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How intermediaries manage knowledge to support public procurement of innovation: The case of UK defence

Kostas Selviaridis [a,*], Elvira Uyarra [b]

[a] Department of Management Science, Lancaster University Management School, Bailrigg Campus, Lancaster LA1 4YX, United Kingdom
[b] Manchester Institute of Innovation Research, University of Manchester, Booth Street West, Manchester M15 6PB, United Kingdom

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ABSTRACT

We investigate how innovation intermediaries mobilise their knowledge management capacities to support public procurement of innovation (PPI). Prior research on PPI intermediation has highlighted various knowledge-intensive roles of intermediaries (e.g., as subject experts and trainers), but how exactly intermediaries are organised internally and how they operate to source, process, and transfer PPI-related knowledge remains elusive. We offer novel insights through a rich case study of intermediation in the UK defence context, where intermediaries are tasked with addressing gaps in innovation-oriented procurement knowledge and capabilities and help to improve procurement performance. We contribute to PPI intermediation literature by showing how intermediaries utilise their absorptive capacity and desorptive capacity to manage technical, commercial, and managerial knowledge in support of PPI implementation. We also extend the broader literature on innovation intermediaries by unveiling the organisational structures, processes, and routines underpinning the enactment of intermediary absorptive and desorptive capacities; and elucidating the distinctive nature of desorptive capacity in the context of innovation intermediation. We additionally demonstrate that intermediaries' absorptive capacity, rather than that of client organisations, creates value for intermediaries and their clients alike.

1. Introduction

Public procurement of innovation (PPI) is increasingly touted as a potential demand-side innovation policy tool (Edler and Georghiou, 2007; Aschhoff and Sofka, 2009) aimed at promoting innovations that address societal challenges (Edquist et al., 2015). Although research recognises the role of public procurement in stimulating innovation for the common good (Mazzucato, 2021), the implementation of PPI remains challenging (Uyarra et al., 2020). Public buying organisations, for instance, grapple with articulating their needs and designing innovation-friendly tenders and contracts (Georghiou et al., 2014; Selviaridis et al., 2023). Similarly, there is limited engagement, pre-procurement, between buyers and suppliers to explore problems and co-shape technological solutions accordingly (Selviaridis and Spring, 2022; Uyarra et al., 2014). These and other PPI implementation hurdles are well-documented and have been attributed, at least partly, to gaps in PPI knowledge and capabilities – for instance, limited knowledge of suppliers' technological capabilities and offerings and weak ability to craft specifications that encourage supplier-led innovation (e.g., Edler et al., 2015; Grimbert et al., 2024; Obwegeser and Müller, 2018; Rolfstam, 2013).

Innovation intermediaries, defined as a class of actors who connect demand and supply and support the innovation process (Holland et al., 2024; Howells, 2006), can help address PPI knowledge limitations. The literature on PPI intermediation has identified various roles and associated activities of innovation intermediaries in this respect. For example, intermediaries serve as "content experts" providing technological, market, and procurement expertise; "brokers" who connect buyers and suppliers and facilitate interactive learning; and "trainers" supporting capability development in PPI (e.g., Edler and Yeow, 2016; Selviaridis et al., 2023; Van Winden and Carvalho, 2019). These reported contributions of intermediaries, specifically in terms of compensating for PPI knowledge and capability gaps, are consistent with the broader innovation intermediation literature: intermediaries are knowledge-intensive organisations who add value by sourcing, processing, and transferring technical and managerial knowledge (De Silva et al., 2018; Holland et al., 2024).

Yet, we know little about how intermediaries organise themselves and how they operate to manage and transfer PPI-related knowledge. Specifically, the organisational structures, processes, and routines that

* Corresponding author at: Department of Management Science, Lancaster University Management School, Lancaster LA1 4YX, United Kingdom.
E-mail address: k.selviaridis@lancaster.ac.uk (K. Selviaridis).

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intermediaries deploy to perform their knowledge management and sharing roles in PPI remain elusive. Such a focus is imperative because knowledge residing in individuals is explicated (Nonaka, 1991) and institutionalised at the organisation level through structures, processes, rules and procedures (Crossan et al., 1999). As these are enacted repeatedly, they are internalised by managers (Nonaka and Takeuchi, 1995) and embedded in routines, defined as recurrent behavioural patterns of activity and cognitive regularities (Salvato and Rerup, 2011). Structures, processes, and routines are thus salient mechanisms that underpin the knowledge management capacities of intermediaries in general, and enable intermediaries to effectively support PPI in particular: while prior research has hinted at the criticality of intermediary structures, processes, and routines (e.g., De Silva et al., 2018; Van Winden and Carvalho, 2019), it has yet to analyse these elements systematically. This focus is also significant for policy, as it can increase our understanding of the inner workings of PPI intermediation and its effectiveness (Edler and Yeow, 2016), specifically in relation to supporting buyer knowledge and capability development.

To explore how intermediaries manage knowledge to support PPI implementation, we draw on the concepts of absorptive capacity and desorptive capacity. Absorptive capacity refers to organisational processes, routines, and structures embedding the ability to source, assimilate, transform, and exploit knowledge for innovation purposes (Zahra and George, 2002). Prior research has predominantly focused on the absorptive capacity that *client organisations* need to effectively collaborate with intermediaries and benefit from their services (e.g., Knockaert et al., 2014; Lin et al., 2016). However, the absorptive capacity of *intermediaries* themselves remains under-researched.

Equally crucial is desorptive capacity, understood as the ability to transfer knowledge to other organisations and reap benefits (Lichtenthaler and Lichtenthaler, 2009). This ability, embedded in various structures (e.g., dedicated technology transfer units), processes and routines, involves identifying knowledge transfer opportunities and supporting recipient organisations to apply such knowledge (Lichtenthaler and Lichtenthaler, 2010; Ziegler et al., 2013). The desorptive capacity concept is particularly relevant for intermediaries since their business models and activities are mostly based on inside-out (outbound) knowledge flows (Lichtenthaler, 2013) – for instance, facilitating technology transfer and providing expertise to their clients (Alexander and Martin, 2013; Howells, 2006). Yet, desorptive capacity has not been empirically studied in the context of innovation intermediation.

Building on Lichtenthaler (2013), we conceive of innovation intermediaries as organisations who mobilise both their absorptive capacity and desorptive capacity to tackle PPI knowledge shortfalls and add value while supporting PPI implementation. Our study offers novel insights into this dual capacity mobilisation, addressing the research question: *How do innovation intermediaries source, process, and transfer knowledge to support PPI implementation and add value?*

We study this issue in the UK defence context, where innovation-oriented procurement is challenging, not least due to knowledge and capability limitations. Innovation is imperative for the UK Ministry of Defence (MoD) given the elevated role of quantum computing, cyber, space, and Artificial Intelligence (AI) technologies in contemporary defence and security operations (HM Government, 2023). The latest Strategic Defence Review (SDR) reconfirmed the UK Government's aim to self-sufficiently develop and source technological innovations (MoD, 2025a). Such technology sovereignty (Edler et al., 2023) is pertinent in defence. Beyond investing in new technologies, the MoD must be able to respond fast to the evolving needs of the Armed Forces (HM Government, 2021; MoD, 2025b). The Ukraine war has been a stark reminder of the need to continuously upgrade military capabilities. In this sense, innovation is not an MoD goal per se, but rather a means to fulfil military end users' needs.

Defence procurement is critical for sourcing technological innovations. The MoD's 2023–2033 defence acquisition plan has allocated circa £288 billion for the procurement of new equipment (House of Commons Public Accounts Committee, 2024), while the recent SDR sets aside 10 % of the annual procurement budget for the integration of latest technologies (MoD, 2025a). However, MoD procurement has faced longstanding criticism regarding its ability to deliver new equipment and solutions on time and within budget (House of Commons Defence Committee, 2023; House of Commons Public Accounts Committee, 2021). Seeking to address challenges in specification-setting, contracting, and early supplier engagement, the MoD has used intermediaries. We empirically study a key intermediary, hereafter referred to as Alpha, that the MoD contracted to support defence procurement. Our case-based research offers rich insights into Alpha's knowledge management capacities and approach.

Our study makes several key contributions. First, we advance research on PPI intermediation by showing how intermediaries mobilise their absorptive capacity and desorptive capacity to manage and share PPI-related knowledge, extending beyond the knowledge-intensive roles previously identified (e.g., Edler and Yeow, 2016). Second, we contribute to the literature on innovation intermediaries (e.g., Lichtenthaler, 2013) by uncovering the organisational structures, processes, and routines that enable intermediaries' absorptive and desorptive capacities, whilst elucidating the distinctive nature of desorptive capacity within intermediaries. Third, we challenge the prevailing focus on clients' absorptive capacity (e.g., Lin et al., 2016) by demonstrating how intermediaries' absorptive capacity creates value for intermediaries and their clients alike.

2. Theoretical background

2.1. Intermediation in public procurement of innovation

Public procurement of innovation (PPI) has evolved from early conceptualisations focused on "public technology procurement" (Edquist and Hommen, 2000) to become recognised as a multifaceted demand-side innovation policy instrument designed to stimulate, develop, and acquire innovative solutions that address societal challenges (Edler and Georghiou, 2007; Mazzucato, 2021). This expanded understanding of PPI encompasses multiple dimensions, rationales, and potential innovation impacts that extend beyond purely technological innovation including, for example, process and organisational innovations that improve the delivery of public services (Edler and Georghiou, 2007; Uyarra and Flanagan, 2010).

Research has examined PPI implementation (Uyarra et al., 2020), identifying key barriers such as limited buyer-supplier interactions; weak articulation and signalling of needs; limited knowledge of supply markets and technologies; and specification and contracting approaches discouraging innovation (Georghiou et al., 2014; Uyarra et al., 2014). Innovation intermediaries can help address these implementation issues by compensating for PPI knowledge limitations (Edler and Yeow, 2016). Empirical research on PPI intermediation has shown that intermediaries offer technology and supply market expertise and help buyers and end users to articulate their needs and specify their requirements (Boon et al., 2011; Edler and Yeow, 2016). In the context of the circular economy transition, for example, intermediaries facilitate buyer-supplier interactions, pre-procurement, to aid specification-setting tasks (Rainville, 2021). Intermediaries thus broker connections and enable conversations, both within the buying organisation, and with suppliers, which lead to informed definitions of problems and needs, and solution co-creation (Van Winden and Carvalho, 2019). They also help shape markets, for instance by helping to reframe needs and specifications of requirements in a way that creates new possibilities for technological solutions and suppliers (Miller and Lehoux, 2020; Selviaridis and Spring, 2025).

Intermediaries consult on tendering and contracting approaches and can even perform procurement tasks on behalf of buying organisations (Edler and Yeow, 2016). They also educate buyers and suppliers on

innovation procurement and adoption aspects, thereby helping to build PPI capacity (Selviaridis et al., 2023). Despite its benefits, PPI intermediation presents risks and limitations: innovation intermediaries can be seen as "outsiders" who potentially compromise value for money and may lack legitimacy and authority to realise the required institutional and procedural changes (Klerkx and Leeuwis, 2008; Selviaridis et al., 2023). Furthermore, outsourcing procurement to for-profit intermediaries can contribute to the erosion of buying organisations' capabilities in the long run, and lead to the loss of public sector knowledge and capacity more broadly (Mazzucato and Collington, 2023).

Notwithstanding these limitations, research on PPI intermediation shows that intermediaries leverage their specialist knowledge to support buyers and suppliers and add value. However, it remains little understood how intermediary organisations source, process, and share knowledge to support PPI, and what the relevant organisational mechanisms at play are. To frame our study of the knowledge management capacities of intermediaries, we synthesise the broader literature on innovation intermediation (e.g., Bessant and Rush, 1995; De Silva et al., 2018; Holland et al., 2024) with prior knowledge management research.

2.2. Innovation intermediaries and knowledge management

Innovation intermediaries add value to innovation development and diffusion processes primarily through knowledge management: they source and process knowledge and generate new knowledge, also by recombining internal and external knowledge sources (Howells, 2006; De Silva et al., 2018). In addition, intermediaries transfer knowledge to relevant actors, including buyers and suppliers (Van Lente et al., 2003; Kivimaa, 2014; Rainville, 2021). This knowledge intensity and knowledge management capacities are indeed common characteristics across various types of innovation intermediaries such as research and technology organisations (RTOs), user-oriented intermediaries supporting demand articulation processes, providers of knowledge-intensive business services, and intermediaries facilitating sustainability "transitions" (Bessant and Rush, 1995; Boon et al., 2011; Howells, 2006; Kivimaa et al., 2019). De Silva et al. (2018), for instance, examine the knowledge management practices of RTOs. In this context, knowledge residing with intermediaries' employees and external collaborators as well as the ability to grasp and shape knowledge in innovation ecosystems help to create value within intermediaries (ibid.).

