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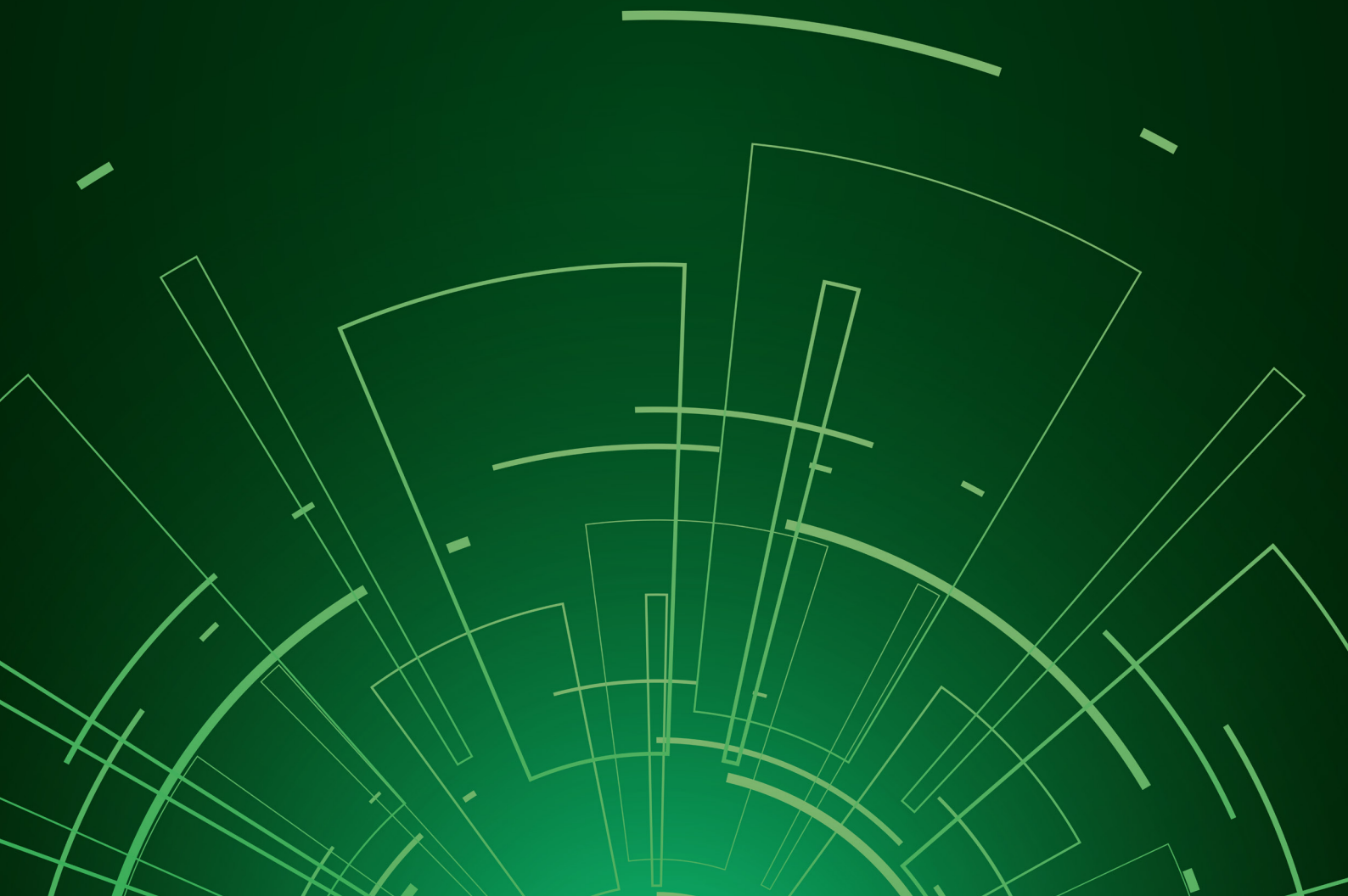
Command and Control in the Future

Concept Paper 2: The Defence C2 Enterprise

Rebecca Lucas, Conlan Ellis, James Black, Peter Carlyon,
Paul Kendall, John Kendall, Stephen Coulson, Louis Jeffries



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Research Report

Command and Control in the Future

Concept Paper 2: The Defence C2 Enterprise

Rebecca Lucas, Conlan Ellis, James Black, Paul Kendall, John Kendall, Stephen Coulson, Peter Carlyon, & Louis Jeffries

Strategic Analysis Support Contract

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Prepared for the Development Concepts and Doctrine Centre (DCDC)

Preface

This is the second in a series of four papers examining how Command and Control (C2) will manifest in the future. The other papers in this series are as follows:

- Concept Paper 1: Black, James, Rebecca Lucas, John Kennedy, Megan Hughes & Harper Fine. 2024. *Command and Control in the Future: Concept Paper 1 – Grappling with Complexity*. Santa Monica, Calif.: RAND Corporation. RR-A2476-1.
- Concept Paper 3: Conlan Ellis, Rebecca Lucas, Stella Harrison, James Black, Ben Fawkes, Martin Robson, Alan Brown, & Edward Keedwell. 2024. *Command and Control in the Future: Concept Paper 3 – Command and Control as a Capability*. Santa Monica, Calif.: RAND Corporation. RR-A2476-3.
- Concept Paper 4: Lucas, Rebecca, Stella Harrison, Conlan Ellis, James Black, Ben Fawkes, Martin Robson, Alan Brown, & Edward Keedwell. 2024. *Command and Control in the Future: Concept Paper 4 – Enablers*. Santa Monica, Calif.: RAND Corporation. RR-A2476-4.

The overarching study is being delivered by the Development, Concepts and Doctrine Centre (DCDC) Strategic Analysis Support Contract (SASC) with the Global Strategic Partnership (GSP), a consortium of UK and international research organisations providing strategic analysis and academic support to the DCDC within the UK Ministry of Defence (MOD). This paper is intended to capture the findings of a second phase of the study and has been drafted on the assumption that it will be read by an audience with some familiarity with C2 and the preceding paper in the series. Equally, it is intended to feed into the other three papers in the series and therefore stops short of providing fulsome coverage of all aspects of thinking about C2 in the future, including the development of concrete recommendations.

The GSP is led by RAND Europe, part of the RAND Corporation, an independent, not-for-profit research institute that aims to improve policy and decision making through objective research and analysis. RAND's clients include Allied governments, militaries, inter- and non-governmental organisations, and others with a need for rigorous, independent, interdisciplinary analysis.

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Summary

The Defence Command and Control (C2) enterprise will be a key participant in addressing the challenges raised by the anticipated complexity of the future operating environment (FOE) out to 2040+. Such challenges have already been explored in the first of four concept papers in this series for DCDC.[1] This second paper focuses on what will likely constitute the C2 enterprise: that is, the future organisational and technical attributes and processes which will apply available resources to facilitate C2.[2] It then looks at the new requirements these entail, and identifies likely barriers and opportunities to implementing change.

The findings of this paper thus set up further analysis and development of recommendations in the third and fourth papers. These address C2 as a capability, and C2 enablers, respectively.

Figure 0.1 Summary of key findings from Paper 2

The Defence C2 enterprise will require diverse modalities for different contexts and operational requirements, incorporating a variety of partners, often as part of a whole-of-society approach.

Partners within Defence include:
- Head Office
- Command and delivery organisations
- Portfolios, programmes and projects (PPP)
- Executive agencies

Partners in the wider ecosystem include:
- Partners across government
- International partners and allies
- Defence industry
- Other private sector
- Other enabling and influencing organisations

The Defence C2 enterprise will entail new requirements both for individuals within Defence, as well as for Defence as an organisation.

Individuals will need a series of capabilities to enable the future C2 enterprise, including:
- Comfort with complexity and uncertainty
- Soft skills and knowledge
- Technical skills and knowledge
- Diversity

Defence as an organisation will also need a number of properties, including:
- Learning & adaptation
- Flexibility & agility
- Capacity to promote and absorb innovation
- Capacity for interoperability and integration

Both on live operations and in making the necessary longer-term changes to implement the C2 enterprise in the future, Defence will likely face recurring dilemmas, including the need to balance:

- Efficiency versus flexibility, adaptability, and resilience
- Top-down versus bottom-up decision making
- Security versus sharing

Navigating the trade-offs associated with implementing cross-domain integration will also be a key challenge

[1] Black et al. (2024).

[2] This definition is drawn from Vassiliou et al. (2015).

Source: GSP research.

