20 Howard, M., Wu, Z., Caldwell, N., Jia, F. & König, C. (2016) Performance-based contracting in the defence
21 industry: Exploring triadic dynamics between government, OEMs and suppliers. *Industrial
22 marketing management*, 59, 63-75.
- 23 Hu, Q., Boylan, J. E., Chen, H. & Labib, A. (2018) OR in spare parts management: A review. *European
24 Journal of Operational Research*, 266(2), 395-414.
- 25 Hypko, P., Tilebein, M. & Gleich, R. (2010) Clarifying the concept of performance-based contracting in
26 manufacturing industries: A research synthesis. *Journal of service management*, 21(5), 625-655.
- 27 Kim, S.-H., Cohen, M. A. & Netessine, S. (2007) Performance Contracting in After-Sales Service Supply
28 Chains. *Management science*, 53(12), 1843-1858.
- 29 Kleemann, F. C. & Essig, M. (2013) A providers' perspective on supplier relationships in performance-
30 based contracting. *Journal of purchasing and supply management*, 19(3), 185-198.
- 31 Kress, M. (2015) *Operational Logistics: The Art and Science of Sustaining Military Operations*. 2
32 ed. Switzerland: Springer Cham.
- 33 Li, D. & Mishra, N. (2021) Engaging suppliers for reliability improvement under outcome-based
34 compensations. *Omega (Oxford)*, 102, 102343.
- 35 Listou, T. (2013) How to supply a frigate. *International Journal of Physical Distribution and Logistics
36 Management*, 43(2), 134-147.
- 37 Matinheikki, J., Kauppi, K., Brandon-Jones, A. & Van Raaij, E. M. (2022) Making agency theory work
38 for supply chain relationships: a systematic review across four disciplines. *International Journal
39 of Operations and Production Management*, 42(13), 299-334.
- 40 Narayanan, V. G. & Raman, A. (2004) Aligning incentives in supply chains. *Harv Bus Rev*, 82(11), 94-
41 149.
- 42 Ng, I. C. L., Ding, D. X. & Yip, N. (2013) Outcome-based contracts as new business model: The role of
43 partnership and value-driven relational assets. *Industrial marketing management*, 42(5), 730-743.
- 44 Ng, I. C. L. & Nudurupati, S. S. (2010) Outcome-based service contracts in the defence industry - mitigating
45 the challenges. *Journal of service management*, 21(5), 656-674.
- 46 Nikulina, A. & Wynstra, F. (2022) Understanding supplier motivation to engage in multiparty performance-
47 based contracts: The lens of Expectancy theory. *Journal of purchasing and supply management*,
48 28(2), 100746.
- 49 Norrman, A. & Näslund, D. (2019) Supply chain incentive alignment: The gap between perceived
50 importance and actual practice. *Operations and Supply Chain Management: An International
51 Journal*, 12(3), 129-142.
- 52 Nowicki, D., Sauser, B., Randall, W. & Lusch, R. (2018) Service-Dominant Logic and Performance-Based
53 Contracting: A Systems Thinking Perspective. *Service science (Hanover, Md.)*, 10(1), 12-24.
- 54 Oke, A. (2007) Innovation types and innovation management practices in service companies. *International
55 journal of operations & production management*, 27(6), 564-587.
- 56 Randall, W. S., Nowicki, D. R. & Hawkins, T. G. (2011) Explaining the effectiveness of performance-based
57 logistics: a quantitative examination. *The International Journal of Logistics Management*, 22(3),
58 324-348.
- 59 Randall, W. S., Pohlen, T. L. & Hanna, J. B. (2010) Evolving A Theory Of Performance-Based Logistics
60 Using Insights From Service Dominant Logic. *Journal of business logistics*, 31(2), 35-61.
- Roehrich, J. K., Selviaridis, K., Kalra, J., Van Der Valk, W. & Fang, F. (2020) Inter-organizational
governance: a review, conceptualisation and extension. *Production Planning & Control*, 31(6),
453-469.