Effective management and sharing of knowledge between innovation intermediaries and their clients requires absorptive capacity from both sides (Knockaert et al., 2014; Lichtenthaler, 2013). Absorptive capacity is key to innovation as prior technological and market knowledge enables organisations to recognise the value of external knowledge and assimilate and use it to innovate (Cohen and Levinthal, 1990; Lichtenthaler and Lichtenthaler, 2010). Zahra and George (2002) identify four key elements of absorptive capacity: a) knowledge acquisition, referring to identification and sourcing of external knowledge, b) knowledge assimilation, through analysis, interpretation and comprehension activities, c) knowledge transformation, which involves synthesis and recombination of various knowledge sources, and d) knowledge exploitation, referring to knowledge implementation and use.

Research on innovation intermediaries has focused predominantly on the absorptive capacity that client organisations must possess to work with intermediaries and reap innovation benefits. Knockaert et al. (2014), for instance, show that a higher level of client firm absorptive capacity leads to intensified intermediary interactions, which in turn increase the client firm's scope and depth of knowledge. Overall, existing studies suggest that client firms' absorptive capacity determines their innovation performance when collaborating with intermediaries (Lin et al., 2016; Lichtenthaler, 2013). In this sense, intermediaries' knowledge management activities are complementary to those of their clients. This research stream has paid much less attention, however, to the absorptive capacity of *intermediaries* – yet intermediaries clearly require this capacity to be able, for example, to acquire knowledge by screening supply markets for technology (Knockaert et al., 2014) and to exploit knowledge internally by developing new sets of expertise and capabilities (De Silva et al., 2018).

Furthermore, prior literature has largely neglected intermediaries' desorptive capacity: the structures, processes and routines underpinning the ability to externally exploit knowledge by transferring it to recipient organisations (Lichtenthaler and Lichtenthaler, 2009). Lichtenthaler and Lichtenthaler (2010) define desorptive capacity as comprising two key components: a) identification of knowledge transfer opportunities, which involves identifying both possible knowledge recipients and profitable knowledge applications, and b) knowledge application support to recipient firms e.g., through relationship-building and collaboration with recipients and facilitation of knowledge implementation. In contrast to absorptive capacity, which reflects outside-in knowledge flows, desorptive capacity concerns inside-out flows of knowledge, whereby organisations seek to externally exploit their technological assets (Ziegler et al., 2013). Desorptive capacity was originally applied to study, among other topics, patent licensing and the commercialisation of internally developed technologies (e.g., Dezi et al., 2018; Van Dorren et al., 2022). Ziegler et al. (2013), for example, used a desorptive capacity perspective to study external exploitation of patents in the pharmaceutical industry. They identified three distinct modes of patent out-licensing linked to varying levels of firm desorptive capacity in terms of organisational structure suitability, locus and maturity of exploitation initiatives, and intensity and longevity of knowledge transfer.

Desorptive capacity is relevant for intermediaries since they support technical and managerial knowledge transfer (Alexander and Martin, 2013). Lichtenthaler (2013) has conceptually argued that intermediaries require both absorptive capacity and desorptive capacity to support knowledge acquisition and technology transfer activities of their clients. However, there is hitherto no empirical research on intermediaries' desorptive capacity.

A focus on the absorptive and desorptive capacities of intermediaries is especially pertinent in the context of PPI intermediation. This is because it enables zooming in on the underlying structures, processes, and routines that intermediaries mobilise to perform their knowledge-intensive roles, for example as subject experts and educators (Edler and Yeow, 2016; Selviaridis et al., 2023). While the importance of these organisational elements is implied in the literatures on PPI intermediation and on innovation intermediaries, they have not been the focus of analytical attention. PPI intermediation studies (e.g., Edler and Yeow, 2016; Van Winden and Carvalho, 2019) focus on intermediaries' *roles* and *activities*, even though they describe the relevance of programme teams, management roles, processes for designing challenge competitions, and routines for producing technical manuals. Similarly, De Silva et al. (2018) emphasise knowledge-based *practices*, despite showing that dedicated units and project-based teams, processes for exploring external knowledge, and routines for team learning matter for sourcing and processing knowledge. Our empirical study advances this prior research by shining a spotlight on structures, processes, and routines, as the organisational mechanisms that enable intermediaries to bridge PPI knowledge gaps.

3. Method

Empirical research on how innovation intermediaries manage knowledge to support PPI is scarce. We therefore adopted a qualitative, case-based research approach (Yin, 2009). The case method allowed us to explore intermediary structures, processes, and routines in context (Goffin et al., 2019) and understand how intermediaries enact their absorptive and desorptive capacities to source, process, and transfer PPI knowledge.

We studied the contribution of innovation intermediaries in the UK defence context, where knowledge and capability shortfalls in relation

to innovation-oriented procurement persist (Selviaridis and Spring, 2025). Key issues pertain to the articulation of needs and specification-setting; contracting expertise; and buyer-supplier interactions, pre-procurement (Brooke-Holland, 2019; HM Government, 2021). These longstanding challenges mean that defence procurement sometimes performs below par in terms of cost, quality, and timeliness (House of Commons Defence Committee, 2023). Delays in introducing new equipment force the MoD to extend the life of ageing systems to ensure continuity of military operations, thus exacerbating cost inefficiencies and readiness issues.[1] These persisting performance issues have fuelled criticism that UK defence procurement is a "broken system" (House of Commons Defence Committee, 2023). To address some of these knowledge and performance shortfalls, the MoD has sought external support from innovation intermediaries.

We employed a single-case research design (Yin, 2009) and selected Alpha, following a criterion sampling approach (Patton, 2002), because it was, at the time, the only intermediary used by the MoD. A single-case design is suitable when the case is "extreme" i.e., presents rare or unusual characteristics that are important for explaining the phenomenon under study (Yin, 2009). Two characteristics make Alpha an extreme case of PPI intermediation. First, Alpha intermediated between a single, large buyer and multiple defence suppliers, meaning that it fully customised its knowledge management approach to meet the complex, defence-specific requirements of the MoD. By virtue of the defence market structure (monopsony), the MoD is a sole buyer and user of defence-specific technological innovations. Second, the MoD opted to use only Alpha's services because it was an extensive, partnership-based organisation involving all large defence suppliers and other important expert entities, whom the intermediary was drawing knowledge inputs from during its projects. The MoD thus had a vested interest in Alpha's success and supported it, as evidenced for instance by the close engagement of MoD senior decision makers with the intermediary's core management team.

A single-case design was essential for achieving the depth of analysis required to uncover detailed organisational structures, processes, and routines—insights that would be difficult to capture with the breadth necessary for multiple-case comparison, particularly given the scarcity of comparable intermediaries (e.g., serving a single buyer). We assessed and verified case "success" using two main indicators: a) intermediary contribution to PPI effectiveness, as evidenced by more intelligent specifications, cost avoidance or reduction benefits, and faster procurement and pull-through of innovations, and b) the value that Alpha created for the MoD and its suppliers more widely, for instance with respect to MoD learning and supplier increased understanding of the buyer's (future) needs and requirements.

Data access constraints owing to the sensitive nature of defence procurement make this setting challenging to study. Leveraging our contacts, we were given the opportunity to research in detail Alpha and its contractual relationship with the MoD until 2018, when the latest Alpha contract ended. After a service gap of three years, in 2021, the MoD decided to replace Alpha with a competing contractor, the Futures Lab. Our case study thus reports on a past period, but the generated insights are contemporary and highly relevant: during the re-tendering process the MoD sought an intermediary who could retain many of Alpha's structures and operating principles, which the replacement contractor has indeed done.[2] This is additional testament to the fact that Alpha was regarded by key stakeholders within the MoD as a successful example of intermediation.

3.1. Data collection

We collected data between 2018 and 2021 through a combination of semi-structured interviews and the gathering and review of organisational documents and other secondary data sources (refer to Appendix A). We conducted 18 interviews with Alpha senior staff (Managing Director, Technical Director, Delivery Director, and Programme and Project Leads); MoD-Alpha Liaison staff; the Innovation Lead within the Defence Equipment & Support (DE&S), which is the MoD's procurement unit; military end users (e.g., Royal Air Force); and representatives from supplier firms. We developed an interview guide which we used flexibly to accommodate the organisational context and interviewee role. Key themes included Alpha's business model, organisational structure, knowledge management and enabling structures and processes, and support provided to MoD clients. Most interviews were audio recorded and fully transcribed amounting to 289 pages of transcription text. In the three instances where interviewees did not consent to audio recording, we took detailed notes to ensure data completeness and accuracy.

The interview data was triangulated through the review of 69 documents (see Doc #1 to #69 in Appendix B) amounting to over 1270 pages of text – these included 30 organisational documents such as Alpha's presentations and reports; and 39 sources of publicly available secondary data including MoD case studies of Alpha projects. These two types of documents helped to triangulate (Jick, 1979) and complement interviewee accounts of knowledge management and understand in detail Alpha's structures, routines, and processes, for instance regarding MoD decision support and project management. Documents incorporating defence suppliers' views and reflections were also critical for augmenting supplier respondents' accounts. The triangulation of interviewee accounts with substantial, rich documentary evidence, coupled with our strategy to speak to multiple managers from various organisations (i.e., intermediary, MoD, and suppliers), ensured that we minimised possible interviewee retrospective sensemaking and selective recall biases (Golden, 1992).

3.2. Data coding and analysis

We coded and analysed the qualitative data following Gioia et al. (2013). We initially developed a set of first-order codes using open coding (Strauss and Corbin, 1990). These codes captured relevant structures, processes, and routines for intermediary knowledge management, reflecting closely the terms used by research participants or found in documents. For example, the interview quote "*Underpinning everything that we do is a very good intellectual property […] the MoD owns the foreground, it doesn't own the background because that's been acknowledged as being the background IP and owned by company X, Y and Z*" was coded "Alpha IPR structure". Similarly, we coded the document excerpt "*In specific instances the Alpha intellectual capital is strategic and systemic in nature; in such cases the material is issued as a white paper*" as "routine of producing publications on systemic issues". In this sense, while our first-order codes were mainly inductive they still related to prior knowledge management literature, which highlights structures, processes, and

[1] Recent high-profile examples of delayed introduction of new equipment include the Ajax armoured vehicles and the next-generation British Army communications system known as Morpheus. In both cases, the delay has resulted in costly life extensions of existing systems and sub-optimal military capabilities (Sheldon, 2023; Financial Times, 2024).

[2] The Futures Lab is an intermediary organisation ran by the Aurora Engineering Partnership – an alliance between defence suppliers QinetQ, Atkins and BMT. The Futures Lab has retained many of Alpha's original features such as the partnership-based organisational structure (over 180 suppliers and expert entities participate in the Futures Lab); a commercially neutral hub for collaborative innovation; an emphasis on pan-industry assessment of requirements and technological solutions; and the production of knowledge which is directly relevant to MoD acquisition decisions (Global Defence Technology, 2021; QinetiQ, 2024).

Table 1
Data coding categories.

Aggregate dimensions	Second-order themes	First-order codes
Intermediary absorptive capacity for PPI support	**"Intermediary knowledge acquisition"** (identifying and sourcing external knowledge) **"Intermediary knowledge assimilation"** (analysing, interpreting and comprehending external knowledge) **"Intermediary knowledge transformation"** (synthesise and recombine internal and external knowledge sources)	-Partnership-based organisational *structure*: member organisations as source of knowledge -Alpha projects as *structure* for sourcing the right expertise sets -"Decision Support (DS)" *process* (why and what steps) determines external knowledge needs -"Project Management (PM)" *process* (start-up and initiation stages) defines the requisite expertise -Recruitment *routine* to form the project team -Experimentation and demonstrators through projects (*structure*): analysis and comprehension of possible solutions -"Select approach and techniques" stage in DS *process*: suitable methods and tools to analyse and process the sourced knowledge -"Project execution" stage in PM *process*: mid-point reviews and team meetings to interpret and understand project results -"Assurance" *routine* to review project results and guide further work -"Intellectual Capital" as an Alpha *structure* for reusing and building on existing knowledge
	"Intermediary knowledge exploitation" (use and implementation of knowledge by the intermediary)	-Knowledge and Benefits Manager job role (*structure*): helping to identify and re-use existing knowledge -From projects to programmes (*structure*): building on existing knowledge and recombining it with new insights from projects -Alpha intellectual property rights (IPR) *structure* enables knowledge synthesis and recombination - Technical Director job role (*structure*): part of the role is knowledge management, including to consolidate, codify and exploit knowledge within the Alpha partnership. -Execute stage in the DS *process*: using knowledge from projects to create "artefacts" for clients e.g., reports (driving revenue generation) -Repository (*structure*) of generic approaches, methods and tools/ techniques for managing collaborative innovation projects -*Routine* of producing publications on systemic issues (positioning efforts)
Intermediary desorptive capacity for PPI support	**"Intermediary identification of knowledge transfer opportunities"** (identifying possible recipients and knowledge application domains)	- Delivery Director job role (*structure*): identifying possible problems and solution application areas and map the relevant MoD stakeholders -PM and DS *processes* define the scope of problem and expected evidence requirements by client unit within MoD -Engagement *routine*: deep engagement with problem owners and key decision makers within MoD -Impartial evaluation *routine*: cross-industry, objective view of problems and possible technological solutions
	"Intermediary support for knowledge application" (building relationships within client organisation and facilitating knowledge implementation by clients)	-Relationship-building *routine* to work closely with key MoD decision makers with authority and willingness to exploit Alpha outputs. -Implementation support *routine* to aid MoD clients to put knowledge into use during procurement -"Benefits Management" *process*: defining client exploitation of outputs and long-term benefits for client from Day 1 of projects - "Knowledge and Benefits Manager" job role (*structure*): helps to define client end-benefits arising from project outputs and outcomes

routines as organisational elements underpinning knowledge creation and institutionalisation. During this step, we also analysed examples of R&D and demonstration projects that Alpha initiated on behalf of various MoD client units. This helped us to understand how the intermediary's knowledge management contributed to MoD procurement decisions.