The Defence C2 enterprise will need to incorporate a diverse range of modalities for different contexts and operational requirements

Responding to the variety of diverse and dynamic changes in the current FOE already requires a large and complex ecosystem, involving organisational cooperation across Defence, as well as with key external stakeholders. Given the likelihood of increasing complexity in the FOE and the decentralisation of technological innovation in and access to both non-kinetic and kinetic levers, the need for involvement from a diverse set of stakeholders both within and outside Defence is only likely to increase.

Additionally, variations in challenges will likely necessitate different combinations of stakeholders both within and outside Defence. Often, these combinations will need to be assembled or changed quickly to respond to rapidly evolving contexts. This then precludes the possibility of constructing a single, monolithic C2 enterprise; instead a series of C2 modalities and different combinations of actors within the Defence establishment is required, drawn externally from a more holistic 'whole of society' approach.

The need for a dynamic and flexible approach to the C2 enterprise drives new requirements both for Defence personnel and for the organisation itself

Cultivation of suitably qualified and experienced personnel (SQEP), as well as certain properties within the Defence organisation itself, will be a key enabler of this new C2 enterprise and its various modalities. Defence will need to ensure that it can recruit and educate SQEP to build the necessary levels of: comfort in the face of complexity and uncertainty; soft skills; technical knowledge; and diversity of thought. It will also need to adjust its ability to reward and retain such individuals. In addition to accommodating changes in the type of personnel hired, Defence as an organisation will also need to develop its ability to learn and adapt; to demonstrate flexibility and agility; to promote and absorb innovation; and further interoperate and integrate on a significantly greater scale both within Defence and with external partners.

In implementing the necessary changes to the enterprise, Defence must address recurring dilemmas and the challenge of multi-domain integration

In designing C2 systems for the future, Defence is likely to encounter a number of recurring dilemmas or trade-offs which it will need to balance. The research team identified the primary challenges as:

1. Fluctuations in the composition of the Defence C2 enterprise as the partners involved and necessary configurations change over time in response to a dynamic environment.
2. Top-down versus bottom-up decision making as Defence seeks to both enable autonomy of individuals but also maintain unity of purpose.
3. Stealth versus sharing as Defence seeks to maintain classification levels and manage its signatures, while including a wide array of different stakeholders under various circumstances.

Additionally, integration across traditional and newer domains is likely to remain a key overarching challenge, particularly given the need to include domains and partners outside of the traditional Defence

establishment. To this end, change management, the development of C2 as a capability in and of itself, and the practical enablers involved will all be considered further in Concept Papers 3 and 4.

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Figures, tables and boxes

Abbreviations

AI	Artificial Intelligence
C2	Command and Control
CDDO	Central Digital and Data Office
DARPA	Defense Advanced Research Projects Agency
DCDC	Doctrine Command and Development Centre
DCP	Defence Command Paper
DE&S	Defence Equipment and Support
DLOD	Defence Line of Development
DoD	Department of Defense/Defence (US/Australia)
Dstl	Defence Science and Technology Laboratory
FCDO	Foreign Commonwealth and Development Office
FE	Force Exploration
FOC	Future Operating Concept
FOE	Future Operating Environment
GSP	Global Strategic Partnership
IOpC	Integrated Operating Concept
IR	Integrated Review
JADC2	Joint All-Domain Command and Control
JCN	Joint Concept Note
MACA	Military Aid to Civilian Authorities
MDO	Multi-Domain Operations
ML	Machine Learning
MOD	Ministry of Defence
NAO	National Audit Office

NATO	North Atlantic Treaty Organization
NHS	National Health Service
OCCAR	Organisation for Joint Armament Cooperation
PAG	Partners Across Government
PESTLE-M	Political, Economic, Social, Technological, Legal, Environmental and Military
RAS	Robotic and Autonomous Systems
RQ	Research Question
S&T	Science and Technology
SASC	Strategic Analysis Support Contract
SME	Subject Matter Expert / Small or Medium Enterprise
SQEP	Suitably Qualified and Experienced Personnel
SRO	Senior Responsible Owner
STEM	Science, Technology, Engineering and Mathematics
TLB	Top-Level Budget
USAF	United States Air Force

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The authors are grateful to the MOD for its sponsorship of this study and its support and input throughout the research, including feedback on a draft of this concept paper. In particular, thanks are owed to Lt Col Robert Kace, Lt Col Edward Vickers and Cdr Leif Hansson of DCDC – the latter posted from the Swedish Armed Forces, given DCDC's dual role as the Swedish Doctrine and Concepts Centre – as well as Dr Peter Houghton of the UK's Defence Science and Technology Laboratory (Dstl).

The SASC team is also grateful to all those who participated in an expert workshop held at the Australian Department of Defence (DoD) in Canberra in June 2023. Lively discussions and feedback on the interim study findings contributed to a strengthened report.

Finally, the team is thankful for the comments and advice provided by our internal quality assurance reviewers, Dr Benedict Wilkinson and Erik Silfversten.

Despite these valued contributions, any errors or omissions remain the sole responsibility of the authors.

1. Introduction and scope

This chapter introduces the context from which this paper was commissioned, as well as the understanding of command and control (C2) used throughout the wider ongoing study for DCDC. It then situates this paper within the series of concept papers, before laying out research questions and methodology.

1.1. Background and purpose

1.1.1. About Project Mimisbrunnr

Effective and resilient C2 is essential to the basic functions of Defence and to the planning and execution of military operations, up to and including warfighting. While the nature of war remains constant, the character of warfare continues to evolve.[3] So too do the types of missions that the military is expected to undertake, the political, legal and ethical considerations that are placed on decision making, and the threats, technologies and human factors that influence approaches to C2.

According to the UK MOD, C2 is the 'pre-eminent Joint Function' and 'critical to enabling joint action'.[4] Ensuring that C2 systems and organisations remain fit-for-purpose in the face of a changing operational situations and demands is thus essential to maintaining the advantage of the UK and its North Atlantic Treaty Organisation (NATO) Allies over any competitor. To this end, DCDC is conducting ongoing analysis through an initiative known as Project Mimisbrunnr to inform future thinking about C2, including an update to *Joint Concept Note (JCN) 2/17: Future of Command and Control*.[5]

For the purpose of continuity, and in consultation with DCDC, the research team has used the understanding of C2 given in Box 1.1.

Box 1.1 Understanding of C2 as provided by DCDC

'A dynamic and adaptive socio-technical system configured to design and execute joint action' whose purpose is thereby '[to] provide focus for individuals and organisations so that they may integrate and maximise their resources and activities to achieve desired outcomes'.

Source: DCDC based on UK MOD (2017a).

To support this effort, DCDC asked the GSP to produce four exploratory concept papers over the course of 2023 to:

- Inform Defence thinking and experimentation about C2 in the future.

[3] von Clausewitz (1874).

[4] Commander Joint Forces Command, quote. in JCN 2/17. UK MOD (2017a).

[5] Other JCNs tackle the related topics of human-machine teaming (JCN 1/18), information advantage (JCN 2/18) and Multi-Domain Integration (JCN 1/20). Cf. UK MOD (2018; 2020b).

- Explore Defence integration with partners across government (PAGs) and international allies and partners to deliver decision advantage from 2030 onwards (i.e. in the time frame of the Capstone Concepts currently under development).
- Research innovative approaches and revolutionary future understandings of the Integrated Operating Framework.

To this end, Paper 1 aims to provide an indication of how the complexity of the future operating environment (specifically beyond 2030) is likely to shape the capability requirements for C2. It provided a baseline of understanding to inform subsequent papers, each of which explored specific aspects in more detail.[6] Paper 3 explored what might happen to C2 if Defence moves towards conceptualising C2 as a complex capability that is the result of fusing multiple diverse elements. This includes looking at models of organisational change, particularly as applied to large and bureaucratic organisations instituting new approaches to C2 and the associated changes across the Defence Lines of Development (DLODs). Paper 4 discussed at enablers for this evolving capability, particularly in the realm of technology.

1.2. Purpose and questions for Concept Paper 2

Paper 2, meanwhile, is intended to explore the structure of the Defence C2 enterprise in the future, including the types of requirements that an increasingly dynamic and complex FOE is likely to impose. Of note, many of the requirements and associated barriers, opportunities and dilemmas raised by the complexity of the FOE are well recognised in literature; however, the critical question lies in how to take the key steps towards implementation. This paper will endeavour to lay out some of those conceptual issues and their implications in more detail, as a basis for deeper dives into the more practical enablers in Paper 4.