- 1
2
3
4 Roels, G., Karmarkar, U. S. & Carr, S. (2010) Contracting for Collaborative Services. *Management science*,
5 56(5), 849-863.
- 6 Sampson, S. E. & Froehle, C. M. (2006) Foundations and Implications of a Proposed Unified Services
7 Theory. *Production and Operations Management*, 15(2), 329-343.
- 8 Selviaridis, K. & Norrman, A. (2015) Performance-based contracting for advanced logistics services:
9 Challenges in its adoption, design and management. *International journal of physical distribution
10 & logistics management*, 45(6), 592-617.
- 11 Selviaridis, K. & Norrman, A. (2014) Performance-based contracting in service supply chains: a service
12 provider risk perspective. *Supply chain management*, 19(2), 153-172.
- 13 Selviaridis, K. & Spring, M. (2018) Supply chain alignment as process: contracting, learning and pay-for-
14 performance. *International journal of operations & production management*, 38(3), 732-755.
- 15 Selviaridis, K. & Van Der Valk, W. (2019) Framing contractual performance incentives: effects on supplier
16 behaviour. *International journal of operations & production management*, 39(2), 190-213.
- 17 Selviaridis, K. & Wynstra, F. (2015) Performance-based contracting: a literature review and future research
18 directions. *International journal of production research*, 53(12), 3505-3540.
- 19 Smith, J. (2018) *Defence Logistics: Enabling and Sustaining Successful Military Operations*. Kogan Page.
- 20 Sols, A., Nowick, D. & Verma, D. (2007) Defining the Fundamental Framework of an Effective
21 Performance-Based Logistics (PBL) Contract. *Engineering management journal*, 19(2), 40-50.
- 22 Sumo, R., Van Der Valk, W., Duysters, G. & Van Weele, A. (2016a) Using performance-based contracts
23 to foster innovation in outsourced service delivery. *Industrial marketing management*, 59, 12-24.
- 24 Sumo, R. A. F., Van Der Valk, W., Van Weele, A. J. & Bode, C. (2016b) Fostering incremental and radical
25 innovation through performance-based contracting in buyer-supplier relationships. *International
26 journal of operations & production management*, 36(11), 1482-1503.
- 27 Sumo, R. A. F., Van Der Valk, W., Van Weele, A. J. & Duijsters, G. M. (2016c) How incomplete contracts
28 foster innovation in inter-organizational relationships. *European Management Review*, 13(3), 179-
29 192.
- 30 Tidd, J. (2013) *Managing innovation : integrating technological, market and organizational change*. Fifth
31 edition. ed.
- 32 Weber, L. & Mayer, K. J. (2011) Designing Effective Contracts: Exploring the Influence of Framing and
33 Expectations. *The Academy of Management Review*, 36(1), 53-75.
- 34 Yin, R. K. (2018) *Case study research and applications : design and methods*. Sixth edition. ed.
- 35 Yoho, K. D., Rietjens, S. & Tatham, P. (2013) Defence logistics: an important research field in need of
36 researchers. *International Journal of Physical Distribution and Logistics Management*, 43(2), 80-
37 96.
- 38 Zimmermann, R., D.F. Ferreira, L. M. & Carrizo Moreira, A. (2016) The influence of supply chain on the
39 innovation process: a systematic literature review. *Supply chain management*, 21(3), 289-304.
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Table I. Details of the interviews from cases A and B