Our coding progressively moved from these largely inductive, first-order codes to higher-level categories, as we began to iterate more systematically between our data and relevant literature (Dubois and Gadde, 2002). Specifically, we decided to draw on the concepts of absorptive capacity and desorptive capacity when it became apparent that these fitted the observed intermediary processes, routines, and structures for knowledge management. Indeed, existing literature operationalises absorptive and desorptive capacity in terms of structures, processes and routines (Zahra and George, 2002; Lichtenthaler and Lichtenthaler, 2009). This coding approach was also in keeping with Lichtenthaler's (2013) view of intermediaries' possessing both absorptive capacity and desorptive capacity.

We therefore employed axial coding (Strauss and Corbin, 1990) to reorganise codes according to the constituent elements of the absorptive capacity and desorptive capacity concepts. For example, we linked the first-order codes "Partnership-based structure: member organisations as source of knowledge" and "Recruitment routine to form the project team" to the second-order theme "intermediary knowledge acquisition", one of the four elements of absorptive capacity (Zahra and George, 2002). Similarly, we grouped the first-order codes "engagement routine", "impartial evaluation routine", and "Delivery Director job role" to the second-order theme "intermediary identification of knowledge transfer opportunity", a conceptual component of desorptive capacity (Lichtenthaler and Lichtenthaler, 2010). We followed this approach to generate second-order themes for each element of absorptive capacity and desorptive capacity. We finally linked the second-order themes to "intermediary absorptive capacity for PPI support" and "intermediary desorptive capacity for PPI support", as aggregate dimensions. Table 1 shows our coding structure. Appendix C displays multiple indicative quotes from interviews and documents assigned to first- and second-order codes.

4. Case analysis and findings

We first describe Alpha and its structures, processes, and routines, and subsequently analyse how the intermediary sourced, processed, and transferred knowledge to its MoD clients to support PPI decisions. The analysis is informed by the concepts of absorptive capacity and

Table 2
Examples of Alpha projects and related innovations.

Project	Alpha activities and outcomes	Actors involved
Future ground search solutions	Alpha was tasked with identifying suitable sensor technologies used to detect ground threats (e.g., bombs). The project involved R&D in multiple technologies and assessed options for standardisation across a range of products. The study identified 14 sensor technologies, out of which five were found infeasible to adopt. The assessment also identified opportunities to integrate medium-range stand-off equipment with unmanned air systems equipped with ground search sensors. The project also examined the requirements for integrating such technologies into Army's operating procedures and identified ways to reduce training needs and logistical burden. Five solutions qualified for further consideration, helping the MoD to understand better viable solution options and their performance potential. **This understanding informed specification-setting; avoided costs; and reduced the risk of delay in the initial approval stages of the procurement process**.	British Army decision makers; DE&S; suppliers of various sensor technologies; Alpha project team
Army operations control room training solutions	Alpha organised and coordinated experimentation and simulation activities to define requirements and assess technological solutions for a visual solution for training soldiers in the Operations Control room. The end-user requirements were tested and refined through multiple mock-ups. Concept demonstrators were then set up to test two promising solutions (web-based and a 3D virtual environment). The web-based solution was subsequently tested for integration into Army's legacy IT systems. **The procurement was thus de-risked, and the solution was adopted fast and deployed in a timely fashion in foreign MoD operations.**	British Army senior officers; end-users (soldiers); simulation software solution providers; Alpha project team
Ground-based air defence systems	Alpha was asked to help inform the development of systems requirements for a new solution that integrates ground-based radars with a ground defence system and an interceptor missile system. Alpha worked closely with military end users to identify requirements, validate working assumptions and develop a preliminary assessment of the new system architecture using operational analysis techniques. It subsequently conducted research into requirements for integrating the new system e.g., user training and recruitment of new personnel. **The project improved MoD's understanding of issues** related to radar and missile system performance as well as safety aspects. In turn, **this understanding informed the development of specifications as part of the procurement process. It also accelerated contract award and solution implementation (30 months in total).**	MoD Ground Air Defence and Surveillance Programme team; relevant suppliers; Alpha project team
State-of-the-art submarine combat systems	Alpha developed a new approach (operating model) for the procurement of upgraded submarine combat systems to ensure Royal Navy protection against contemporary and future threats. As opposed to the current model, the new procurement approach required buy-in and collaboration among all supply chain tiers (from prime contractor to small suppliers). Alpha held workshops with all stakeholders to identify barriers in the current model, and this knowledge was used to develop a set of principles and policies to underpin the new procurement approach. The approach was visualised to reduce complexity and was subsequently tested, refined and validated jointly with all stakeholders. **The new, collaborative procurement approach enables faster acquisition and integration of software into submarines via agile/iterative development and testing of solutions jointly with the supply chain. This approach can also increase the end users' involvement in specifying software requirements.**	DE&S (submarine combat group); DSTL; Royal Navy Command; suppliers; Alpha project team

desorptive capacity, the theoretical lenses we adopted. We also analyse and evidence the value that the intermediary created through its knowledge management activities.

4.1. Overview of Alpha

Alpha was contracted by the MoD to support decision-making regarding the definition, development and acquisition of new equipment and services that the UK Armed Forces use. The intermediary was originally framed as a "partnership", modelled on the US defence collaborative innovation approach: it comprised member organisations from multiple MoD departments (e.g., military end-users, procurement, and R&D), large and small defence suppliers, universities, and expert entities such as consultancies (Alpha Doc #5 and #7). Alpha was operationally led by one of the large UK defence suppliers who, akin a prime contractor, coordinated partners and provided physical infrastructure and management systems.

Alpha operated on a for-profit basis and generated revenue based on an annual fixed price plus a variable fee paid by the MoD to fund specific Alpha projects. The variable fee was capped to an agreed maximum per contract period. During its latest contract term, Alpha completed more than 240 projects involving experimentation, R&D and technology demonstration related to innovations that the MoD had been considering (Alpha Doc #1). The typical Alpha project commenced with a question or problem facing an MoD client unit. Each project was preliminarily assessed by Alpha's senior management team. It was subsequently executed by Alpha managers along with suitable experts recruited from partner organisations such as defence suppliers, MoD end users, and technology specialists. Table 2 provides indicative examples of Alpha projects focusing on specific innovations.

The projects generated technical, commercial, and managerial knowledge that the MoD then used to inform its procurement activities. Examples include insights into new technologies and knowledge inputs of market specialists and end users that directly fed into MoD procurement-related decisions (MoD Doc #16 and #33–35), notably a) articulation or refinement of military needs, b) specification of solution requirements, c) assessment of technological solution options, including requirements for solution integration within existing MoD service processes and capabilities, and d) procurement and contracting methods.

Table 3
Alpha organisational structure and key management roles.

Organisation structure	Key job roles
Senior leadership team	**Managing Director:** overall responsibility for strategy and leadership and involvement in decisions regarding project initiation; close engagement with senior MoD decision-makers and MoD client units. **Delivery Director:** responsible for engaging with MoD client units to shape and initiate projects; participation in recruiting experts to projects; supporting MoD clients to implement the project-generated outputs/knowledge to realise benefits in terms of innovation procurement and adoption. **Technical Director:** responsible for selecting appropriate approaches and tools/methods that Alpha project teams use to tackle the MoD client questions or problems; responsible for ensuring high-quality project delivery and outputs (assurance function); participation in recruiting experts to projects and developing repositories of knowledge (e.g., Generic Approaches and white papers).
Middle management (under leadership team)	**Head of Finance:** responsible for intermediary finance and accounts and related financial decisions **Knowledge and Benefits Manager:** supporting Alpha project teams and MoD client units to define end-benefits arising from projects and their outputs; directing project teams to existing sources of knowledge, held in the intermediary's Intellectual Capital (knowledge base). **Portfolio Manager:** overseeing the portfolio of Alpha projects and programmes across multiple MoD application domains. **Chief Architect and Chief Analyst:** responsible for development and application of technical methods and analytical techniques during projects
Programme- and project-specific funded roles	**Commercial Managers:** supporting commercial decisions of the intermediary, executing sourcing tasks and managing the MoD contract. **Accounting and Finance Managers:** supporting project accounting and finance and invoice management **Cyber Lead:** delivering cyber capability related programme **Intelligence Lead:** leading programme regarding intelligence solutions **Air systems Lead:** delivering programme focusing on air defence solutions **C4ISR Lead:** leading the programme of work on C4ISR solutions **Ad-hoc Project Leads:** responsible for delivering Alpha projects in other areas
MoD-Alpha Liaison team	**Project Support Managers:** providing technical and IT support to projects **MoD-Alpha Liaison Manager:** managing contractual relationship between MoD central and Alpha; ensuring alignment of goals, coordination and collaboration. **Senior Military Advisors:** providing inputs into Alpha projects/programmes to ensure that they are relevant to defence context and MoD's technology and innovation needs; coordination with MoD's R&D unit (DSTL).

4.2. Alpha's organisational structures, key processes and routines

Alpha employed around 40 people (Alpha Doc #6), including a leadership team of over 20 senior managers (e.g., Delivery Director, Technical Director and MoD-Alpha Liaison team) and middle managers (e.g., Knowledge and Benefits Manager and Project Support Managers). These management roles were funded through the annual fixed fee paid by the MoD. Table 3 outlines the organisational structure and key job roles within Alpha. The structure of Alpha largely reflected the project-based nature of the organisation – specifically, the need to provide suitable expertise, ensure the delivery of high-quality project outputs, and engage with MoD project champions and military end users. Job roles focusing on specialist domains (e.g., air systems, cyber, and intelligence) were funded through revenue generated by Alpha projects or emerging programmes (Alpha Doc #2 and #18). The latter referred to a series of projects that had, over time, been grouped together owing to their overlapping focus on a specific technology or MoD application area. The "Knowledge and Benefits Manager" role ensured that knowledge and intellectual property (IP) accumulated through prior projects and ongoing programmes could be called upon and potentially re-used, as and when appropriate.

Project-based collaboration between a diverse set of actors was enabled by Alpha's custom-made IP rights structure – this recognised and protected any "background IP" that suppliers and other partner organisations contributed to a project, while assigning any knowledge and IP generated by the project ("foreground IP") to the MoD, with the possibility for such project-specific IP to be licensed back to suppliers. The knowledge and IP generated by projects was systematically recorded, stored, and shared within the intermediary in a centralised online repository called the "Collaborative Working Environment" (Alpha Doc #17). This was a collection of project-specific websites and a technical library containing the knowledge outputs and the foreground IP that projects generated. Alpha staff collectively referred to these knowledge stocks – residing in individual experts, partner organisations and the intermediary's IT system – as the intermediary's "Intellectual Capital" (Alpha Doc #4).

Alpha was also relying on a set of organisational processes and routines to execute projects and manage and transfer the generated knowledge to its MoD clients (Table 4). Alpha's key processes pertained to project management and client (MoD units) support to realise benefits arising from Alpha's projects and make informed procurement decisions. These processes were formally defined by Alpha staff and codified in Alpha literature (e.g., Alpha Doc #4 and #5). Alpha also relied on a set of operating routines e.g., for recruiting experts to projects, providing technical assurance, engaging with MoD decision-makers and end users, and supporting them to use knowledge to inform the procurement process. These routines were largely reflected in Alpha's operating principles such as "independent assurance", meaning that technical guidance and ongoing monitoring of projects was available; "engagement" (with relevant MoD stakeholders, suppliers and other experts); and "exploitation" of project outputs so that the generated knowledge could be applied within the MoD.

Two key Alpha processes – "Decision Support" and "Project Management" – were linked to stocks of knowledge that the intermediary had developed specifically for managing collaborative innovation projects. For instance, the third stage of the Decision Support process "select approach and techniques" was linked to Alpha repositories of a) available technical approaches (e.g., experimentation, sprints, demonstrators) that project teams could choose to employ in a specific project, and b) a suite of methods to visualise project outputs to facilitate knowledge application by clients. These repositories were known as the "techniques selection matrix" and "visualisation matrix", respectively. Similarly, the "start-up" and "initiation" stages of the Project Management process were supported by Alpha's "Generic Approaches", a knowledge repository which mapped types of projects to suitable technical approaches (Alpha Doc #4). These stocks of codified knowledge were readily accessible to project teams. Alpha projects also generated insights regarding wider, systemic challenges facing the defence innovation and procurement communities such as over-specification of requirements and inflexible budgeting and contracting methods. This systemic knowledge was captured in Alpha publications ("white papers" and "technical insights"), as the intermediary's senior staff developed a habit of producing such reports (e.g., see Alpha Doc #23–27).