1.2.1. Research questions

The following research questions (RQs) provided by DCDC guided the development of this paper:

- RQ1: Based on current best forecasting of the FOE (i.e. the demand placed upon the C2 enterprise) and the likely state of science and technology (S&T) and workforce trends (i.e. the potential supply of technical and people solutions to enhance C2), what are the opportunities, challenges and dilemmas for designing the future C2 enterprise?
- RQ2: What are the most significant properties that collectively drive the effectiveness of this enterprise? How might these properties interact with each other?
- RQ3: What barriers might need to be overcome to realise these properties within Defence? What opportunities might exist?
- RQ4: What barriers might need to be overcome to realise these properties within a whole-of-society approach? What opportunities might exist?
- RQ5: What new requirements (new capabilities, concepts, functions and necessary activities, etc.) does such an approach entail?

[6] For more information about Concept Paper 1, see Black et al. (2024).

1.3. Methodology

This paper drew heavily on previous work for DCDC, the broader MOD, and Allied defence establishments in the United States, Australia and elsewhere by organisations including RAND. This includes the Force Exploration (FE) 4 and 5 workshops, as well as a number of reports on C2 and the Defence enterprise as listed in the bibliography for this paper. Finally, as part of elucidating the challenges raised by the complexity of the FOE, this paper also builds on the extensive literature review that was conducted for Paper 1.[7]

For this paper in particular, the research team pursued two primary strands of work: a targeted literature review and an expert consultation. The team conducted a targeted and rapid literature review of material related to organisational change management, particularly in large public sector organisations. It then drew on consultations with GSP partners including the University of Exeter and QinetiQ Simulation and Training Ltd (Qtsl). Finally, the research team was able to take advantage of notes from a workshop that DCDC conducted in Canberra in June discussing the future of C2 with expert input from RAND Australia, as well as key stakeholders from the Australian DoD. Participants of this workshop are listed in Annex A. These inputs were then consolidated through internal workshops involving the RAND Europe team and through consultation with DCDC on emerging findings.

1.4. Structure of the document

The remainder of this paper is structured as follows:

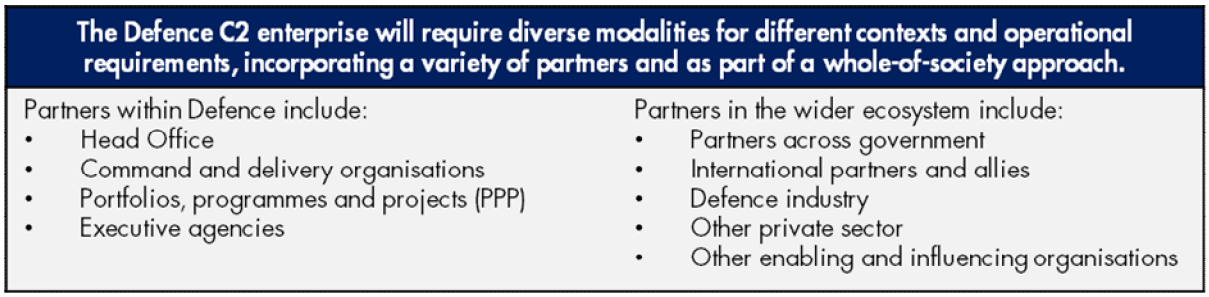
- Chapter 2 discusses the Defence C2 enterprise, in particular the reach of that enterprise in light of the challenges it is likely to face in the FOE.
- Chapter 3 explores the new requirements and properties for Defence personnel that result from the necessary C2 enterprise in the future.
- Chapter 4 examines the barriers and opportunities around implementation of the necessary changes for addressing these challenges and acquiring the necessary properties.
- Chapter 5 sets out conclusions and next steps, including areas to explore in the final two papers.

[7] For additional information about how this literature review was conducted, as well as the findings, see the first paper produced for DCDC, Black et al. (2024).

2. Understanding the Defence C2 enterprise

This chapter seeks to identify how the current boundaries of the UK Defence enterprise are defined, before proceeding to consider the boundaries of the C2 enterprise more specifically. It then considers how these boundaries might change in the future, in particular due to requirements imposed by the FOE. The contents of this chapter are summarised in Figure 2.1.

Figure 2.1 Summary of Chapter 2 findings



Source: GSP research.

2.1. The UK Defence enterprise already spans a wide and diverse ecosystem

UK Defence is expected to respond and adapt to a dynamic context. The 2023 Defence Command Paper Refresh (DCPR), for instance, recognised that the FOE is increasingly contested, and that 'states face increasingly complex and diverse security challenges' ranging from state threats, to non-state actors, to climate change.[8] Paper 1 in this series explored a number of political, economic, social, technological, legal, environmental and military (PESTLE-M) macro-trends that are likely to continue to drive change, as well as some of the corresponding manifestations of complexity.[9]

Given the multiple converging factors that are likely to impact the FOE, Defence is faced with the challenge of preparing for and coordinating effects on and responses to a variety of actors. As a recent RAND publication pointed out, the natural consequence is that 'UK Defence encompasses not only the UK MOD but a wider ecosystem'.[10] As well as the MOD and the Armed Forces operating across all domains, there are diverse other stakeholders relevant across the decision cycle, increasingly including links to allies and partners, PAGs, industry, academia, non-government organisations and even the general public. Cohering

[8] UK MOD (2023a).
[9] Black et al. (2024).
[10] Ogden et al. (2023).

the activities of this diverse set of actors necessarily involves a mix of top-down coordination and bottom-up or lateral collaboration – as well as an inescapable level of inefficiency and disorder – not only between the disparate parts of Defence, but also wider government, industry and society.

The boundaries of the Defence enterprise are already fluid and will likely remain so, with the size and shape of the enterprise required to tackle any one problem and the nature of the relationships between the different internal components in constant flux. For example, previous RAND publications have recognised the pressure on Defence to increasingly take on Military Aid to Civil Authorities (MACA) roles to support civilian agencies.[11] The complexity of the FOE and the diversity of operations that Defence might be called to undertake mean the necessary approaches and appropriate stakeholders are constantly shifting – including the C2 paradigm employed. This requires flexibility from all participants as well as open communication to understand the arrangements at a given moment. Multiple C2 'states' may also coexist simultaneously across the enterprise – differentiated by operation type, a changing threat environment, etc. – and managing multiple different approaches in parallel or switching between them as conditions or priorities change will require trust, practice and careful coordination.[12]

2.1.1. Defence itself is not a single entity

As a recent RAND report for DCDC points out, '[b]oth in the UK and across the world, Defence is made up of a range of organisations'.[13] The same report describes this enterprise's multiple components, ranging from the Department of State to Military Strategic Headquarters and myriad other smaller enabling or delivery organisations.[14] While these organisations often are working towards shared goals, they can often have different visions of how to achieve these goals, reflecting differences in their mission objectives, remit, culture and available means. Table 2.1 provides a brief overview, derived from the existing Defence Operating Model (currently under review).

Coordinating these disparate elements in support of a single united aim is an enduring challenge. One recent manifestation of this is the difficulty associated with realising the full potential of multi-domain operations (MDO). For the UK, Allied nations, as well as adversaries, the challenge has generated a variety of different concepts aimed at better coordinating effects across different domains. New operating concepts such as NATO's Cross Domain Command Concept and the US's Joint All-Domain C2 (JADC2) share a common recognition of the importance of working across diverse domains in a more integrated manner that goes beyond the pre-existing focus on 'jointery'.[15] However, truly integrating activities and/or effects across even a single-domain or in single-issue organisations has proven a significant challenge. Nevertheless, the need for this integration, as well as the level of difficulty involved, is only likely to continue to grow as Defence approaches the 2035 time frame, given the scale and complexity of the challenges presented by the FOE.[16]

[11] Caves et al (2021).

[12] Black et al. (2024).

[13] Ogden et al. (2023).

[14] Ogden et al. (2023).

[15] Priebe et al. (2020); Black et al. (2022); Lucas et al. (2022).

[16] Black et al. (2022); Priebe et al. (2020).

Table 2.1 Key stakeholders within the Ministry of Defence

Organisation	Roles and responsibilities
Head Office	Head Office is responsible for generating and testing the resources and future force structure and capability needs outlined by the Command Paper and other key strategy and policy documents.
Command and delivery organisations	Top-Level-Budget holders (TLBs), including Air Command, Army Command, Strategic Command, Navy Command, the Defence Nuclear Organisation, the Defence Infrastructure Organisation, Head Office and Corporate Services, who are responsible for delivering their respective Command or Organisational Plan.
Portfolios, programmes and projects (PPP)	Each Command manages a sub-portfolio of change and capability programmes, which are funded based on approved business cases and defined benefits outlined in mandates for each Senior Responsible Owner (SRO).[17]
Executive agencies	Organisations that support Defence that fall outside of the single services. These include the overall acquisition and procurement authority, Defence Equipment & Support (DE&S), the Defence Science and Technology Laboratory (Dstl) and specialised offices such as the Submarine Delivery Agency (SDA).