No.	Case	Organisation	Title	Duration of Interview
1	A	Commercial customer	Deputy Project Manager	Note-taking / ~80 minutes
2		Commercial customer	Head of Contracts Department	Note-taking / ~60 minutes
3		Operational customer	Senior officer	Note-taking / ~60 minutes
4		Provider	Case A Vice President	Recorded Interview / 66 minutes
5		Provider	Case A Procurement Director	Recorded Interview / 75 minutes
6		Provider	Case A Head of Contract Delivery	Recorded Interview / 53 minutes
7		Provider	Case A Head of Business Management	Recorded Interview / 64 minutes
8		Provider	Case A Contract Delivery Manager/ Sub-supplier A3	Recorded Interview / 56 minutes
9		Provider	Case A Sub-supplier A3 Coordinator	Note taking / ~60 minutes
10		Sub-supplier A1	Programme Executive	Recorded Interview / 72 minutes
11		Sub-supplier A2	Programme Manager	Recorded Interview / 63 minutes
12		Sub-supplier A3	Director of Engineering	Note-taking / ~60 minutes
13		Sub-supplier A3	Programme Manager	Note-taking / ~60 minutes
14		Sub-supplier A4	CEO	Recorded Interview / 61 minutes
15	B	Provider	Provider's Head of Business Management	Recorded Interview / 99 minutes
16		Provider	Case B Head of Manage Business	Recorded Interview / 133 minutes
17		Provider	Case B Head of Supply Chain	Recorded Interview / 90 minutes
18		Provider	Case B Executive Manager	Recorded Interview / 81 minutes
19		Provider	Case B Procurement Executive	Recorded Interview / 118 minutes
20		Sub-supplier B1	Service Solutions Manager	Recorded Interview / 43 minutes
21		Sub-supplier B2	Senior Manager	Note-taking / ~60 minutes

Table II Contract design and contract management codes and categories

Contract Design Codes and Categories			
Data Source	1 st Order Concept	2 nd Order Theme	Aggregate Dimension (informed by agency theory)
(Interviews, observation, secondary data)	Per use for mature products would align the interest of the customer, Prime and sub-suppliers.	Payment mechanism	Reduce goal incongruence
(Interviews, observation, secondary data)	Pain and gain would incentivise sub-suppliers to improve their products and services.		
(Interviews)	Cost plus opens the book, which affects confidentiality.		
(Interviews, secondary data)	Turnaround time contract with the service-offering sub-supplier to align both parties' goals but not perfect.		
(Interviews, observation, secondary data)	PBL contract with the sub-supplier contract is not always necessary to improve the service or product		
(Interviews)	Achievable bonuses would incentivise sub-suppliers to be innovative.	Financial incentive	
(Interviews, observation, secondary data)	Penalties only affect innovation decisions	Time-based incentive	
(Interviews, observation)	Short-term contracts are better for new products. They allow the prime contractor to understand the weapon systems without financial risk.		
(Interviews, observation)	Long-term contracts are better for mature products. They incentivise the prime contractor to invest.		
(Interviews, observation)	Contract duration needs to be aligned with the product life cycle.		
(Interviews, observation, secondary data)	The longer the contract under a pain-and-gain mechanism, the more money can be recycled into the weapon system.		
(Interviews, observation, secondary data)	The partnership and sub-supplier contracts need to be partnered too early so that the sub-suppliers can have full visibility.	Improve visibility	Reduce information asymmetry
(Interviews, observation, secondary data)	Engage sub-suppliers in the early phases of PBL drafting to help them understand customer requirements and pre-plan.		
(Interviews, observation)	Setting the mindset of the provider for a win-win approach is important to improve transparency and reduce information asymmetry.	Pick the right sub-suppliers	
(Interviews)	The categorisation is helpful in identifying sub-suppliers who are able to improve their services and sub-suppliers who require closer scrutiny.		
(Interviews, observation)	Contracting high reputed sub-suppliers will help improving the service and products.		