4.3. Intermediary absorptive capacity for PPI support

Certain intermediary structures, processes, and routines enabled the acquisition, assimilation, transformation, and exploitation of PPI

Table 4
Alpha organisational processes and routines.

Key concepts	Brief description
Alpha processes	**Decision Support:** made up of five stages ("Determine decision for support"; "Define evidence requirements"; Select approach and techniques"; Develop approach"; and "Execute and Review"). The process sought to define a set of activities and procedures for the delivery of client projects. It also specified key inputs and outputs per stage e.g., knowledge requirements and client stakeholder engagement. **Project Management:** consists of four stages ("Start-up"; "Initiation"; "Execution"; and "Closure"). The process served as a guide for project leads and teams regarding the typical lifecycle of Alpha projects and related activities. It also specifies decision points (e.g. project initiation and execution "gates") and review points (e.g., mid-point review and client exploitation meeting). **Benefits Management:** this process seeks to ensure that Alpha projects and their outputs translated into tangible end-benefits for MoD client departments in terms of informing procurement decisions and activities. The process defines a hierarch of milestones i.e., from Alpha project outputs and outcomes to client benefits following knowledge implementation. Outputs refer to Alpha project reports and other artefacts, while outcomes are immediate results resulting from Alpha outputs. End-benefits require knowledge use and implementation within the MoD client organisation. The Knowledge and Benefits Manager supports the definition of end-benefits for each Alpha project.
Alpha routines	**Recruiting external experts in projects:** according to knowledge requirements of a project, Alpha senior managers advertise jobs, assess CVs, short-list and interview candidates, and select and orient external experts. **Assuring technical completeness and quality of projects:** organising technical assurance meetings to ensure that projects are on time and lead to high-quality outputs. **Codifying, storing and re-using knowledge:** project-generated knowledge is stored in the intermediary's Intellectual Capital repository; any new techniques or approaches are recorded and stored in the Alpha Generic Approaches or the technique selection and visualisation matrices. The Knowledge and Benefits Manager and project/programme Leads encourage re-use of knowledge when appropriate. **Producing Alpha publications (e.g., white papers):** developing written outputs to raise awareness about systemic issues regarding defence innovation and procurement and propose solutions, based on Alpha's accumulated knowledge and experience. **Engaging with MoD stakeholders:** working closely with MoD problem owners and other stakeholders in advance of initiating a project to understand the issue at hand and shape the project appropriately; continuing interactions throughout the project. **Building close relationships with MoD decision makers:** developing good working relationships with MoD decision makers and end users to facilitate knowledge transfer and implementation activities. Some Project and Programme Leads had built strong relationships with MoD senior staff because of conducting multiple assignments for them. **Supporting knowledge implementation by MoD clients:** the Delivery Director and project/programme Leads supporting knowledge exploitation and use e.g., advising on design of agile procurement models and outcome-based specification method; and doing evaluation studies to assess the effects of such novel practices. **Enabling impartial evaluation during projects:** managing projects in a way that they would lead to the generation of objective, pan-industry evidence to avoid risks of supplier or technology lock-in. Project teams are formed accordingly to enable objective evaluation.

knowledge (see Table 1 and Appendix C).

Regarding ***intermediary knowledge acquisition***, the partnership-based and project-oriented structural characteristics of Alpha facilitated the sourcing of appropriate sets of expertise from a wide pool of external organisations. As Alpha's Technical Director put it: "*We draw in 'best athletes' [suitable experts] from across 175 different organisations in the partnership to construct a project team to work on a project depending on…obviously the skills required determine the kind of people we're looking for.*" Consequently, each Alpha project had been the locus of external knowledge acquisition depending on the MoD client issue at hand e.g., refining requirements for a novel solution or assessing technological options. To form suitable project teams, the Alpha leadership team developed a routine of identifying, rigorously assessing, and recruiting external experts to projects. This included frequently publishing job adverts for projects, assessing candidates, and helping with the orientation of the selected individuals: *"[…] what does your CV look like against the requirement, grade them, put them on a shortlist, share that amongst three interviewers who have all read the CVs. Bring them in, interview them."* (Delivery Director, Alpha). But while the above structures and recruitment routine facilitated external knowledge sourcing, Alpha's Decision Support and Project Management processes were critical for identifying and defining external knowledge needs in the first place. For example, during the "define evidence requirements" stage of the Decision Support process (Alpha Doc #4) Alpha staff specified in rather precise terms the expertise sets required for a given project (refer to Appendix C).

Intermediary knowledge assimilation manifested mainly through project-specific activities, as Alpha projects were key means for the analysis and interpretation of external knowledge. Specifically, experimentation and concept and technology demonstrators were facilitating the comprehension of knowledge related to various aspects of a given innovation (Alpha Doc #19–20). In other words, the knowledge that external experts were contributing to a project was being interpreted in the context of a particular novel solution. This was, in turn, helping Alpha senior managers to better understand if and how the externally-sourced knowledge could be useful for supporting MoD's decision-making: *"One way we thought we'd create the conditions for the collaboration and then participation, and the way we generate evidence, was to demonstrate […] the fact that you could corral a lot of data and present it, visually present it, in a way that would allow you to understand trends very quickly."* (Intelligence Lead, Alpha). Knowledge assimilation was significantly aided by the intermediary's processes – specifically, the "select approach and techniques" stage of the Decision Support process offered a suite of methods that project teams could use to analyse the externally sourced technical and managerial knowledge. Similarly, the "project execution" stage of the Project Management process (Alpha Doc #4) stipulated mid-point reviews during which project teams, along with Alpha senior managers, were taking stock and interpreting external expertise. Alpha's technical assurance routine was reinforcing such analysis and comprehension by setting periodic reviews of project results and guiding further work.

Intermediary knowledge transformation concerned Alpha's efforts to synthesise and, in many cases, recombine external and internal (existing) knowledge through its projects. Knowledge transformation was facilitated by the intermediary's IP rights allocation structure (Alpha Doc #17): this encouraged partner organisations to contribute knowledge and IP without the fear of leakage of proprietary information, because such "background IP" was fully protected. The IP rights structure also enabled knowledge synthesis and recombination in that "foreground IP" generated by Alpha projects was assigned to the MoD client and licensed to contributing suppliers: *"I can bring staff in and go 'this is my, what's called background IPR, I bring this on a registry with you and you cannot reveal it to others', but within a project team you'd use it quite freely […] But you could build on it and go beyond it with what we call foreground IPR, which is IPR developed during the [Alpha] project, which was then owned by the MoD and licensed back for industry for any UK government use."* (C4ISR Lead, Alpha). At the heart of intermediary knowledge transformation activities was Alpha's ability to re-use existing technical and commercial knowledge and build on it to fulfil the aims of a specific project: *"It's one of the key principles of the [Alpha] Way so that what we say is that we will not reinvent knowledge where it already exists. We have an obligation to reuse rather than reinvent."* (Technical Director, Alpha). Knowledge re-use was possible due to the systematic recording and storage of expertise in the Alpha's Intellectual Capital, the

intermediary's main knowledge repository. In addition, the Knowledge and Benefits Manager within Alpha played an important role in directing project teams to knowledge gained from previous projects, which was potentially relevant for the project at hand. Alpha's programmes of work, as emerging groupings of projects with adjacent objectives and knowledge requirements, was another manifestation of the intermediary's ability to re-use technical knowledge and build on it to generate cohesive sets of expertise in particular technology or MoD application domains.

Regarding ***intermediary knowledge exploitation***, the intermediary embedded in its structures, processes, and routines the capacity to utilise the project-generated knowledge, largely for internal purposes, and to benefit from it. For instance, the accumulated experience and knowledge arising from managing more than 200 projects enabled the intermediary to develop its "Generic Approaches" and other repositories such as the "visualisation matrix" (Alpha Doc #17) – these were sets of codified knowledge, abstracted from projects and distilled into categories of tools and methods, that contributed to effective management of collaborative innovation projects. In a similar vein, Alpha senior managers developed a routine of producing publications (e.g., Alpha Doc #23–27) on systemic defence procurement challenges (e.g., formal processes and procedures making it difficult to revisit specifications in line with evolving military needs). These papers sought, at least partly, to showcase Alpha's expertise and value-adding activities. In addition, the "execute" stage in Alpha's Decision Support process stipulated using project-specific knowledge to produce "artefacts" such as project reports for the client, which helped the intermediary to earn revenue. Although much of knowledge exploitation was indeed inward-facing and produced benefits for the intermediary, it also provided a basis for adding value to MoD client units. Specifically, artefacts such as client project reports not only helped Alpha to make money but also served as the starting point for supporting client decision-making: "*We generate evidence which underpins the MoD procurement process and related decisions. We draft 'artefacts' based on analysis of problem and potential solutions – these are primarily project reports delivered to MoD stakeholders*" (Managing Director, Alpha). The Technical Director role also encapsulated responsibilities for knowledge use for the benefit of the MoD: *"[…] knowledge management and exploitation is a big theme […] we have an obligation to promote exploitation and package the materials so that it can be exploited [by the MoD]. And that is a principle that applies throughout everything that we do."* (Technical Director, Alpha).

4.4. Intermediary desorptive capacity for PPI support

Specific Alpha processes, routines, and structures underpinned its capacity to transfer knowledge to the MoD, and to inform the MoD's procurement decisions and activities.

Intermediary identification of knowledge transfer opportunities involved close engagement of Alpha senior managers with relevant MoD stakeholders to explore MoD challenges and understand which military problems could be conducive to an Alpha intervention (project) to support procurement. The Delivery Director job role was critical in this respect, as this person was responsible for identifying potential knowledge recipients within the MoD and possible knowledge application areas: *"My task was to understand the MoD landscape and where there might be problems that were susceptible to the [Alpha] methodology. And to work with the MoD stakeholders to answer some basic questions about whether or not there really was a problem that needed an [Alpha] type solution […] you'd even begin to look at how you might in very broad terms solve that problem, and what the benefits of solving that problem through the [Alpha] methodology would be."* (Delivery Director, Alpha). Accordingly, the intermediary developed a routine for ensuring extensive engagement with MoD decision makers and problem owners prior to the commencement of any project: *"An early evaluation of the project requires active engagement of the MoD customer, the project sponsor. We require that MoD sponsors involve 1* or 2* individuals [MoD senior officers] as project champions. The aim is to ensure MoD user commitment, participation and collaboration in the projects."* (Managing Director, Alpha). Alpha's Decision Support and Project Management processes catered for defining the scope of the client's problem and requirements for evidence generation activities – for instance, whether an end-user's need is appropriately defined, as the starting point of the procurement process. The intermediary's ability to identify opportunities for knowledge transfer to the MoD was also enabled by Alpha's "impartial evaluation" principle (Alpha Doc #17): this meant that any Alpha project would need to provide a pan-industry assessment of the MoD problem and possible technological solutions. Inter-organisational project teams helped to ensure such objective assessment (refer to Appendix C).

Intermediary support for knowledge application reflected the Alpha leadership team's efforts to form close relationships with relevant MoD decision makers. The intermediary developed a client relationship-building routine, as part of its "exploitation" principle (Alpha Doc #2), to encourage MoD problem owners to use project-generated knowledge. In addition to the Delivery Director and the Managing Director, Project and Programme Leads within Alpha played an important role in building relationships with MoD staff: *"The advantage of knowing each other, trusting each other, all that kind of human thing, but also being around long enough to make sure the first set of recommendations, if he or she wanted to implement them, they actually were and we help them do it, rather than just they had a report to read and, you know, it doesn't work first time then human nature is 'well I'm not sure this is going to work', whereas if you've got somebody holding your hand, then it probably improves it."* (C4ISR Lead, Alpha). The intermediary also helped MoD client units to implement project outputs, for example by aiding specification-setting or contracting tasks: *"At the end of that project my responsibility again was to […] effectively take the output back to the MoD and help them exploit it, because I've got no axe to grind […] I do have a motivation to see that work passage through the MoD's treacle so, that it can get to the situation where the MoD can take advantage of the recommendations or the products that we've produced."* (Delivery Director, Alpha). Central to the intermediary's ability to support clients to implement knowledge was the "Benefits Management" process. This essentially stipulated defining, prior to the commencement of Alpha projects, routes for MoD client exploitation of project outputs to help realise longer term benefits, for instance faster procurement of new equipment or reduced costs: *"The [Alpha] Benefits Management [process] facilitates progress by centring discussions on the end benefits that any task or activity undertaken by Alpha will eventually help [MoD] stakeholders realise."* (Alpha Doc #4). Relatedly, the intermediary's Knowledge and Benefits Manager was responsible for shaping client end-benefits for each project (see Appendix C).