Source: adapted from Ogden et al. (2023).

2.1.2. The Defence enterprise needs to stretch beyond the UK MOD

It is widely agreed that Defence in its narrowest sense – the MOD and the Armed Forces – cannot face the challenges outlined above alone. Instead, as is outlined in Paper 1, it will have to work with organisations outside of Defence, and even outside of government, to collaborate and bring multiple kinetic and non-kinetic levers to bear. Different actors bring different, and in some cases unique, contributions to the Defence enterprise, enabling better response to dynamic situations. These contributions include but are not limited to: sensing and awareness; access, networks, relationships and influence; specialist knowledge and understanding; specialist effectors (e.g. in a given domain or activity); spare capacity and ability to surge; useful geography, basing, infrastructure and supply chains; and underlying IP, technology, industrial or financial resources.

Table 2.2 provides a brief and non-exhaustive overview of the types of actors that are likely to need to be included in the Defence C2 enterprise.

[17] Comptroller and Auditor General (2020) in Ogden et al. (2023).

Table 2.2 External participants in the UK Defence C2 enterprise

Organisation	Roles and responsibilities
Partners across government (PAGs)	Achieving strategic goals will likely require coordinated action with departments across government including HM Treasury, the Cabinet Office, the FCDO, the Home Office, the Department for Education, the Department for Science, Innovation and Technology, the Department for Culture, Media and Sport, UK Export Finance, plus a significant number of other departments and agencies including the intelligence community and law enforcement. This may also include coordination with Parliament, as well as scrutiny assurance and support functions such as the National Audit Office and Public Accounts Committee.
International partners and allies	This group ranges from participants in bi- or multilateral formal agreements (e.g. NATO, the Joint Expeditionary Force, the Five Eyes alliance, AUKUS, the US/UK Mutual Defence Agreement, the Allied Rapid Reaction Corps and the Organisation for Joint Armament Cooperation (OCCAR), as well as countries with whom more ad hoc or transactional cooperation may be needed in terms of, for example, access, basing and overflight.
Defence industry	Includes companies with which Defence and government more broadly have long-term mutually dependent relationships across multiple projects and capabilities, as well as new entrants and start-ups from sectors where Defence is not a dominant customer.
Other private sector	This diverse group encompasses businesses and corporations outside of the traditional industry partners with whom Defence already works on a regular basis, to encompass novel sources of innovation and dual-use technologies (e.g. communications technologies) as well as key stakeholders in societal resilience (e.g. critical national infrastructure). This may include UK or multinational corporations, as well as the finance sector
Other enabling and influencing organisations	Includes citizens, the media, telecommunication companies, academia and non-governmental organisations. Such stakeholders may be based within the UK (e.g. the National Preparedness Commission, the British Red Cross, UK Research and Innovation, the National Trust, etc.) or may play a more global role (e.g. Meta, Twitter/X, the Red Cross, Médecins Sans Frontières, the United Nations and its agencies, etc.). This may also include those with specific expertise, such as anti-terror and cyber security organisations.

Source: adapted from Ogden et al. (2023).

In addition to the use of private contractors in support of Defence operations, for example, Defence might work with financial institutions and PAGs to support the blocking of illicit terrorism finance or prosecute a campaign of economic statecraft against a hostile state actor.[18] Defence also routinely draws on independent research, wargaming and analysis from academic experts and think tanks to inform or challenge decision making, or purchases access to data and services from industry to support operations. It can also take advantage of private sector capabilities such as Starlink's satellite communication constellations or SpaceX's space launch capabilities, or added air- and sealift capacity.

[18] See HM Treasury and Home Office (2021) for a more detailed discussion of HMG's approach to terrorist financing.

Working in collaboration where capabilities already exist in PAGs or the private sector is often significantly more time- and cost-efficient than trying to cultivate new capabilities from the ground up within Defence. However, doing so still requires Defence to continuously foster connections with a diverse range of organisations.

2.2. The Defence C2 enterprise must be able to rapidly combine different configurations of actors to maximise the UK's ability to confront a complex, fast-changing FOE

Different challenges are likely to require varying combinations of stakeholders, often at short notice, and their involvement will manifest in different ways in different contexts. For example, when taking aa 'whole of society approach', different countries organise their resources in different ways: some subordinate everything to the military while others emphasise the importance of civilian control up to the point of a formal declaration of war.[19] Nordic-Baltic countries, for instance, embrace a form of 'Total Defence concept' that differs substantially from the UK's model of civil-military relations and defence/civil defence planning. The various national approaches may be backed by distinct legal powers, institutional structures and cultures or mindsets, and they may not be immediately replicable in the UK given differing political and historical contexts. UK Defence thus needs to determine which bespoke approaches to cooperation with diverse stakeholders are most suitable for its particular requirements.

As an additional challenge, external organisations typically cannot be compelled or controlled by Defence in the traditional sense of military C2; instead, Defence must seek to collaborate and cooperate with, rather than lead or direct, other participants in the enterprise. In some cases, this may require Defence to take an explicitly subordinate role, such as in MACA; this entails following/being influenced, rather than leading/influencing. These varied dynamics require Defence to be able to work effectively in collaboration, compromising with partners with potentially differing objectives and asymmetrical capabilities, concepts, organisational setups and cultures, and means of shaping the FOE.[20] Therefore, the complexity fo the FOE means that, rather than existing as a single organisation or hierarchy, the future Defence C2 enterprise will likely include a shifting variety of diverse organisations working together to achieve common aims when possible. In cases where this is not possible, the aim should continue to be to 'align organisations through unity of purpose', as outlined in JCN 2/17.[21]

The key actors in this space and their salience to a given problem or role within the C2 approach(es) employed for a given operation are likely to change over time and depending on context. Given the trends of increasing complexity and dynamism in the FOE, it seems likely the number of interested parties will only increase.

[19] For examples of how different countries organise their approach to societal resilience and the different roles played by defence, see Caves et al. (2021).

[20] Ogden et al. (2023).

[21] UK MOD (2017a).

2.3. Defence will need to cultivate and maintain multiple parallel relationships with a diverse community of stakeholders

To ensure the contribution of diverse stakeholders to the C2 enterprise in the future, Defence will need to get better at cultivating and maintaining effective relationships with and between them. It will need to be able to draw together different configurations of partners, often at short notice, to tackle emergent challenges or opportunities. This network is something which must be actively developed and organised such that latent relationships can be easily called upon and translated into practical collaborative action when required.

This can be done through a range of existing bilateral and multilateral mechanisms such as joint training and exercising with military allies or PAGs, but Defence has less practical experience with how to develop and sustain close working ties with industry, NGOs, academia or the public. How relationships should be constructed varies by organisation, as discussed in Section 2.2. Continuing innovation in forms of Defence engagement with an increasingly heterogenous mix of organisation types, each with their own internal structures, cultures and ways of working, is thus required. To encourage collaboration, a fundamental shift in MOD culture towards burden sharing and partnering will likely be required.[22] Additionally, Defence will need to experiment with managing a greater number and diversity of parallel relationships with sets of key partner organisations at any one time – some of those arrangements being long term and more formalised, others being more emergent, ad hoc and transitory.

One possible example of an instructive model can be seen in the Divisional (Diversified) organisational phenotype proposed by Henry Mintzberg.[23] Here, a small central team guides multiple highly autonomous units. This organisational structure is common for large multinational corporations which own multiple revenue streams or brands. Decision making is decentralised, with little communication between each sub-system. In this phenotype, each unit could potentially be operating under a different structure, with the common aim of increasing revenue for the parent organisation.[24] Another example is provided in Box 2.1.

Box 2.1 Example – Corporate organisation and franchising at McDonald's

McDonald's, one of the world's largest and most successful fast-food chains, has implemented a divisional organisational structure to facilitate its operations. This structure has evolved over time to enable the company to implement varying strategies simultaneously across a wide geographical range. As one example of this evolution, in 2015 McDonald's transitioned from a geographically based divisional structure (dividing its business into the United States, Asia/Pacific, Middle East & Africa, and Other Countries & Corporate) to one based on market type and strategy (separated into United States, International Lead Markets, High Growth Markets, and Foundational Markets & Corporate). Each of these new divisions operates under its own leadership and organisational structure and has a separate strategy; this is intended to maximise efficiency while maintaining flexibility.

Source: Thompson (2022).

[22] Lucas et al. (2022).

[23] Lunenburg (2012).