(Interviews, observation, secondary data)	Prime learns from prior experience would help avoid poor sub-suppliers which will affect innovation.		
(Interviews, observation)	Misalignment between PBL KPIs and sub-suppliers' KPIs would affect service improvements.	Proper SOW	
(Interviews, observation)	imposing KPIs on local companies could cause service deterioration		
(Interviews, observation)	Fewer stipulations can help sub-suppliers innovate.		
(Interviews, observation, secondary data)	SOW needs to be very clear and to reduce ambiguity as much as possible.		
Contract Management Codes and Categories			
Data Source	1st Order Concept	2nd Order Theme	Aggregate Dimension (informed by agency theory)
(Interviews, observation)	Maintaining high-failure items locally will help to reduce the repair cycle lead time.	Control the supply chain	Reduce outcome uncertainty
(Interviews, observation, secondary data)	Having control over the supply-chain network is important to improve the repair cycle.		
(Interviews, observation)	Being aware of surrounding challenges (e.g. politics, technological developments) will help sub-suppliers keep improving.	Improve visibility	
(Interviews, observation)	Increased transparency will help to reduce information asymmetry and improve knowledge-sharing.		
(Interviews, observation)	Integrated IS will improve knowledge- and information-sharing.		
(Interviews, observation)	Changing the relationship structure will help to improve the integration of the Prime and sub-suppliers.	Funding & Support	Integrate the Prime's and sub-suppliers' operations
(Interviews, observation)	Funding sub-suppliers to grow and invest is vital to improving their services and product quality.		
(Interviews, observation)	Social interaction can help teamwork and relationships and lead to improved service and reliability.	Having strong social interaction will help to promote a healthy environment	
(Interviews, observation)	Sustaining a good relationship with the Prime over a longer period would affect the service.		
(Interviews, observation)	Assuring sub-suppliers of future business relationships will motivate them to improve.		
(Interviews, observation)	Collaboration can help to identify challenges.	Coordination and collaboration between the Prime and sub-suppliers are vital to share knowledge and improving the service	
(Interviews, observation)	End-user coordination is just as important as back-end actors.		
(Interviews, observation)	Prime engaging in dual actions affects the relationship.		
(Interviews, observation)	Ensuring a good working environment can incentivise sub-supplier staff to be innovative.		
(Interviews, observation)	Training sub-suppliers would improve teamworking.		

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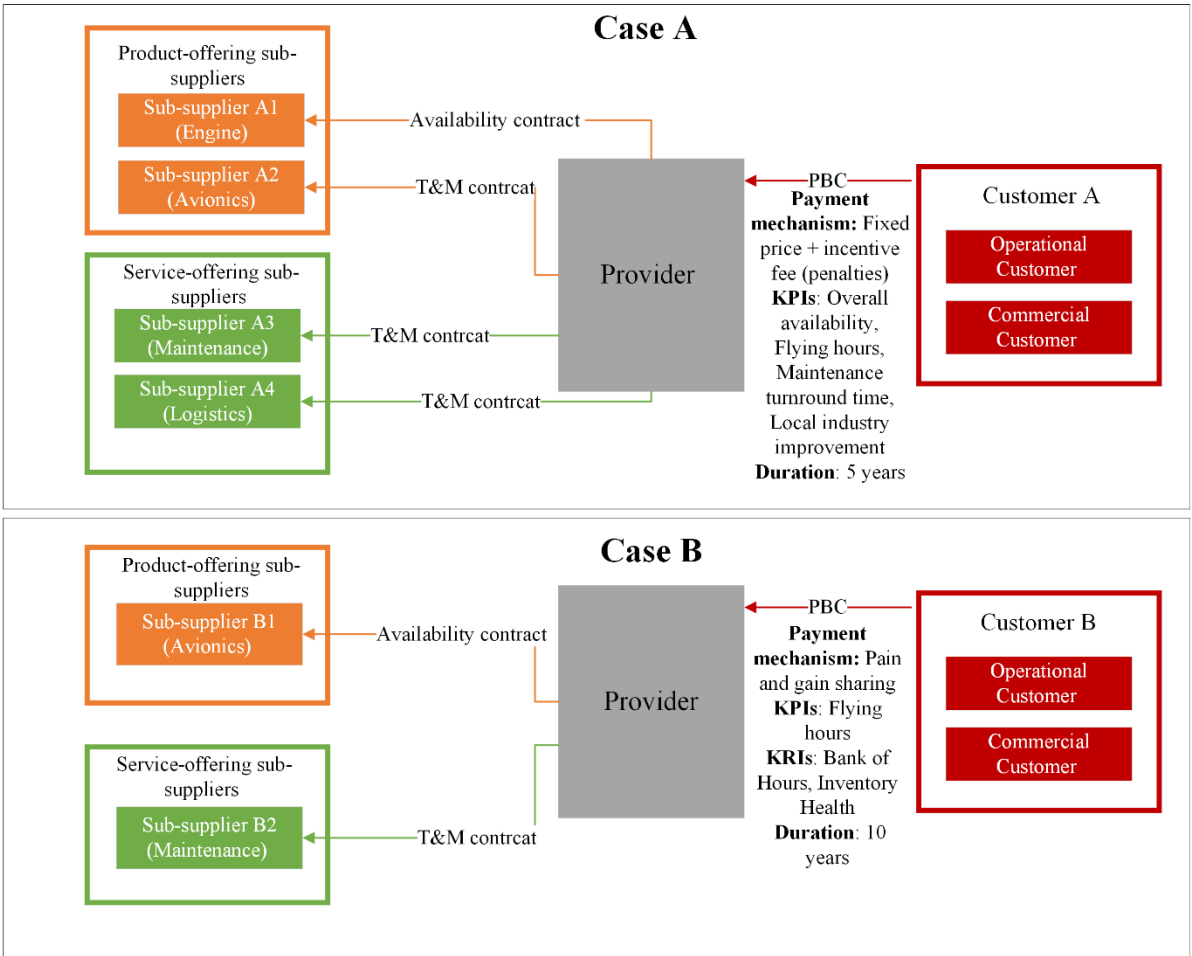
Table III. Sub-supplier contract design and management strategies