4.5. Intermediary knowledge management and value creation

The intermediary's knowledge management approach created value for the buying organisation (MoD), defence suppliers, and the intermediary (see Table 5). Although from a contractual point of view Alpha's formal client was the MoD, the intermediary's "partnership" structure meant that Alpha also sought to generate benefits for suppliers.

The MoD and its individual departments benefited from the technical, commercial, and managerial knowledge that Alpha generated through its projects. Technical knowledge included a better understanding of needs and requirements and feasible technological options, for instance how novel technologies could be combined with commercial-off-the-shelf solutions. Commercial knowledge mainly concerned inputs into specification-setting, budgeting, and contracting methods that enable faster and more flexible acquisition of novel solutions. Managerial knowledge referred to insights regarding, for example, procedural and cultural barriers to new technology adoption, and any organisational adjustments required within the Armed Forces to embed into their processes the considered innovations.

There is strong evidence (e.g., MoD Doc #31 to #46) to suggest that these diverse knowledge sets were indeed used by the MoD to inform

Table 5
Intermediary knowledge management and value creation.

Organisation	Value created	Evidence from interviews and documentary sources
Buying organisation (MoD)	Buyer use of Alpha-generated knowledge to define/refine needs, specify requirements, assess innovative solutions, and design procurement and contracting approach More knowledgeable, cost-efficient and flexible procurement in certain cases of acquiring novel solutions Alpha influenced change in certain procurement projects, although it did not achieve a large-scale transformation of defence procurement	• "[Alpha] it's part of understanding the context, understanding the enterprise view of the whole thing […]. Obviously, my boss loves [Alpha], that's what he would say it brings to defence." (Innovation Lead, MoD DE&S) • "By being involved in [Alpha] projects […] the MoD gets a much better understanding of what industry can provide." (Respondent, Supplier 2) • "[Alpha] has provided the MoD and Defence Science and Technology Laboratory with a highly refined definition of the requirements for cyber capability which has been comprehensively evaluated and de-risked." (MoD Doc #32: Alpha case study, MoD Cyber capability) • "MoD has taken the outputs of the [Alpha] projects and incorporated them into architectures, design patterns, requirements and assessment criteria as it contracts for real information capability under its Defence Information Strategy. It is able to do this from an intelligent customer perspective." (MoD Doc # 39: Alpha case study, MoD IT capabilities upgrade programme) • "And I don't think there's much doubt and I think whether you talk to MoD sponsors or big industry or the little industry, or whoever has been involved, I think most people would say even if there wasn't a demonstrable financial benefit or operational benefit that came out of the activity, the MoD walked away being much more aware of what it should be asking for and what it could ask for." (C4ISR Lead, Alpha) • "Immediate and consequent through life savings from this short, comprehensive [Alpha] study represent an order of magnitude reduction in cost to the MoD over previous training solutions." (MoD Doc #33: Alpha case study, Helicopter simulator) • "As a result of [Alpha] developing and demonstrating the innovation process, the MoD has taken a new approach to procuring this key capability and ensured that the solution will continue to incorporate the latest technology." (MoD Doc #37: Alpha case study, Open-source intelligence system) • "The MoD acquisition entity is large and complex and has many different teams. So certainly, in some teams and in some parts, then I would say yes [we influenced change], but whether any of that filtered through into policy or whatever. I don't know." (Technical Director, Alpha) • "It's down to a few people in the Navy, Army, Airforce and Joint Forces Command who've got to sit down, do that thinking early and then make sure the people in DE&S go buy the right stuff that fits in because it takes so long to buy stuff, you're talking about 10–15 years in some cases, before stuff goes into service. Then, the world has changed not just once but several times, particularly anything to do with software, obviously. And they've never really cracked that problem." (C4ISR Lead, Alpha). • "We are embedding a spiral development approach that enables us to be responsive and adaptable to a changing environment, ensuring advantage on the battlefield. This includes delivering a minimum deployable capability quickly, and then iterating it in the light of experience and advances in technology – rather than waiting for a 100 % solution that maybe too late and out of date." (MoD Doc #61: Integrated Procurement Model, 2024, p. 6). • "Creating the environment that supports iterative development: changing our financial process to provide the necessary financial headroom and our contractual models to make spiral work. Building flexibility in our decision-making processes, whilst retaining robust governance." (MoD Doc #61: Integrated Procurement Model, 2024, p. 6) • "We are developing a new alliance with industry that includes engaging the industrial base earlier in force and capability development to help shape what we do and ensure our requirements are informed by what the markets can provide […] developing a more holistic approach to supplier management that enables pace of delivery and spiral development." (MoD

(*continued on next page*)

Table 5 (*continued*)

Organisation	Value created	Evidence from interviews and documentary sources
		Doc #61: Integrated Procurement Model, 2024, p. 5)
	Supplier employees' learning and technical expertise development through participation in Alpha projects Supplier improved understanding of the MoD's (future) needs and requirements. This understanding informed supplier investment decisions	• "[Supplier 4 name] believes that the benefit to the Industry Partner [large defence suppliers] includes the learning and growth of their employee through their experience at [Alpha], improved knowledge of MoD's thinking in specific areas and especially access to the outputs of all the Alpha projects through the Collaborative Working Environment (CWE) [Alpha's knowledge repository]. Access to the CWE can significantly improve the understanding within the Industry Partners of the MoD's intentions regarding future capabilities. This benefits the Industry Partners in better informing both their technology investment (PV) decisions and in better targeting the solutions they offer to MoD." (Alpha Doc #17 – Supplier 4 view on Alpha partnership, p. 15). • "[…] from the industry perspective they [suppliers] gain influence, they gain understanding, and, in some cases, they gain influence and understanding where they wouldn't have even got a seat at the table because they're so small." (Delivery Director, Alpha).
Defence suppliers	Large defence suppliers identifying potential sub-suppliers (SME suppliers) with specialised expertise; prime contractors could work with these small sub-suppliers to develop and sell a novel solution to the MoD.	• "As a prime systems integrator, our business is principally in the delivery of capability through the synergy of disparate components. To succeed, we must have a very clear understanding of our customer's needs which may not always be well expressed in formal requirements documents. [Alpha] projects that tease out those needs through industry and user engagement, prior to any formal acquisition, help us to understand what the user really wants and inform our decisions on whether to invest to pursue those opportunities." (Alpha Doc #17 – Supplier 5 view on Alpha partnership, p. 16). • "For me, [Alpha] represents a unique opportunity to help the MoD to shape its requirements, understanding the art-of-the-possible from industry, and of equal importance, to help to shape and focus the industrial and academic sector choices regarding private venture investment. This collaboration with industry lies at the heart of the [Alpha] model." (Alpha Doc #17 – Supplier 6 view on Alpha partnership, p.17). • "The open participation of interested industry parties also helps with identifying potential members of the supply network, who may be SMEs with key niche products – a central component of innovation." (Alpha Doc #17 – Supplier 5 view on Alpha partnership, p. 16). • "As a small business, the engagement with [Alpha] has been a positive experience leveraging off existing knowledge developed with our MoD client and approaches which found a natural fit into the Alpha partnership. In particular, the Alpha principle through the selection process which does not differentiate between large and small companies and which offers genuine impartiality in the selection process – unusual in the current market." (Alpha Doc #17 – Supplier 6 view on Alpha partnership, p. 17).
Intermediary (Alpha)	Intermediary knowledge and capability development Intermediary positioning as expert entity and important actor in defence innovation system	• "[Alpha] demonstrated a shift from a few large warfighting experiments to a significant number of wide-ranging decision support activities which were largely customer-funded, so-called 'cash for questions' […] Alpha saw the emergence of informal 'programme areas…air training, IT and intelligence, each managing a number of related projects." (C4ISR Lead, Alpha) • "The [Alpha] portfolio areas of work: information for force development; intelligence and cyber; maritime and support; air systems and platforms; IT use in defence" (Alpha Doc#1)
	Intermediary revenue and profit generation	• "The white papers were a distillation, if you like, of what we'd done from a slightly detached point of view. The [Alpha] Generic Approaches and the Collaborative Working Environment were much more prosaic […] And I could say well I think this sort of task is ideally suited to this sort of approach, bang, 'here is a Generic Approach to experimentation' where we do fail fast, or rapid, agile type work." (Delivery Director, Alpha) • "We've developed an engineering system over the

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Table 5 (*continued*)

Organisation	Value created	Evidence from interviews and documentary sources
		last few years, which we call the [Alpha] Way. And it's really an instantiation of a systems approach into that environment. So, we have a number of principles that are articulated in the Alpha Way which are the, if you like, the bedrock of what we do." (Technical Director, Alpha). • "Because I had done a lot of these jobs, I was at least tolerably acceptable to all of them [MoD DE&S]. I could go and have a chat with them without being seen as some bloody agitator or, well, 'you don't really understand how our… of course we've got to protect the public purse, so we've got to take everything you've done and put it in the bin and start again'. So, we were overcoming some of those sorts of issues." (Delivery Director, Alpha) • "We performed an evaluation of the key Defence constructs to assess which types of innovation models are being utilized in the extant defence innovation landscape […] a mapping, between innovation models and innovation constructs and then relates them to relevant functional areas of the Defence Operating Model […] other 'hidden' relationships exist between other constructs – for example DSTL makes use of industry and academia to deliver fundamental and applied research, [Alpha] is a partnership between MoD, industry and academic, etc." (Alpha Doc #27: White paper on UK defence innovation, p. 30). • "This white paper draws on best practice from a variety of [Alpha] projects to describe a practical approach to the evolution of capability through small scale, low risk increments. The proposed approach – called Continuous Capability Development – is particularly but not exclusively relevant to the agile acquisition of systems […] variants of this approach have been tested and refined in a wide range of [Alpha] projects which, taken together, give reasonably high confidence in its effectiveness across a range of measures" (Alpha Doc #23: White paper on agile procurement/Continuous Capability Development, p. 5). • Alpha estimated revenue in the order of £140 during the 5-year period under investigation. Revenue based on fixed annual fee plus revenue per project (240+ projects executed in total) (Alpha Doc #1 and #2).

Table 5 (*continued*)

Organisation	Value created	Evidence from interviews and documentary sources
		5-year period under investigation. Revenue based on fixed annual fee plus revenue per project (240+ projects executed in total) (Alpha Doc #1 and #2).

innovation-oriented procurement decisions regarding definition or refinement of needs; specification of solution requirements; technology assessment including requirements for integration of innovative solutions into existing military capabilities; and design of suitable procurement and contracting approaches. In the case of cyber defence innovations, for instance, *"[Alpha] has provided the MoD and Defence Science and Technology Laboratory with a highly refined definition of the requirements for cyber capability which has been comprehensively evaluated and de-risked."* (MoD Doc #32). A key MoD benefit was a better understanding of its requirements vis-à-vis what was technologically viable for suppliers to provide: *"For me, [Alpha] represents a unique opportunity to help the MoD to shape its requirements, understanding the art-of-the-possible from industry."* (Alpha Doc #17, Supplier 6 view on Alpha, p.17). This enhanced MoD understanding was resulting in more knowledgeable specifications and faster and more cost-efficient procurement in many instances of novel solutions we examined (Table 5).

Alpha thus helped to inform MoD decision-making and improve PPI outcomes. Alpha senior managers conceded, however, that the intermediary's knowledge transfer did not transform the way the MoD buys innovations. Key challenges included resistance to change and the churn of people within the MoD: "*There are examples where you can change. Why am I a bit reserved? Because it took a lot of effort […] But it's a patchy sort of penetration really of the total marketplace."* (Delivery Director, Alpha). Nevertheless, there is evidence to suggest that technical, commercial and managerial knowledge that Alpha helped to create, through its projects, was reflected into the MoD's (2024) "Integrated Procurement Model" (MoD Doc #61 and #63). Approaches promoted by Alpha such as "spiral" (iterative) procurement, flexible investment approvals and budgeting and contracting, and earlier supplier engagement to craft industry-informed specifications (see Table 5) have also been taken up by the MoD as part of the ongoing reforms of defence procurement (MoD, 2025a).