[24] Lunenburg (2012).

Mintzberg and McDonald's present examples of teams within a single organisation functioning in a highly autonomous way, and Defence could adapt such models to establish methods for managing the various components of the C2 enterprise. However, this is something which requires the identification of diverse requirements, and then cultivation of necessary skills through learning and training. This topic will be explored in the next chapter. Given the demands of the FOE, as well as the dynamic mission sets that will be faced in the 2030+ time frame, Defence will not be limited to a single monolithic C2 enterprise. Instead, the various C2 modalities required to operate effectively will likely involve shifting coalitions of diverse partners, each with their own structures, hierarchies (or lack thereof), and ways of working, all tailored depending on the task or situation at hand.

This chapter has presented examples of the expansive ecosystem within which Defence must operate, and has discussed the need to be able to rapidly constitute different C2 modalities and to better cultivate and manage diversity and variety within the Defence C2 enterprise as the basis for advantage in the FOE. The next chapter will discuss the requirements that such an approach is likely to impose on Defence.

3. Identifying new requirements

This chapter explores the new requirements that may arise from the increasing need for Defence to achieve two key tasks: developing and delivering conditions-based approaches to C2 and managing the associated bespoke configurations of actors, roles and responsibilities across the enterprise. It also explores the need to shift between these as operational demands change and even to juggle the demands of managing multiple diverse C2 approaches in parallel if so required – a challenge unfamiliar to most organisation types.[25] The chapter first discusses the traits that individuals and teams are likely to require to deliver on this more fluid vision of the future Defence C2 enterprise. It then covers the properties that Defence will likely need to cultivate, support, enable and empower these individuals and teams. The contents of this chapter are summarised in Figure 3.1.

Figure 3.1 Summary of Chapter 3 findings

The Defence C2 enterprise will entail new requirements both for individuals within Defence, as well as for Defence as an organisation.	
Individuals will need a series of capabilities to enable the future C2 enterprise, including: • Comfort with complexity and uncertainty • Soft skills and knowledge • Technical skills and knowledge • Diversity	Defence as an organisation will also need a number of properties, including: • Learning & adaptation • Flexibility & agility • Capacity to promote and absorb innovation • Capacity for interoperability and integration

Source: GSP research.

3.1. Ensuring that individuals with the necessary skills are in place throughout Defence will be a key enabler for C2 in the future

Ultimately the C2 enterprise is and will continue to be made up of individuals, organised into groups and teams. Furthermore, notwithstanding the rapid and unpredictable changes to technology that are likely to occur in the 2035+ time frame, humans are expected to remain key to effective C2 systems well into the foreseeable future, with technology remaining an enabler in most conditions.[26] Ensuring that Defence has the necessary suitably qualified and experienced personnel (SQEP) will therefore continue be a key requirement for enabling the C2 enterprise both to function and adapt over time.

[25] Thompson (2022).

[26] Lucas, et al. (2022).

This section discusses the key requirements that have emerged from previous C2 work in this area, as well as in the literature and research conducted specifically for this paper. Of note, identifying these needs is only part of the challenge. Defence also recognises that it faces significant challenges and a need to innovate in terms of how it accesses, recruits, develops, incentivises and retains individuals with the requisite knowledge and skills across the whole Defence enterprise. As noted in the DCPR and the underpinning Haythornthwaite Review on Armed Forces Incentivisation (HRAFI), novel recruitment strategies and career tracks (see Section **Error! Reference source not found.**.3), as well as new approaches to training and education across Defence, are needed to cultivate and retain the necessary SQEP in a contested labour market.[27]

Some of the associated reforms could go against decades, or even centuries, of military practice: shifting from a bottom-fed, rank-focused and more generalist workforce model towards the cultivation of bespoke career pathways for skill groups or even individuals to cultivate talent in niches such as C2. For example, among its many recommendations, HRAFI emphasised the need for Defence to:

> Recommendation 51: Design career pathways that holistically incentivise skills acquisition, reskilling and upskilling by using all elements of a total reward approach. Skills-based pay is only one element, and often not the one that will make the biggest difference. Each career pathway must clearly define what separate skills and rank based progression looks like, identify key learning and development opportunities and how they map to career path and explicit experience requirements, simplify and focus training, define the markers for increases in the total reward package, and so on. Significant freedoms will need to be offered in these trials to enable this to happen affordably.
>
> Recommendation 52: Reorganise career management around skills groups rather than rank groups for these professions. Once clear pathways are designed, career managers must have the tools and information necessary to manage individuals through them. They will need the flexibility to appoint people of different ranks to the same job. This will also have to operate alongside rank-based career management elsewhere in the organisation. A clear strategic approach will only be possible if leaders drive fundamental changes in process, language, and behaviours.[28]

Such recommendations were developed by HRAFI in relation to all of Defence but hold direct relevance to the acute challenges of developing and effectively employing C2-specific SQEP within the C2 enterprise. Implementing such reforms, building on the commitments outlined in the DCPR, would constitute a major change in Defence's traditional approach to workforce and career management; it is thus likely that any reforms will face barriers of the kinds further discussed in Chapter 4 of this paper. Nonetheless, enabling better access to SQEP is essential if the C2 enterprise is to cultivate the traits discussed below, necessitating that Defence consider a range of models without being bound by legacy ways of organising itself.

3.1.1. Comfort in the face of complexity, uncertainty and change

Given the anticipated properties of the FOE, future personnel involved in C2 systems are expected to need the ability to operate effectively under conditions of uncertainty, complexity and rapid change.[29] This may include specific knowledge of prescribed or established methods for thinking about complexity, such as

[27] UK MOD (2023b). RAND was a key partner in the production of the Haythornthwaite review, conducting much of the underpinning analysis.

[28] UK MOD (2023b).

[29] Black et al. (2024).

those outlined in Paper 1.[30] Personnel will therefore need sufficient experience to be comfortable making decisions in circumstances of uncertainty, thus gaining the ability to operate and excel, both cognitively as an individual and organisationally, when dealing with simple or complicated situations, and thrive in the face of complex 'wicked problems'.[31] Such abilities should be spread throughout the organisation, rather than just existing at the top levels, as distributed authority is likely to be a feature of many C2 enterprises in the future, not least given the projected threat environment discussed in Paper 1.[32]

Some of this ability set is based on aptitude; Defence will therefore need to think about how it can identify and attract suitable individuals, potentially through novel recruiting methods. Other skills can be enhanced with training and education, partly through formal teaching and practise of specific approaches such as systems thinking, and partly via on-the-job experience with taking decisions and exploiting opportunities under unfamiliar circumstances.[33] Training and education in this area will need to be persistent and ongoing in order to adapt to changing requirements; considerations about comfort with complexity may also need to be integrated into various areas of professional military education to ensure continuous exposure.

3.1.2. Soft skills and knowledge

The increased need to operate in the face of uncertainty is only one change that will have significant implications for the types of so-called 'soft' skills and training that may be required to enable C2 in the future. The growing requirement to work with a shifting array of internal and external partners, many of whom will come with different hierarchies or organisational models, will require interpersonal skills such as relationship building, empathy, cultural understanding and the ability to exert influence.[34]

Additionally, new forms of subject matter expertise (SME) are likely to be relevant for better understanding adversaries as well as partners, especially where Defence is working with or against actors with whom it does not have a long track record (e.g. when looking at new partners beyond the United States and NATO, or engaging with emerging private sector players beyond the traditional defence industry).

3.1.3. Technical skills and knowledge

Just as interpersonal and other soft skills are important, so too are the technical skills required to understand the technologies that will enable C2 in the future. Advances in AI, computational power and communications technology[35] are examples of areas of innovation that, if implemented and exploited effectively, could enable a transformation in approaches to C2 in the future. This makes it crucial to ensure that Defence employs individuals with the ability to critically engage with emerging technologies, and incorporate them within the C2 workflow effectively while mitigating any associated risks or biases.[36] Skill gaps persist across Defence, hampering the sector's ability to effectively use and de-risk new technologies. Data literacy, in particular, is missing at the higher levels of military organisation.[37] Building these

[30] For more information about specific methods of thinking that can be used to address complexity, see Concept Paper 1, Black et al. (2024).

[31] Hughes et al. (2023).

[32] Lucas et al. (2022); Black et al. (2024).

[33] See Black et al. (2024) for more information about the various approaches to complexity.

[34] Lucas et al. (2022).

[35] These are some of the many example technologies which may impact C2, a topic explored in greater detail in Concept Paper 4.

[36] Balis & O'Neill (2022). The integration of novel technologies into C2 systems will be discussed in greater depth in Section 3.2 of this paper, as well as in Concept Papers 3 and 4.