Contract Design Strategies										
Strategies	Sub-strategies	Key construct	PBL/A	PBL/B	Product-offering sub-suppliers			Service-offering sub-suppliers		
					Provider-Sub A1	Provider-Sub A2	Provider-Sub B1	Provider-Sub A3	Provider-Sub A4*	Provider-Sub B2*
Reduce goal incongruence	<u>Payment mechanism</u>	Pay-per-use – fixed price – cost plus – pain-and-gain effect on improvement	X	X	X	X	X	X	X	X
	<u>Financial incentive</u>	Bonuses' and/or penalties' effect on improvement		X	X	X	X	X	X	X
	<u>Time-based incentive</u>	Contract length affects investment decisions, which will lead to improvement	X	X	X	X	X	X	X	X
Reduce information asymmetry	<u>Improve visibility (Draft phase)</u>	Engage sub-suppliers in early phases of PBL drafting to help them understand customer requirements and pre-plan		X	X				X	
	<u>Reduce adverse selection</u>	Picking the right sub-suppliers will help to improve outcomes	X	X	X	X	X			
	<u>Statement of Work (SOW)</u>	Having a proper SOW will reduce information asymmetry	X	X	X	X	X	X	X	X
Contract Management Strategies										
Strategies	Sub-strategies	Key construct	PBL/A	PBL/B	Product-offering sub-suppliers			Service-offering sub-suppliers		
					Provide-Sub A1	Provide-Sub A2	Provide-Sub B1	Provide-Sub A3	Provide-Sub A4	Provide-Sub B2
Reduce outcome uncertainty	Localisation	Maintain high-failing products locally to reduce lead-times		X	X	X				
	Control the supply chain	Having control over the supply chain network is important to improve the repair cycle	X	X	X					
	Awareness of contract delivery challenges	Being aware of surrounding challenges (e.g. politics, technological developments) will help sub-suppliers keep improving	X	X						
	Increase transparency	Increased transparency will help to reduce information asymmetry and improve knowledge-sharing	X	X	X	X	X	X	X	X
	Share the right data	It is important that all actors share the same logic and are using the same measures.	X	X						
Integration	Scope and structure	Changing the company structure will help to improve integration of the Provider and sub-suppliers						X		
	Funding and support	Funding sub-suppliers to grow and invest is vital to improve their services	X	X	X	X	X			
	Social interaction	Having strong social interactions will help to promote a healthy environment	X	X	X	X	X	X	X	X
	Coordination and collaboration	Coordination and collaboration between the Provider and sub-suppliers is vital to sharing knowledge and improving the service	X	X	X	X	X	X	X	X

X: Indicates the sub-strategies were observed in the contracts under study (whereas a shadowed box indicates the sub-strategy was not observed)

*: Indicates the contract is between the provider and the provider's subsidiary.

Figure 1: Illustration of cases A and B



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and Production Manag

Figure 2: Research model - designing and managing sub-supplier contracts to foster incremental innovation in PBC