Defence suppliers also benefited from their engagement with Alpha and the participation in its projects. The findings suggest that supplier employees who had been seconded to Alpha projects gained knowledge and developed expertise in various technology domains (Table 5). More importantly, involvement in Alpha projects and close engagement with MoD end users, military technology specialists and DE&S staff, was helping suppliers to improve their understanding of the MoD's needs and requirements, in relation to both current and future military capabilities. According to the Technical Director of Alpha, for instance: *"By involving industry [suppliers] in projects, industry develops a much better understanding of what the MoD really needs"*. This improved supplier understanding was used to inform decisions within supplier firms with respect to business development and R&D investments: *"[Alpha] projects that tease out those needs through industry and user engagement, prior to any formal acquisition, help us to understand what the user really wants and inform our decisions on whether to invest to pursue those opportunities."* (Alpha Doc #17, Supplier 5 view on Alpha, p. 16). Participation in Alpha projects also helped large defence suppliers to identify supply chain partners – especially small suppliers with specialised technological capabilities whom large defence contractors could collaborate with: *"[Alpha] is able to provide the best possible advice to MoD by having a very wide range of SMEs with highly specialised, in-depth knowledge to call on to staff projects. The [SMEs] themselves benefit by being able to undertake challenging, funded study work. The Industry Partners [large defence*

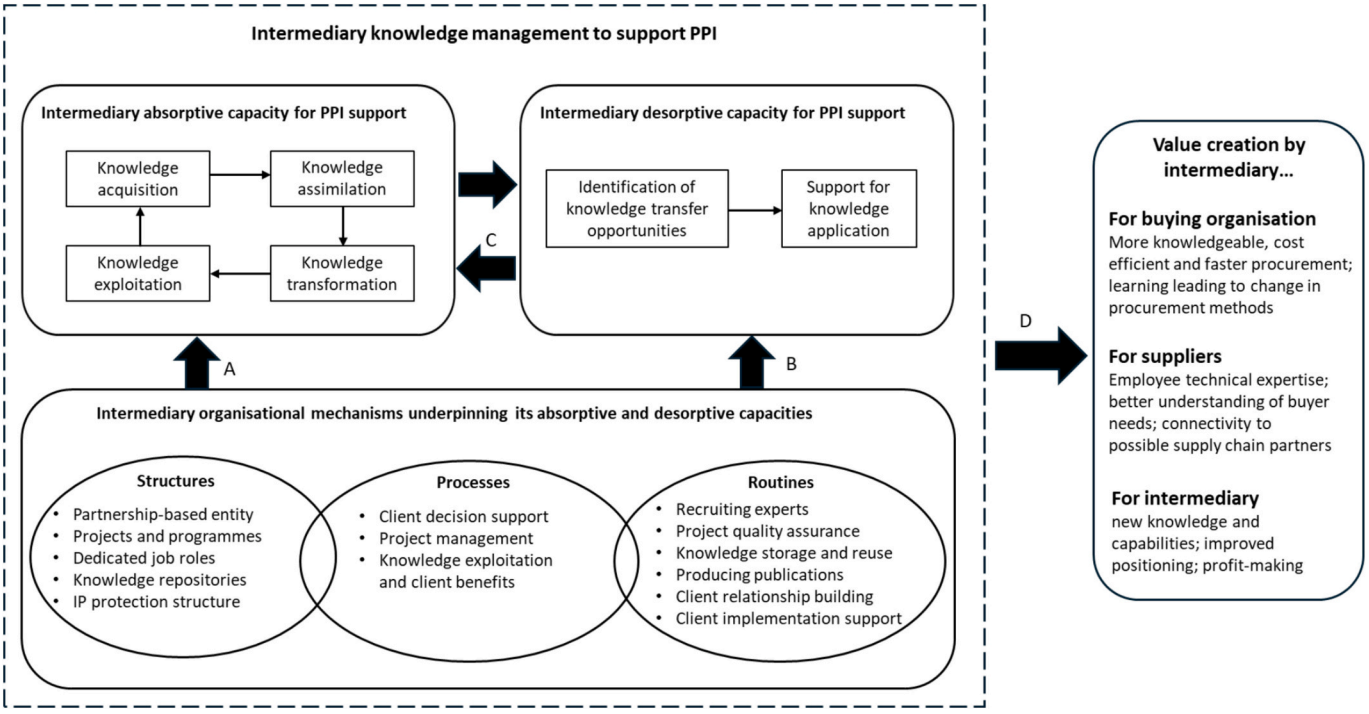


Fig. 1. Intermediary knowledge management to support public procurement of innovation.

suppliers] benefit by having a highly informed supply chain to draw on for future delivery of capability to MoD." (Alpha Doc #17, Supplier 4 view on Alpha, p.15).

Alpha also created value for itself. Crucially, Alpha's structures, processes, and routines helped the intermediary to build a strong technical knowledge base, *despite* its project-based orientation and reliance on temporary external expertise. The intermediary thus expanded its capabilities into a wide range of technological domains (Alpha Doc #2, #8–14 and #18), as also manifested through the proliferation of emerging programmes: *"[Alpha] demonstrated a shift from a few large warfighting experiments to a significant number of wide-ranging decision support activities which were largely customer-funded, so-called 'cash for questions' […] Alpha saw the emergence of informal programme areas…air training, IT and intelligence, each managing a number of related projects."* (C4ISR Lead, Alpha).

Such knowledge and capability development enabled the intermediary to position itself as an important actor within the defence innovation system, for instance through producing expert evaluations and reports on systemic issues regarding defence procurement and innovation (e.g., Alpha Doc #23 and #27). In addition, the intermediary benefited financially as its MoD-commissioned projects were generating revenue and profits.

5. Discussion and conclusions

We set out to examine how innovation intermediaries source, process, and transfer knowledge to aid PPI implementation and add value. Our study generates theoretical insights regarding intermediary knowledge management for PPI support. Fig. 1 synthesises our findings into a research model. Innovation intermediaries mobilise their absorptive capacity and desorptive capacity to manage and share PPI-related knowledge. The mobilisation of these capacities is underpinned and enabled by a core set of intermediary structures, processes, and routines, which our empirical study unveiled.

Intermediary absorptive capacity for PPI support manifests in a combination of structures, processes, and routines aiding intermediary knowledge acquisition, assimilation, transformation, and exploitation (Arrow A). Key structures include the partnership-based organisation that enabled sourcing expertise from a wide pool of external partners; the focus on projects and programmes of work as the key means for capturing, assimilating, and transforming external knowledge; and a clear IP rights allocation structure and various intermediary knowledge repositories that facilitated knowledge recombination and exploitation. These structures are interwoven with intermediary routines and processes facilitating knowledge acquisition, assimilation and exploitation – for instance, the recruitment routine helped in appointing external experts to work on projects, while processes for project management and client decision support enabled the analysis and interpretation of external knowledge and its combination with internal expertise.

In a similar vein, a core set of intermediary structures, processes, and routines underpins and enables the enactment of desorptive capacity for PPI support (Arrow B). This capacity is partly reflected in the intermediary's structures. An example is the creation of specific job roles (e.g., Delivery Director and Knowledge and Benefits Manager) geared towards close engagement with clients and end-users to a) jointly explore how intermediary-generated knowledge could help solve specific client problems, and b) identify how knowledge could be applied to create benefits for clients. These organisational roles are complemented by intermediary routines, such as engaging with clients and other relevant stakeholders, building client relationships, and supporting clients to implement the knowledge generated by intermediary-initiated projects. Processes also play an important role in supporting knowledge transfer activities of the intermediary – for instance, the client decision support process stipulated that any client must specify its requirements for evidence generation. Similarly, the benefits management process ensured that client end-benefits resulting from using intermediary-generated knowledge are explicated from the outset.

Our research reveals a bidirectional relationship between intermediary absorptive capacity and desorptive capacity, whereby the latter can also influence the former (Arrow C). While intermediary knowledge acquisition, assimilation, and transformation form the basis for subsequent knowledge transfer and application support, our study also shows that intermediary work to identify knowledge transfer opportunities can often trigger searches for knowledge acquisition. Identifying problems

and their owners within the client organisation informs the intermediary's definition of client requirements for evidence generation and determines which sets of knowledge should be acquired by the intermediary during its projects. This suggests that, in the context of PPI intermediation, absorptive capacity and desorptive capacity may interact in more nuanced ways, as compared to their typically discrete treatment based on the distinction between outside-in and inside-out knowledge flows (Lichtenthaler and Lichtenthaler, 2009).

Intermediary absorptive and desorprtive capacities create value not only for the buying organisation, but also for suppliers and the intermediary itself (Arrow D). Regarding the buyer, intermediary knowledge transformation and knowledge transfer and application support play a key role in informing PPI decisions and driving improvements in procurement methods and processes. Suppliers benefit mainly from their participation in intermediary projects: intermediary knowledge sourcing, assimilation, and transformation activities help suppliers to develop technical knowledge and improve their understanding of the buyer's needs and of other suppliers' capabilities. The intermediary creates value for itself mainly through knowledge exploitation internally, which results in the development of technical and managerial capabilities, improved positioning, and revenue and profit generation.

5.1. Research contributions

Our research model and findings extend prior research on the supporting role of intermediaries in public procurement of innovation. While existing literature has identified various knowledge-intensive roles and activities of innovation intermediaries (e.g., Edler and Yeow, 2016; Rainville, 2021; Selviaridis et al., 2023; Van Winden and Carvalho, 2019), it has not fully explained the organisational mechanisms within intermediaries that enable such roles and activities. We add to this literature by showing that intermediaries' absorptive capacity and desorptive capacity are a key means for sourcing, processing, and transferring PPI-related knowledge, thereby facilitating PPI decision-making and associated activities.

Our research also contributes to the broader literature on innovation intermediaries (e.g., Alexander and Martin, 2013; De Silva et al., 2018; Howells, 2006; Knockaert et al., 2014; Lichtenthaler, 2013) in two main ways. First, we extend Lichtenthaler's (2013) concept of intermediaries' possessing both absorptive capacity and desorptive capacity by elucidating the internal structures, processes, and routines that underpin these capacities. Lichtenthaler (2013) has stressed that intermediaries' ability to collaborate with their clients and gain access to their clients' technological expertise is an important element of intermediaries' absorptive capacity. We complement such insights by showing that, owing to its structures, an intermediary can source valuable knowledge from external organisations other than its clients. Relatedly, our study further illuminates the nature and role of desorptive capacity in innovation intermediation, for instance in relation to supporting technological knowledge transfer (Alexander and Martin, 2013). Differently from Lichtenthaler (2013), we find that intermediary identification of knowledge transfer opportunities is not limited to technical knowledge but includes commercial and managerial knowledge relevant for PPI decision-making. We also show that an intermediary's desorptive capacity reinforces its absorptive capacity in that knowledge transfer opportunity identification activities by intermediary managers help shape the intermediary's requirements for knowledge acquisition.

Second, we demonstrate that the absorptive capacity of innovation intermediaries, rather than that of client organisations, drives value creation (De Silva et al., 2018). Prior research (e.g., Knockaert et al., 2014; Lin et al., 2016) has focused on the absorptive capacity that client organisations must possess to work effectively with intermediaries, largely neglecting the absorptive capacity of intermediaries themselves. We extend this literature by offering detailed insights into what intermediary absorptive capacity entails and how it can add value for buyers, suppliers, and intermediaries alike. While Knockaert et al. (2014) found that the absorptive capacity of intermediaries is mainly reflected in its R&D managers who learn about latest technology trends, we show that intermediary absorptive capacity extends beyond the knowledge residing in its employees – it encompasses the ability of intermediaries to source external expertise aligned with project aims and needs. It also involves investing in internal knowledge repositories, IP allocation structures, and project management processes and routines supporting knowledge assimilation, transformation and exploitation.

5.2. Policy implications

The focal intermediary generated knowledge and supported the MoD's procurement decisions and activities. Our study thus shows that PPI intermediation can add value for public buying organisations, provided that intermediaries invest in their knowledge management capacities and underpinning organisational apparatus, and that buying organisations meaningfully engage and collaborate with the intermediaries they require support from.

At the same time, however, the intermediary's contributions neither led to radical changes in the way the MoD contracts for innovation nor fully addressed persisting procurement performance issues (e.g., House of Commons Public Accounts Committee, 2021; MoD, 2025b). Indeed, the knowledge that Alpha transferred did not seem to always “stick” within the MoD, reflecting PPI intermediation limitations noted in prior research (e.g., Selviaridis et al., 2023). This suggests that the MoD, including its procurement unit, must improve further its absorptive capacity to be able to benefit more substantially from intermediaries. Specifically, the MoD's assimilation and transformation of intermediary-generated knowledge can be enhanced by increasing understanding within the MoD of what intermediaries do. Tackling internal resistance also requires that the MoD takes “ownership” of relationships with intermediaries and embeds them more effectively within the MoD innovation management and defence procurement infrastructures. In this respect, it is hopeful that DE&S has recently changed its approach in that the Futures Lab – Alpha's successor – is integrated and managed by the DE&S's Future Capability Group, a MoD innovation unit specialising in the pre-concept stage of procurement (QinetiQ, 2024). In addition, improving the exploitation of intermediary-generated PPI knowledge requires reducing the frequency of personnel rotation within the MoD to ensure continuity in relationships between MoD decision makers and intermediary managers. Addressing these issues is imperative for the MoD to expand its absorptive capacity for sourcing innovations through intermediation.