[37] Davies (2023).

foundational skills is a pre-requisite if literacy in advanced technologies, such as AI, is required in the future across different aspects of Defence.

Individuals across the Defence C2 enterprise will need to be equipped with specific hard skills and technical knowledge to design and improve C2 systems, as well as understand, de-risk and operate the types of technology that will underpin C2 systems so as to get the most out of these advances. Additionally, Defence will need to improve collaboration with industry in order to ensure the available space to encourage innovation in this area (see Section 3.2.3 for further discussion about promoting and absorbing integration across the Defence enterprise). Box 3.1 offers an example of the importance of having appropriately skilled individuals in the necessary places.

Box 3.1 Example – USHealthCare.gov and the need for technical skills

One clear finding from the literature is that involving staff with the right technical skills from the beginning is key. If a new technology is driving changes to an organisation, it appears to be vital that suitably skilled staff are involved in the planning, execution and monitoring of the transformation effort.[38] For example, the USHealthCare.gov insurance exchange had to be radically re-structured three years after its launch in 2013, because the 'right people with the requisite deep technical skills were not asked to help shape the strategy and monitor its implementation'.[39] An agile team of specialists was required to reform the website, drawing on technical skills that the initial leadership team lacked. Ensuring the right people are involved at various levels *from the start* will therefore be crucial to C2.

Source: GSP research based on Balis & O'Neill (2022) and Allas et al. (2018).

However, Defence's ability to access and employ individuals with the requisite computer science, data science, systems thinking and other STEM knowledge and skills is and will likely remain challenged.[40] These skills will continue to be in high demand both in the private sector and other areas of government, creating significant competition should Defence seek to directly recruit these individuals. Previous publications note concerns about losing potential individuals to higher-paying jobs in the private sector, particularly for those with technical skills.[41] There have been numerous suggestions about how to address this, both by cultivating Defence's internal workforce through, for example, providing non-monetary incentives such as training, and by creating mechanisms via which Defence can access external talent (e.g. through the Reserves, contractors, secondments, gamification and crowd-sourcing of inputs, etc.) on a more ad hoc basis.[42]

3.1.4. Diversity

Access to a diverse set of actors, levers or resources either as part of the system or through a call for external resources (with accompanying implications for speed) is perceived to be a key enabler of adaptability, agility and resilience.[43] Additionally, varying types of background and experience will support Defence as it seeks to collaborate with the shifting array of actors who will make up C2 networks in the future.[44] Determining the necessary levels of diversity will require iteration; the level and types of required diversity will also likely

[38] Allas et al. (2018).

[39] Allas et al. (2018).

[40] Lucas et al. (2022).

[41] UK Ministry of Defence (2023b); Hughes et al. (2023).

[42] UK Ministry of Defence (2023b); Hughes et al. (2023).

[43] Hughes et al. (2023); Lucas et al. (2022); DCDC Canberra Workshop, June 2023. External resources in this case may imply use of Reserves, or of external contractors and other areas of private industry that are not part of the traditional Defence establishment.

[44] Lucas et al. (2022).

change over time. Achieving such diversity will undoubtedly involve many different types of characteristics, including the skill sets and aptitudes discussed in Sections 3.1.2 and 3.1.3 above as well as varying experience and background.

Diversity is seen not only as an enabler of C2 systems themselves, but also of the organisational change that will be required to achieve such systems. The presence of diversity of perspective, thought and skillset within an organisation has been demonstrated to lead to improved outcomes, including enhanced innovation performance, problem-solving abilities, knowledge creation and organizational commitment.[45] These factors enable teams to generate and exchange a wider range of information and knowledge, strengthening the capacity of C2 systems. Change management literature has found diversity to be critical in other large-scale change efforts: for example, diversity was found to be a key enabler of cultural change in the police and private sector.[46]

Of course, diversity also raises its own set of challenges in terms of ensuring shared understanding and frames of reference. This further increases the importance of cultivating the skillsets discussed above, as well as cultivating a common sense of mission and purpose to avoid the risk of misalignment, incoherence and conflict within the organisation.[47]

3.2. To enable C2 systems in the future, Defence as an organisation will also need to cultivate a number of characteristics and abilities

In addition to having individual personnel with certain characteristics or experience, organised within effective teams, Defence as an organisation will also need to cultivate and exhibit specific properties to enable C2 systems to function effectively in varied and challenging settings. While the following section is by no means exhaustive, literature identified the following four areas as being of most prominence: learning and adaptation; flexibility and agility; capacity to promote and absorb innovation; and capacity for interoperability and integration. Of note, all involve trade-offs, which are discussed in more detail in Chapter 4.[48]

3.2.1. Learning and adaptation

As the FOE continues to be a dynamic and complex space, the requirements for C2 systems are similarly likely to change at pace.[49] Thus, in addition to a single C2 system being highly unlikely to suit all situations, it will not be optimal to maintain systems in a static manner; instead, the sector will need to change and adapt over time to meet the evolving contexts in which it must achieve its goals.[50] C2 systems will therefore require the ability to monitor, identify and understand signals of the need for change (e.g. in C2 approach) and then make the pan-Defence Lines of Development (DLOD) changes necessary and to do so at relative pace (determined by scale of implementation and time frame).[51]

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[45] Slapakova et al. (2022).

[46] Martin (2022). A more detailed discussion of drivers of cultural change is included in Concept Paper 3.

[47] Training and exercises, as discussed in Concept Paper 3, are also an important for establishing this shared understanding. Ellis, et al. (2024).

[48] The challenge of balancing trade-offs between requisite properties is further explored in Concept Paper 3. Ellis et al. (2024).

[49] See Black et al. (2024) for more information about complexity in the FOE.

[50] Hughes et al. (2023).

[51] Lucas et al. (2022).

This will mean establishing mechanisms for the testing and iteration of new C2 concepts and organisations, both in an experimental context and on live operations, as well as ways to identify and incorporate lessons from previous attempts, including failure. Section 4.1.4 talks in more detail about the importance of creating space to fail, which will likely be a key enabler of this characteristic and requires shifts in organisational culture, mindset and incentive structures (e.g. around career progression and leadership) given the current pressure at all levels to avoid (or mask) failure.

3.2.2. Flexibility and agility

The projected complexity of the FOE means that Defence will likely need to move between, or manage in parallel, different C2 configurations and teams to both proactively mitigate and respond to the impacts of fast-changing and dynamic events.[52] This raises a need for 'conditions-' or 'scenario-based C2', referring to the evolving realisation of multiple C2 systems and modalities, each including different stakeholders and sets of interrelationships between them, as well as a range of potential approaches and effects based on circumstance.

While agility is not equivalent to speed, gaining decision advantage by outmanoeuvring adversaries' relative decision making cycles and times to effect will often be a necessary enabler to create and exploit emergent windows of opportunity.[53] This likely means that Defence will need to have multiple different, highly modular systems and collaboration frameworks in which partners (whether internal to Defence, drawing from across government, or international allies and partners) can come and go as needed, with lead times or interoperability barriers minimised wherever possible to enable the desired agility.[54] The ability to organise the C2 enterprise to enable moving between systems or approaches in a timely manner will thus be a key requirement for C2 in the future.[55]

3.2.3. Capacity to promote and absorb innovation

The ability to support identification, development and integration of new technology, tools, concepts, etc., to the enterprise at pace and scale, overcoming pan-DLOD barriers (notably including organisational culture and the mindset around risk), is also important. Innovation, while frequently involving technology, is nevertheless a human-centred process. Encouraging diversity of thought, and an organisational resilience which allows for the capacity to fail, are just as essential as technological adaptation for the promotion of innovation.[56]

The literature on innovation diffusion as it relates to emerging technologies suggests that there are different forms of knowledge: 'awareness' of new technologies, 'principles' knowledge of how the technology could be used, and then 'how to' knowledge concerning the practical implementation of those technologies in a given context.[57] All are considered key to successful, technology-driven transformations. A series of case studies into technologically driven transformations in the NHS found that change efforts often failed to educate their leadership or staff on the practical 'how to' aspect of new technologies, contributing to the

[52] Dodd & Markham (2012). Dodd & Markham offer more discussion of multiple ways in which C2 can be more agile in the future, including through changes intended to anticipate future events and optimise function, rather than simply responding to events.

[53] Lucas et al. (2022).

[54] Hughes et al. (2023).

[55] For additional discussion of how organisations can enhance their agility to create new C2 capabilities for unanticipated circumstances, see Bjurström et al. (2021).

[56] Callegaro (2017).

[57] Kyratsis et al. (2012).

failure of 12 technology adoption decisions out of a total of 38 considered.[58] This supports wider evidence suggesting that engaging employees early with respect to emerging technologies or the implementation of novel ideas and approaches is key to enabling successful transformation.[59]

3.2.4. Capacity for interoperability and integration

As discussed in Chapter 2, C2 systems in the future will likely require the ability to converge effects across all domains and Services, but also to collaborate more effectively with a diverse range of actors across and beyond UK Defence (e.g. PAGs, allies, industry, etc.).[60] Looking out to the 2030s and beyond, effective C2 systems are therefore expected to facilitate interoperability and cooperation between a wide variety of partners: not only between humans across different organisations, but also between humans and AI and with robotic and autonomous systems (RAS).[61] Challenges including seams between domains, technical interoperability challenges, and novel domains, are expected to continue to create barriers and obstacles to such effective cooperation.[62]

Balancing the UK's desire for sovereignty with the strategic and operational benefits of integrating technologies and organisational systems with key allies like the United States and NATO will also be a challenging issue to navigate. On the one hand, an interoperable C2 system could enhance the effectiveness of joint or multinational operations. Yet centralised, consistent systems bring with them the risk of having a singular point of failure, whereas a more diverse approach with built-in redundancies could prove more robust and resilient, spreading the focus of adversaries. The role of advanced communications technologies, AI and quantum technologies also suggest that the private sector organisations driving these industries could be valuable potential partners supporting not only the traditional acquisition cycle but also the delivery and continuous improvement of C2 capabilities during live operations in the future.[63] Establishing productive working relationships will be a crucial challenge to navigate, both from a security point of view – in terms of the information shared – and in relation to practical issues such as overcoming the enduring barriers to developing, acquiring and fielding new systems and platforms in a timely and cost-efficient manner.[64]

[58] Kyratsis et al. (2012).

[59] Dillon et al. (2022).

[60] Priebe et al. (2020); Lucas et al. (2022); Hughes et al. (2023); Black et al. (2024).

[61] Retter, Lucas et al. (2021).

[62] Priebe et al. (2020).

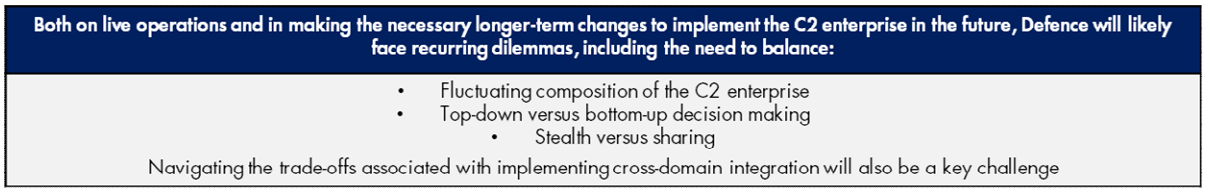
[63] Balis & O'Neill (2022).

[64] For a more detailed discussion on the challenges of Defence forming relationships with industry, or on acquisition, see Retter, Muravska et al. (2021).

4. Navigating recurring dilemmas

This chapter identifies some of the barriers and opportunities that Defence is likely to encounter in implementing changes of the kind needed if it is to achieve the organisational- and individual-level properties outlined in the previous chapter. It begins by addressing three specific recurring dilemmas that C2 systems will face in the future, before moving on to a brief discussion of the overarching challenge of multi-domain integration. The chapter's findings are summarised in Figure 4.1.

Figure 4.1 Summary of Chapter 4 findings



Source: GSP research.

4.1. The requirements anticipated for C2 systems in the future raise several trade-offs and dilemmas that Defence will have to resolve

The recognition of a need for scenario-based C2 refers to the realisation that multiple C2 systems including different configurations of stakeholders, and thus different C2 enterprises – whether existing sequentially or in parallel – will be needed to meet the requirements of the FOE.[65] The FOE will likely require the cultivation of certain properties across an ecosystem of diverse structures, processes and stakeholder configurations. For each C2 system or approach thus adopted, decision makers will face key trade-offs with regard to how they organise. This section therefore discusses three key dilemmas[66] that emerged repeatedly in the research undertaken for this paper, namely:

- Managing fluctuations in the composition of the Defence C2 enterprise
- Weighing top-down versus bottom-up decision making
- Balancing security versus sharing.

[65] Clark et al. (2020); UK MOD (2017a).

[66] This is not intended as an exhaustive list but rather a representative list of some of the key challenges that the research team perceived as being most critical in C2 systems in the future. Concept Papers 3 and 4 explore such issues further. Ellis et al. (2024); Lucas, Harrison et al. (2024).

Additionally, it should be noted that any changes to something as large, complex and comparatively poorly understood as the Defence C2 enterprise will have cascading effects and unintended consequences elsewhere. This will likely create additional emergent challenges and problems as the transition progresses.[67]

4.1.1. Efficiency versus flexibility, adaptability and resilience

As discussed in Chapter 2, in the future Defence is unlikely to have one single, monolithic C2 enterprise that can be clearly defined and isolated; instead, the size, shape, composition, internal dynamics and external interfaces of the Defence C2 enterprise are likely to fluctuate depending on a variety of contextual factors such as the actors involved, the nature of the operational challenges or opportunities faced, and the time frame and environment in which a particular action needs to be taken.[68]

The more specifically these different Defence C2 enterprises are defined, the easier it will be to design systems and approaches that are best suited to their requirements; however, this then precludes the necessary flexibility to move between each and to bring in new partners as needed (see Section 0). Optimisation for one specific setting, task or problem brings efficiency, but at the expense of flexibility, adaptability and resilience – the building blocks of robustness – in the face of deep uncertainty and potential unexpected shocks from the FOE.[69] Conversely, a 'jack of all trades' approach risks being a 'master of none', ceding the advantage to hostile actors; this is especially problematic for expeditionary powers such as the UK or US, who have global commitments and interests, and thus struggle to optimise for specific regional problem-sets in the way that, say, Russia, China or Iran can.[70]

Decision makers will thus need to focus on where the benefits of such a bounded definition outweigh the loss of flexibility, versus those situations in which that flexibility must be the priority.

4.1.2. Top-down versus bottom-up decision making

Another dilemma relates to whether change should be driven from the top down or the bottom up. This is applicable both to the long-term question of reforming the C2 enterprise, and the more near-term demands of decision making in an operational setting.

There is a great deal of discussion in the literature about C2 in the future regarding whether the best way to pursue the transformation of the Defence enterprise is through top-down change programmes, or by encouraging more bottom-up and loosely controlled experimentation in structures, processes, technology, etc., from across the organisation.[71] Early change management literature, stemming from Kurt Lewin's three ideas of 'planned change' – involving unfreezing, shifting and refreezing behaviour – gradually became criticised for promoting an overly hierarchical notion of change, and for suggesting that organisations were so slow moving that their behaviour and ways of working could be fixed.[72] These ideas became replaced by 'emergent' models of change. Emergent theorists still emphasised the role of leadership; however, they characterised it with a greater emphasis on empowering other people to act on their vision, through such methods as creating achievable 'small wins' to sustain motivation over protracted periods of change.[73]

[67] Taylor & Louth (2020).
[68] Lucas et al. (2022).
[69] Black et al. (2021).
[70] Lempert et al. (2016); Popper (2022).
[71] Hughes et al. (2023).
[72] Rawson & Davis (2023).
[73] Kotter (1995).

Thus, while successful change efforts often have a strong, decisive leadership driving transformation, many of the most successful and enduring transformations draw upon the expertise of frontline staff and sustain motivation through regular two-way communication.[74] Striking the right balance between directed change programmes on the one hand, and encouraging input and engagement across the organisation on the other, will be a major challenge to navigate. Frontline and operational staff also have crucial insights that a senior leadership team may lack, lending weight to the argument that change should be driven in a more bottom-up fashion.[75] Additionally, while this section primarily discusses these trade-offs in the larger organisational sense, the same dilemmas will be present in teams of every size, and will need to be addressed.

The ability to be flexible and adapt quickly to situations of low or no connectivity will be a key capability for C2 systems.[76] While some of the solutions may be non-technical (e.g. simple visual or audible signals to replace more sophisticated communications), in order to mitigate the risk of decision paralysis presented by loss of established C2 hierarchies, decision makers will have to weigh the risks created by devolving authority to lower levels (e.g. slower speeds of decision making, inefficiencies or redundancy, pursuit of conflicting agendas, etc.).[77] As noted in Section 3.2.3, not only will personnel need to be comfortable operating in the face of uncertainty, but also commanders will need to be comfortable that, in such a situation, their subordinates will correctly understand their intent and continue to take appropriate action (e.g. when reaching back to higher echelons is not possible). Furthermore, they will need to be sure that that action does not create major unintended consequences in other areas or domains, facilitating convergence of effects across domains without degenerating into self-defeating incoherence of action.[78] This is likely to be an area where trial and error will be required (see Section **Error! Reference source not found.**), as individuals learn to adjust to new hierarchies and respond to communications or C2 outages.