In parallel, the MoD needs to further develop its PPI knowledge internally to mitigate the risk of loss of expertise and capability erosion (Mazzucato and Collington, 2023). Concrete interventions in this space include recruiting more commercial experts within DE&S and training them on innovation-oriented procurement. To this end, the MoD could capitalise on intermediaries' knowledge provision. For example, we identified iterative (“spiral”) procurement of fast-spin, software-rich solutions and flexible contracting for quick uptake of digital innovations and low-cost autonomous systems as approaches that Alpha had championed and promoted. The acceptance and uptake of these approaches within the MoD is growing (MoD, 2024), as also shown by the introduction of a “segmented procurement approach”, whereby faster and more agile contracting will be used to procure and adopt fast-spin innovations (MoD, 2025b). DE&S personnel training would help to embed these approaches more effectively into the new UK defence procurement system in the making.

5.3. Boundary conditions and generalisability

The research is based on a single case of an intermediary supporting PPI in the UK defence context. We define two boundary conditions (Busse et al., 2017) to assess and discuss the generalisability of our findings: a) the structure of the market or industry that intermediaries

serve, and b) the type of intermediary in terms of operating model and service scope.

The intermediary we studied served a single, large buying organisation (MoD) by virtue of the monopsonist nature of the UK defence market. In other words, Alpha intermediated between a sole buyer of novel defence solutions and multiple defence suppliers, thereby tailoring its knowledge management capacities to fit the requirements of the MoD. Our findings are likely transferable to other countries with a similar defence market structure. For example, the US Department of Defense (DoD) is a large buyer and user of new technologies who has used intermediaries to accelerate the development and sourcing of private sector-led innovations (Shah and Kirchhoff, 2024). Although these so-called "Defense Innovation Organisations" have diverse aims and operating models, they converge in terms of fulfilling some key functions such as helping to define DoD end users' problems and needs, exploring technological solutions, and supporting innovation development and acquisition (Kotila et al., 2023). Sourcing external knowledge, creating new knowledge, and transferring it to relevant DoD units are at the core of what these intermediaries do.

Beyond defence, the findings are possibly generalisable to other public sector settings that feature a sole, powerful buyer. For example, in the UK healthcare context intermediaries such as Health Innovation Networks (2024) support the National Health Service (NHS) to source technological innovations. These intermediaries create and transfer knowledge to the NHS to inform its PPI decisions in ways akin to those we observed in defence. Nevertheless, our findings would be less applicable in market settings where PPI intermediation involves engaging with a large set of buyers and of suppliers. In such cases, the intermediary's structures, processes, and routines are unlikely to be customised to any individual buyer. Intermediary resource constraints may also mean that less emphasis is put on absorptive or desorptive capacity elements, for instance client support for knowledge application.

In addition, Alpha operated as a rather inclusive, membership-based partnership. It relied on a large network of external organisations for knowledge inputs into its technically oriented (R&D and demonstration) projects. Our findings are likely transferable to other intermediary types that have a similar operating model and service scope. An example is the UK "Catapults" – these are intermediary organisations founded by the UK Government to foster and support collaborative R&D in several technology domains and sectors (Spring et al., 2017). Catapults source and transform knowledge inputs from external organisations, including businesses and universities, and support buyers and suppliers to contract for innovation. For instance, the Connected Places Catapult supports public authorities' PPI activities in areas like transport and construction. However, our results are less generalisable to other types of intermediaries that may not rely on external partners for knowledge inputs and focus on simple services such as brokering connections between supply and demand.

5.4. Limitations and future research

Our single-case design places limits to generalisability in the ways discussed above. Further research across sectors and institutional contexts is required to develop a more encompassing theory of intermediaries' knowledge management capacities and their role in supporting PPI implementation. In addition, we did not explicitly examine how the absorptive capacity of the intermediary interacted with the absorptive capacity of the MoD and even that of defence suppliers, who were actively involved in the intermediary's projects. Future research could examine these interactions and their effects on PPI decisions and outcomes. Understanding the complementarity (or lack thereof) between the absorptive capacity of a buying organisation and that of an intermediary is especially important when buyers switch intermediaries, or when they work in parallel with multiple intermediaries. Further research is also needed to examine how intermediary absorptive capacity and desorptive capacity might interrelate and (co)evolve, and the conditions influencing their development or dissipation.

CRediT authorship contribution statement

Kostas Selviaridis: Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Elvira Uyarra:** Writing – original draft, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Summary of data collection activities

Data collection methods	Data collection details	Themes covered
Semi-structured interviews: **18 sessions**	- 8 interviews with Alpha managers (e.g., Managing Director, Delivery Director, Technical Director, Project and Programme Leads) - 2 interviews with MoD managers (DE&S Innovation Lead and MoD-Alpha Liaison Manager) - 6 interviews with managers of defence suppliers - 2 interviews with military end-users (Royal Air Force Programme Managers)	Intermediary operating model and principles; how the partnership-based organisation functions; Alpha projects and programmes of work; engagement with MoD client units; Alpha knowledge management; Alpha processes and routines to support project-based work for MoD client units; DE&S innovation procurement and view of Alpha's role and contribution; defence suppliers' view of Alpha and collaborative innovation; military end-users' perspective on innovation procurement.
Organisational documents and archival records (primary data): **30 documents (489 pages in total)**	Documents describing Alpha's internal structures; business model; operating principles; key processes for managing projects and supporting MoD decision-making; periodic reports of projects; and project results achieved; Alpha news and updates; Alpha documents outlining specific projects; Alpha series of white papers and other technical publications; DE&S innovation strategy report and presentation slides – **see the full list of documents in Appendix B (Table B.1).**	Intermediary projects and their management; organisational structure and key management roles; key Alpha processes for managing collaborative innovation projects; Alpha knowledge management approach, including knowledge repositories; Alpha engagement with MoD and impacts on defence procurement

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Data collection methods	Data collection details	Themes covered
Policy reports and other publicly available secondary data sources: **39 sources (784 pages in total)**	Publicly available secondary data including MoD case studies of Alpha projects; UK parliament reports on defence procurement; and MoD policy reports e.g., on defence and security strategy and on planned reforms of defence procurement – **see the full list of secondary data sources in Appendix B (Table B.2).**	Outcomes of Alpha projects and benefits for the MoD; MoD acquisition plans; challenges surrounding MoD procurement of innovative solutions; ongoing reform of defence procurement system; transition to and operation of the new intermediary (Futures Lab)

Appendix B. List of documents and other publicly available secondary data

Table B.1
Organisational documents collected and analysed during the fieldwork.

Doc #	Topic	Authored/published by	Year	No. of pages
1	Key information about Alpha (ppt.)	Alpha Managing Director	2017	19
2	Alpha role and processes	Alpha Project Lead	2018	2
3	Alpha roles in innovation process	Alpha C4ISR Programme Lead	2018	14
4	Alpha Way: a quick reference guide	Alpha comms team	2016	8
5	Overview of Alpha (Guidebook)	Alpha comms team	2017	8
6	Alpha organisation summary	Alpha senior management	2014	2
7	Alpha membership	Alpha comms team	2016	2
8	Alpha projects July–December 2014	Alpha senior management	2014	4
9	Alpha projects January–June 2015	Alpha senior management	2015	3
10	Alpha projects July–December 2015	Alpha senior management	2015	2
11	Alpha projects January–June 2016	Alpha senior management	2016	3
12	Alpha projects July–December 2016	Alpha senior management	2016	3
13	Alpha projects January–June 2017	Alpha senior management	2017	4
14	Alpha projects July 2017–Mar 2018	Alpha senior management	2018	2
15	Alpha Ops control training project	Alpha C4ISR Programme Lead	2018	3
16	Alpha: What you need to know	UK Ministry of Defence	2018	6
17	The Alpha partnership and its value	Alpha internal magazine	2018	20
18	Alpha partnership update	Alpha senior management	2018	11
19	Alpha projects and approaches	Alpha internal magazine	2017	23
20	Alpha experimentation approach	Alpha internal magazine	2015	27
21	Alpha driving defence innovation	Alpha internal magazine	2015	23
22	Alpha and defence collaboration	Alpha internal magazine	2014	15
23	Alpha white paper on agile procurement (CCD approach)	Alpha Technical Director	2014	32
24	Alpha white paper on defence architectures	Alpha Chief Architect	2014	44
25	Alpha white paper on complex systems in defence	Alpha Technical Director	2015	60
26	Alpha technical insights paper on complex systems evaluation	Alpha Chief Analyst	2016	6
27	Alpha white paper on UK defence innovation system	Alpha Managing Director and Technical Director	2017	60
28	DE&S innovation strategy	Defence Equipment & Support	2016	24
29	Defence strategic priorities and DE&S exploitation of R&D (ppt.)	DE&S Innovation Lead	2017	23
30	DE&S news and ongoing projects	DE&S internal publication	2017	36
Total: 30				**Total pages: 489**

Table B.2
Secondary data sources relevant to MoD procurement and Alpha's role.

Doc #	Topic	Authored/published by	Year	No. of pages
31	Alpha case study: Air ISTAR	Ministry of Defence	2018	3
32	Alpha case study: Cyber capability	Ministry of Defence	2018	3
33	Alpha case study: Helicopter simulator	Ministry of Defence	2018	3
34	Alpha case study: Future air refuelling	Ministry of Defence	2018	3
35	Alpha case study: Future ground search	Ministry of Defence	2018	3
36	Alpha case study: Ground air defence	Ministry of Defence	2018	4
37	Alpha case study: Open-source intelligence programme	Ministry of Defence	2018	3
38	Alpha case study: Upgrade of submarine combat systems	Ministry of Defence	2018	4
39	Alpha case study: MoD IT capabilities upgrade programme	Ministry of Defence	2018	3
40	Alpha case study: MoD rapid messaging	Ministry of Defence	2018	3
41	Alpha case study: Explosive ordnance disposal equipment	Ministry of Defence	2018	3
42	Alpha case study: Improving British Army capabilities	Ministry of Defence	2018	4
43	Alpha case study: British Army combat service support	Ministry of Defence	2018	3
44	Alpha case study: Joint battlespace management capability	Ministry of Defence	2018	3
45	Alpha case study: Support of Royal Navy fleet	Ministry of Defence	2018	4
46	Alpha case study: British Army command and control systems	Ministry of Defence	2018	4
47	UK defence procurement policy	House of Commons (HC) Library	2003	62
48	Introduction to defence procurement	HC Library	2019	46
49	Defence single source contract regulations	HC Library	2020	14

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Table B.2 (*continued*)

Doc #	Topic	Authored/published by	Year	No. of pages
50	Performance of major defence procurement contracts	HC Public Accounts Committee	2021	24
51	Defence procurement system review	HC Defence Committee	2023	60
52	MoD defence equipment plan 2022–32	Ministry of Defence	2022	65
53	MoD defence equipment plan 2023–33	HC Public Accounts Committee	2023	26
54	MoD defence operating model	Ministry of Defence	2020	40
55	MoD integrated operating concept 2025	Ministry of Defence	2020	20
56	UK defence and security industrial strategy	HM Government	2021	112
57	Emerging defence technologies	HC Library	2021	24
58	Security, Defence and Foreign Policy Integrated Review Refresh	HM Government	2023	
59	Lessons learned from review of Ajax armoured tanks programme	Clive Sheldon (KC)	2023	172
60	DE&S performance review	HC Defence Committee - Lockheed Martin evidence	2023	6
61	MoD Integrated Procurement Model	Ministry of Defence	2024	9
62	MoD procurement reform	Financial Times	2024	4
63	Defence procurement reform – Integrated Procurement Model	Ministry of Defence and Minister of Defence Procurement	2024	8
64	Aurora Engineering Partnership overview	QinetiQ	2023	3
65	Information about the Futures Lab	QinetiQ	2023	3
66	Futures Lab replaces Alpha (press release)	QinetiQ	2021	2
67	Futures Lab description (flyer)	QinetiQ	2021	2
68	Futures Lab overview	Global Defence Technology	2021	5
69	MoD-Alpha contract review	National Audit Office	2005	24
Total: 39				**Total pages: 784**

Appendix C. Empirical evidence in support of the first-order and second-order codes