4.1.3. Security versus sharing

Technology offers the promise of consistent, reliable C2 systems that enable constant sharing of information between dispersed teams and nodes in multiple domains to enhance shared situational awareness.[79] However, while such shared awareness would be useful for coordinating activities, constant sharing would almost necessarily make dispersed teams more vulnerable to detection and thus targeting by hostile forces.[80] Decision makers will therefore need to decide the circumstances under which sharing information is worth the risk and those in which stealth and survivability are paramount.[81]

Furthermore, while some of the answers to this quandary will be technologically based (e.g. enhanced signature management, hardening of headquarters, improved active defences), others will be non-technical or procedural solutions.[82] This may include dispersing future deployed headquarters or communications capabilities; however, it will likely also involve systems to better prioritise which information needs to be shared and when, and how to prioritise various communications under certain circumstances.

[74] Allas et al. (2018).
[75] Allas et al. (2018).
[76] Lucas et al. (2022).
[77] Black, Gustafson et al. (2022).
[78] Ogden et al. (2023).
[79] Hughes et al. (2023).
[80] Lucas et al. (2022).
[81] Watling (2023).
[82] Lucas et al. (2022).

4.2. Integration across domains is anticipated to be a key challenge for C2 in future multi-domain operations

In the future, C2 systems are anticipated to require integration of actions and effects across multiple domains, including not only the five military domains recognised by the UK (land, air, maritime, cyber and electromagnetic, and space) but also more contested concepts such as the 'human' domain and the information environment. In contrast with previous 'joint approaches', multi-domain operations (MDO) involve collaboration and understanding the convergence of effects between and across domains, rather than just understanding warfighters in different domains operating in parallel.[83] Many countries, including the UK, its partners and allies, and its adversaries, have been working to develop effective approaches to operating in this manner, including the USAF's JADC2 and NATO's Cross Domain Command Concept.

Such cross- or multi-domain approaches require at the very least enhanced interoperability between Services, but also ideally allies, partners, PAGs and others, and more importantly, a C2 approach that is sufficiently robust but also adaptable to new environments and challenges.[84] There are significant implications for training and exercise requirements, as well as doctrine and operating concepts.[85] In addition, new ways of operating and organising personnel to ensure sufficient expertise in and familiarity with working within and across different domains may be required, as discussed in Box 4.1.

Box 4.1 Example – JADC2 and multi-domain planning

Previous RAND research for the USAF has shown that, because planning staff typically come from a single service, they often lack a comprehensive understanding across all domains. Further, even when they reach out to planners experienced in other domains, such individuals are often not an integrated part of the team, and therefore may be subject to classification constraints or simply may not be available consistently. External experts may also be viewed as 'outsiders' or advocates for their service, rather than a full planning partner or unbiased subject-matter expert (SME). To ensure that they have the correct personnel, expertise and trust in place, the USAF has started a new career field for multi-domain planners. Determining how these multi-domain planners collaborate with domain SMEs, however, remains a key challenge for USAF.

Source: Priebe et al. (2020).

As Defence goes about managing the type of organisational transitions and changes that will be required to enable C2 systems, it will continue to face a number of dilemmas and trade-offs, as well as the overarching challenge of coordinating multi-domain effects. How to balance these trade-offs is an issue that has been explored at length in prior RAND research for DCDC, as well as the NATO C2COE and the American and Japanese militaries, but for which there is still no definitive answer as countries around the world continue to experiment with multi-domain C2 approaches and associated technical and non-technical solutions.[86]

The 'right' answer to any particular dilemma may also change depending on the context in which a C2 system must operate; furthermore, challenges will change over time as the FOE evolves. However, the basic nature of these dilemmas is likely to persist across different C2 systems.

[83] Lucas et al. (2022).

[84] NATO C2COE (2021); Black, Gustafson et al. (2022); Tammen (2021).

[85] Marler et al. (2022); Priebe et al. (2020).

[86] Johnson (2018); Priebe et al. (2020); Lingel et al. (2020); Black & Lynch (2021); Hornung et al. (2020); Lingel et al. (2021a; 2021b); Black et al. (2022); Marler et al. (2022); Marler et al. (2023).

5. Conclusion

Building on the earlier findings of Paper 1, which outlined the likely PESTLE-M trends shaping the FOE and examined how this complexity will drive a need for new approaches to C2, this second paper has explored how the Defence C2 enterprise will likely manifest, and the requirements this will impose:

- The envisaged complexity of the FOE means that the Defence C2 enterprise in the future will need an ability to fluctuate between different conditions-based C2 approaches as different collaborators, contexts and challenges arise. Defence must be able to generate, enact and dispense with multiple different configurations and paradigms as changing conditions require, and juggle multiple different C2 modalities in parallel – a substantial organisational challenge without easy solutions.
- As Chapter 2 discusses, this means that a single monolithic 'Defence C2 enterprise' will likely be inappropriate; instead, a number of scenario and/or time-bound modalities will need to operate in parallel or in collaboration. Definitions of the enterprise will therefore need to be inclusive and comprehensive, but also flexible enough to accommodate new stakeholders and configurations.
- Chapter 3 elaborated on the ways in which this requirement for multiple, flexible and transitory C2 modalities will require personnel with certain characteristics and skills. While not an exhaustive list, the literature emphasises the importance of several areas, namely: comfort in face of complexity, soft skills, technical skills and knowledge, and diversity.
- Chapter 4 covered the dilemmas that will need to be addressed, likely differently in different circumstances, as well as the overarching challenge of how to realise the much-discussed but still not fully realised benefits of integration across domains. While no two systems will require the same combination of factors, the trade-offs are likely to be similar across different C2 systems. While often thought of as having technological fixes, many of these trade-offs will in fact require different decisions based on both varying circumstances and the constraints and opportunities afforded by the different organisations and personnel involved.

The need for multiple C2 enterprises that span not only different parts of Defence but also extend to external partners suggests that Defence needs to be thinking of C2 from the beginning as a discrete capability that will be proactively cultivated and embedded throughout the enterprise, rather than simply a task that can be allocated to specific individuals at particular times.

Concept Papers 3 and 4 will explore how Defence can think of C2 as a capability, as well as what some of the key enablers will be for C2 systems in the future, particularly involving technology.

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Annex A. Workshop participation

A.1. Workshop 2

The second expert workshop was multi-day workshop held at the Australian Department of Defence (DoD) with participants from the Australian Defence Force, the Australian Defence Science and Technology Group (DSTG), and other experts present in Canberra in June 2023. Attendees at this workshop were as follows:

Table A.2 List of Canberra workshop participants

Date	Name	Organisation
	Dr. Nicola Broderick	DSTG
	Dr. Susan Cockshell	DSTG
	Dr. David Crone	DSTG
	Mr Gavin Dickeson	DSTG
	Mr Paul Durrand	DSTG
13 June	Dr Simon Ellis-Steinborner	DSTG
	Mr Duncan Fletcher	DSTG
	Dr. Caroline Fryer	DSTG
	Ms Janet Hocking	DSTG
	Mr Hing-Wah Kwok	DSTG
	Dr Wesley McTernan	DSTG
	Dr Adam Saulwick	DSTG
	AIRCDRE Arndell Adams	Australian Defence Force
	Dr Cameron Bowles	DSTG
	COL Kurt Brown	Australian Defence Force
	GPCAPT David Clyde	Australian Defence Force
	CDRE Matthew Doornbos	Australian Defence Force
	AVM (R) Andrew Dowse	RAND Australia
	Dr Andrew Flahive	DSTG
	COL Daniel Hartigan	Australian Defence Force
15 June	GPCAPT Matthew Harvey	Australian Defence Force
	Dr Alexander Kalloniatis	DSTG
	Dr John O'Neill	DSTG
	Dr Dale Quinn	DSTG
	Dr Cayt Rowe	DSTG
	Dr Saad Saleem	DSTG
	WGCDR Robert Seabrook	Australian Defence Force
	LTCOL Carolin Skoog	Swedish MOD
	Mr Duncan Tailby	DSTG
	CDRE Stuart Watters	Australian Defence Force
	Cdr Leif Hansson	DCDC
	Lt Col Robert Kace	DCDC