Second-order codes	First-order codes	Evidence: indicative interview quotes and document excerpts
Intermediary knowledge acquisition	Partnership-based structure: member organisations as source of knowledge Alpha projects as vehicles for sourcing the right expertise sets and individuals "Decision Support (DS)" process (why and what steps) determines external knowledge needs "Project Management (PM)" process (start-up and initiation stages): defining the requisite expertise	• "[Alpha] is a partnership between MoD, industry and academia […] since 2013 Alpha has contracted more than 200 projects for the MoD with over 1400 people across the partnership […] the open and collaborative model has proved to be a very effective way for MoD, industry and academia to work together to help provide effective decision making, reduce risk and improve solutions across all areas of the Defence Operating Model" (Alpha Doc #5: Guidebook, 2018, p.2). • "I think that we have to look harder in defence to find those niches as to where we will be more innovative, we will take more risk, and that requires, I think, MoD and industry to take a more partnering approach." (Respondent, Supplier 1) • "[Supplier 3] were already part of the Alpha team, contributing simulations of the new Army sensors…[Supplier 3] then iterated several technical solutions to enable the tool to be deployed on MoD owned IT; it was successfully fielded in time for the next round of training, less than 4 months from initiation of the idea". (Alpha Doc #15: report on Supplier 3's Operations control training solution) • "We draw in best athletes from across 175 different organisations in the partnership to construct a project team to work on a project depending on… the skills required determine the kind of people we're looking for" (Technical Director, Alpha) • "The [Alpha] Decision Support Process is summarised as follows: the 'why' stage determines the decision for support; key inputs include the key facts and stakeholder engagement. The 'what' stage defines evidence requirements; knowledge base as input is important at this stage." (Alpha Doc #4: The Alpha Way: A quick reference guide, p.4).
	Recruitment routine to form the project team	• "The new task was evaluated by the MOD and Alpha core team against a number of criteria in a formal Initiation Gate meeting. If the proposed task cleared this hurdle, the programme team then generated role descriptions for the new [project] team; these were sent out to the partnership, inviting CVs, typically within 3 weeks. Roles in a typical task included technical leads, an architect and specialists in one or more of policy, concept and capability development, military practice, current and emerging technology and costing or commercial." (Alpha Doc #2: operating model and processes, p.1). • "[External experts] go through a rigorous selection process. It's almost like getting into the special forces. We know they're special. They know they're special […] They are taken out of their existing company mindset. They're put into something new. And it almost like gives them a mission to think out of the box, to think more creatively." (Technical Director, Alpha) • "We would always try and encourage any industry to provide people into [Alpha] because that was the way we would get the best available people […] what does your CV look like against the requirement, grade them, put them on a shortlist, share that among three interviewers who all read the CVs. Bring them in, interview them." (Delivery Director, Alpha)
Intermediary knowledge assimilation	Experimentation and demonstration during projects: analysis and comprehension of possible solutions	• "One way we thought we'd create the conditions for the collaboration and then participation, and the way we generate evidence, was to demonstrate […] there was quite a lot there on being able to demonstrate the fact that you could

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Second-order codes	First-order codes	Evidence: indicative interview quotes and document excerpts
	"Select approach and techniques" stage in DS process: suitable methods and tools to analyse and process externally sourced knowledge "Project execution" stage in PM process: mid-point reviews and team meetings to interpret and understand results	corral a lot of data and present it, visually present it, in a way that would allow you to understand trends very quickly." (Intelligence Lead, Alpha) • "In the early stages of a project, we would give the project members some ideas on how to go about conducting the project, some of the methods they might use, some of the tools they might use." (Technical Director, Alpha) • "At the execution stage of the [Alpha] project lifecycle there is a provision for mid-point director reviews. These meetings aid interpretation and comprehension of project results" (Alpha Doc #4: The Alpha Way: A quick reference guide, p.6). • "Each project gets assigned a lead assurer. It's the lead assurer's responsibility to do the technical induction of the project at the start and then to live with the project as it develops and goes through. The lead assurer would generally be an expert in a particular technical domain." (Technical Director, Alpha)
	"Assurance" routine to review project results and guide further work	• "A key mechanism for ensuring process and product quality is to assign each project an expert technical advisor in the form of a Lead Assurer. There are several such assurers in the core team, selected for their expertise across a range of topics relevant to [Alpha] projects. At the start of the project the Assurer will assist the project in deciding on the details of the decision support process it should adopt, including which Methods Techniques and Visualizations to use, and as the project proceeds this relationship will become more one of reviewing the work completed." (Alpha Doc #17: Alpha partnership, p. 8).
	Alpha's "Intellectual Capital" helps to reuse and build on existing knowledge Knowledge and Benefits Manager job role: helping to identify and re-use knowledge From projects to programmes: building on and recombining existing technical knowledge	• "[Alpha] Intellectual Capital is retained in people, partnership organisations and the store of knowledge kept on the collaborative working environment […] Reusing the Intellectual Capital ensures consistency, efficiency and effectiveness" (Alpha Doc #4: The Alpha Way: A quick reference guide, p.6). • "We have a knowledge manager, part of my technical team, there's a knowledge and benefits manager who fulfils both of those roles. And we have a number of technical systems as well for tracking metadata and that kind of thing. But it's very much a human face onto an information system […] it's to provide an interface for project team members who arrive in Alpha. They want to know which projects have been done previously that are relevant." (Technical Director, Alpha). • "In the C4ISR area, a few individuals sought to realise wider benefit to MOD by managing a number of related projects as a Tac C4ISTAR proto-programme, or an emergent programme […] the programme developed in an ad hoc manner by integrating disparately sponsored activities to deliver coherent outcomes. Customers valued this coherence and sponsored further work in a 'moderately virtuous circle'. It built from a novel Training Capability Concept Demonstrator approach which presented emerging training capability concepts in Mission Specific Training (MST) for Afghanistan, which were then iterated with the users over several weekly cycles to refine them." (C4ISR Lead, Alpha)
Intermediary knowledge transformation		
	Alpha IPR structure: enables knowledge synthesis and recombination	• "Underpinning everything that we do is a very good intellectual property […] the MoD owns the foreground, it doesn't own the background because that's been acknowledged as being the background IP and owned by company X, Y and Z, and the MOD in every case chooses to license that intellectual property back to the whole of the partnership on an as required basis." (Delivery Director, Alpha) • "I can bring staff in and go 'this is my, what's called background IPR, I bring this on a registry with you and you cannot reveal it to others', but within a project team you'd use it quite freely […] But you could build on it and go beyond it with what we call foreground IPR, which is IPR developed during the [Alpha] project, which was then owned by the MoD and licensed back for industry for any UK government use." (C4ISR Lead, Alpha)
	Alpha Technical Director job role (*structure*): knowledge management responsibilities – consolidating, codifying and (re)using knowledge DS process (execute stage): knowledge from projects used to create "artefacts" for clients e.g., reports. Repository of generic methods and tools/techniques for managing collaborative innovation projects	• "Raising of the profile of knowledge management into a must-do has meant we've done it at least to a better level than I've ever seen done anywhere else because we didn't have any choice; we've had to do it. And that's been good for us, I think." (Technical Director, Alpha) • "We generate evidence which underpins the MoD procurement process and related decisions. We draft 'artefacts' based on analysis of problem and potential solutions – these are primarily project reports delivered to MoD stakeholders […] but we stop short of developing specifications on behalf of the MoD." (Managing Director, Alpha).
Intermediary knowledge exploitation		
	Routine of producing publications on systemic issues (positioning efforts)	• [Alpha] is careful to curate the intellectual capital it creates so that it can be used subsequently by the partnership and UK Defence more generally. This know-how is captured within a range of products, including [Alpha] Generic Approaches, Guides and White Papers, and these products are made available via the Collaborative Working Environment (CWE)." (Alpha Doc #17: The Alpha partnership, p. 8). • "[…] it is essential that tried and trusted examples of methods and techniques are used whenever appropriate. [Alpha] maintains competence in and employs a range of methods and techniques suited to a wide variety of different problems. The Alpha Way includes a Techniques Selection Matrix. (Alpha Doc #4: The Alpha Way: A quick reference guide, p.5).

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Second-order codes	First-order codes	Evidence: indicative interview quotes and document excerpts
Intermediary identification of knowledge transfer opportunity	Alpha Delivery Director job role: identifying possible problems and solution application areas and mapping the relevant MoD stakeholders PM and DS processes define the scope of problem and expected evidence requirements by client Engagement routine: deep engagement with problem owners and key decision makers within MoD	• "In specific instances the Alpha intellectual capital is strategic and systemic in nature; in such cases the material is issued as a white paper." (Alpha Doc #4: The Alpha Way: A quick reference guide, p.5). • "One of the things that we developed was […] what we called white papers […] so we would look at all of these microscopic examinations of particular problems in the ecosystem and we'd begin to sort of blob them up and say look, there's a theme emerging here." (Delivery Director, Alpha) • "At that highest level, we've got the white papers which are an aggregation and distillation of knowledge and experience for a whole range of different projects." (Technical Director, Alpha). • "My task was to understand the MOD landscape and where there might be problems that were susceptible to [Alpha] methodology. And to work with the MOD to answer some basic questions about whether or not there really was a problem that needed an [Alpha] type solution […] I was a facilitator of those discussions with the wide variety of the MOD and in doing that you would build, if you like, a proposition or a business case, or a problem that needed to be solved and you'd even begin to look at how you might in very broad terms solve that problem, and what the benefits of solving that problem through the [Alpha] methodology would be." (Delivery Director, Alpha) • "The Decision Support Process stipulates that the decision for support should be scoped and agreed at the first stage ('why' stage) of the process." (Alpha Doc #4: The Alpha Way: A quick reference guide, p. 4). • "The project scope is subsequently defined. At Gate 1 the maturity level of the 'problem' is evaluated, whereas at Gate 2 Alpha secures funding by the [MoD] sponsor for project pre-work in relation to using experts to evaluate and scope the problem and the project." (Managing Director, Alpha). • "An early evaluation of the project requires active engagement of the MoD customer, the project sponsor. We require that MoD sponsors involve 1* or 2* individuals [within the MoD] as project champions. The aim is to ensure MoD user commitment, participation and collaboration in the projects." (Managing Director, Alpha).
	Impartial evaluation routine: cross-industry, objective view of problems and possible technological solutions	• "[Alpha] exists to bring together MOD, industry and academia to address problems that cannot be addressed in other ways. Engagement must therefore be conducted comprehensively and rigorously. Every project must undertake stakeholder analysis (using the Defence Enterprise Model) and develop partnership engagement plans. Engagement is facilitated by the availability of predefined engagement mechanisms within the [Alpha] Methods, Techniques and Visualizations." (Alpha Doc #17: The Alpha partnership, p. 7). • "[Alpha helps in] having a better and more objective understanding of what you need to do to make a success of something. So, that's how we view Alpha." (Innovation Lead, MoD DE&S) • "Project teams and partnership engagement activities will be constructed to ensure freedom from bias. Special care will be taken to avoid compromising MoD's commercial competitions" (Alpha Doc #4: The Alpha Way: A quick reference guide, p.4) • "Outcome-based specifications are challenging in terms of the MoD creating supplier competition; it's difficult to engage suppliers early in commercial settings and avoid a single-source scenario." (MoD-Alpha Liaison Manager, MoD)
Intermediary support for knowledge application	Relationship-building routine to support implementation work Implementation support routine to aid MoD clients to put knowledge into use for innovation procurement tasks "Benefits Management" process: defining client exploitation of outputs and long-term benefits for client from Day 1 of projects	• "At the end of that project my responsibility again was to […] effectively take the output back to the MOD and help them exploit it, because I've got no axe to grind […] I do have a motivation to see that work passage through the MOD's treacle so, that it can get to the situation where the MOD can take advantage of the recommendations or the products that we've produced." (Delivery Director, Alpha) • "The advantage of knowing each other, trusting each other […] but also being around long enough to make sure the first set of recommendations, if he or she wanted to implement them, they actually were and we help them do it, rather than just they had a report to read and, you know, it doesn't work first time then human nature is 'well I'm not sure this is going to work', whereas if you've got somebody 'holding your hand', then it probably improves it […] the ones that were serial, where we did three or four or maybe a bit more on the trot, that's where we got more exploitation; the more deep you get into an area, the more… the better you understand it, the more people you can talk to and persuade and therefore there's a sort of… even if the sponsor moves on, you've got a community of interest who kind of have been with you on this journey, and will take this stuff up and move it on and implement it anyway." (S4ISR Lead, Alpha) • "We were able to persuade them [MoD procurement team] …to actually recognise the advantage and to pursue the novel contracting route which was to split out the innovation from the day-to-day service provider. And, although in itself not particularly a revelation, it was unusual, it wouldn't have been the way that they would have gone about that normally." (Managing Director, Alpha) • "You learn different ways of selling it to the MoD and getting them to exploit it, and you get them exploiting it as you go along and not just at the end of various
	"Knowledge and Benefits Manager" job role: it helps to define client end-benefits arising from project outputs and outcomes	

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Second-order codes	First-order codes	Evidence: indicative interview quotes and document excerpts
		things you can do, and I think that's the benefit of… and indeed probably the best bits of work I've been involved in, in terms of exploitation, have been where we've done a series of pieces of work for the same sponsor or the same customer." (S4ISR Lead, Alpha) • "The [Alpha] Benefits Management [process] facilitates progress by centring discussions on the end benefits that any task or activity undertaken by Alpha will eventually help stakeholders realise." (Alpha Doc #4: The Alpha Way: A quick reference guide, p. 5) • "The second aspect of exploitation is avoiding the production of 'shelfware'. [Alpha] is acutely aware that its work must be taken forward by others for it to realise any value. For this reason, every project is required to develop a benefits map and an exploitation plan, with the agreement of explicit exploitation actions where possible. [Alpha] employs a Benefits Manager to assist projects with these aspects." (Alpha Doc #17: The Alpha partnership, p. 8).

Data availability

The data that has been used is confidential.

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