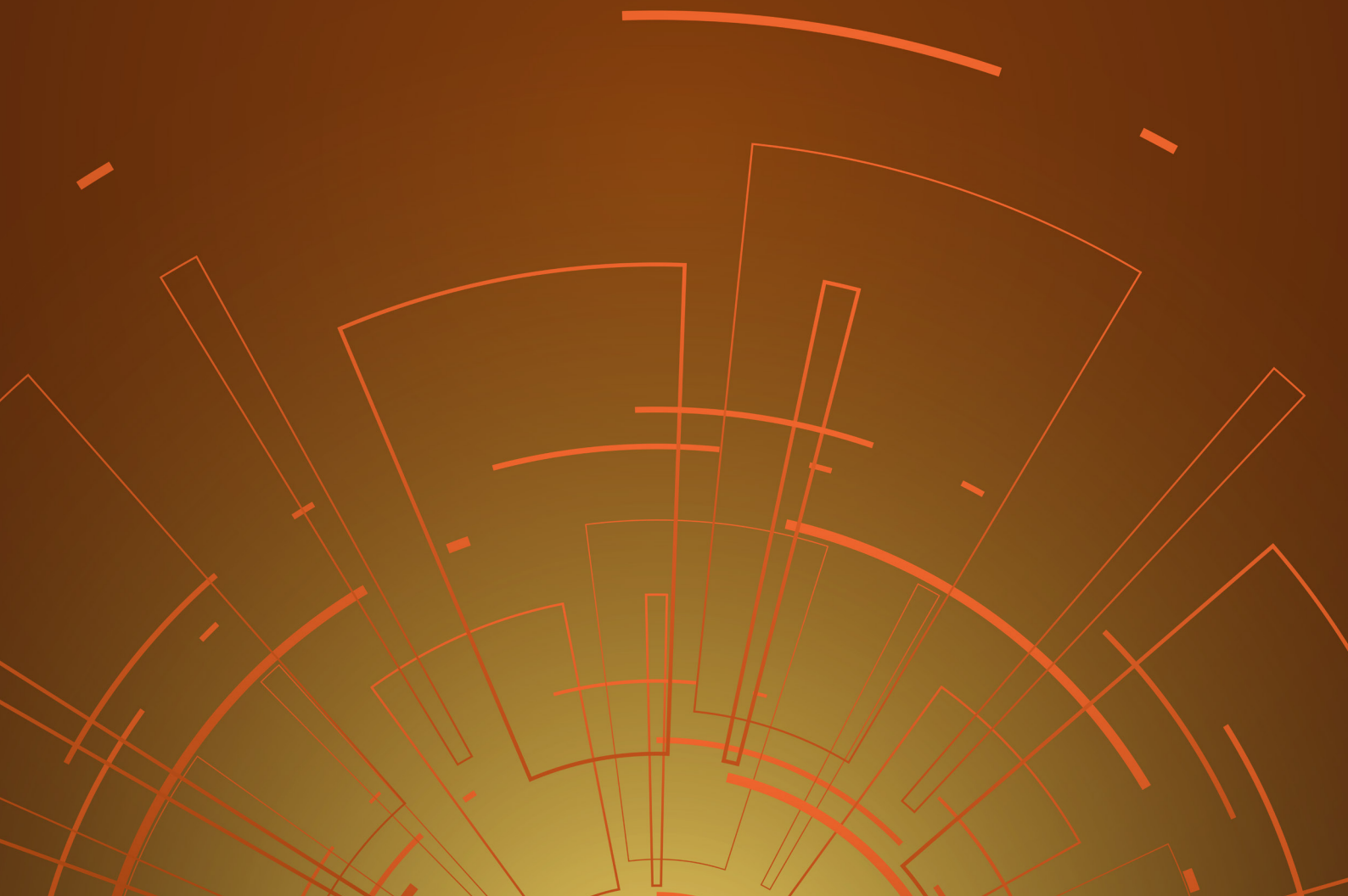


Command and Control in the Future

Concept Paper 3: Conceptualising C2 as a Capability

Conlan Ellis, Rebecca Lucas, Ben Fawkes, Martin Robson,
Alan Brown, Edward Keedwell, James Black



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Preface

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

- **CP1:** James Black, 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 (henceforth Black et al. (2024));
- **CP2:** Rebecca Lucas, Conlan Ellis, James Black, Paul Kendall, John Kendall, Stephen Coulson, Peter Carlyon & Louis Jeffries. 2024. *Command and Control in the Future: Concept Paper 2 – The Defence C2 Enterprise*. Santa Monica, Calif.: RAND Corporation. RR-A2476-2 (henceforth Lucas et al. (2024a)); and
- **CP4:** Rebecca Lucas, 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 (henceforth Lucas et al. (2024b)).

This report is part of a series commissioned by the Development, Concepts and Doctrine Centre (DCDC). As of 1 July 2024, DCDC has been renamed as ‘Defence Futures’, part of the Integration Design Authority. The overarching study is being delivered by 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 third 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 papers 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

This paper considers the development of Command and Control (C2) as a capability to enable the Defence enterprise to better tackle the challenges it is likely to face in the future operating environment (FOE) out to 2040 and beyond. As the third in a series of four Concept Papers (CPs), it builds on previous papers discussing the complexity of the FOE (CP1) and the definition of the Defence C2 enterprise (CP2). It will be followed by a fourth CP that goes into more detail on those enablers, such as new technologies, that would be relevant to achieving a new approach to C2 in the future.

This paper first sets the context and background for this series, including why Defence might wish to conceive of C2 as a continuously evolving capability in the first place. It then delves into how Defence can better enable its people across the organisation, before discussing how Defence itself will need to evolve as an enterprise to enable the cultivation and delivery of novel C2 systems in the 2040 time frame. It ends with a discussion of ways in which Defence can better incorporate new technologies into C2 systems in the future, as a prelude to further analysis of specific technologies in the upcoming CP4.

Conceiving of C2 as a capability

Rather than thinking about C2 as a static set of defined activities that take place across Defence, this paper encourages the discussion of C2 as a more fluid socio-technical capability that must be continuously cultivated in Defence to address the scale and complexity of the challenges that are likely to be faced in the FOE. Such a conceptual approach is taken primarily to enable more holistic and comprehensive understanding of the multiple activities across Defence that must take place to create and enable the C2 systems in the future; such systems will underpin the UK's defence capabilities, such as kinetic fires or the nuclear deterrent. Such activities will need to take place across the Defence Lines of Development (DLODs) and in diverse and varied parts of Defence, including scientific research, procurement, personnel recruitment and training, and the organisational structures and institutional culture of the enterprise itself.

The research team thus concluded, based also on extensive consultations with DCDC and international experts convened for a series of hybrid seminars on C2 in the future, that such a coherent effort was most likely to occur if perspectives within Defence shift to consider C2 as a capability in its own right.

Enabling people to cope with complexity

While developing personnel was discussed at length in CP2, the topic was seen as sufficiently important to be revisited here through the prism of C2 as a capability. Chapter 2 explores four priority areas:

- **Strategic capability management of C2 as a socio-technical system** to ensure that the enterprise is designed and managed in a manner that contributes to an integrated capability with mutually reinforcing social and technical elements.
- **Promoting persistent learning and development** across all levels of Defence to prepare personnel to carry out tasks under conditions of uncertainty and complexity, including where guidance is limited or reachback to higher echelons (e.g. more senior commanders or headquarters) or supporting organisations may not be available.
- **Equipping personnel for different modes of collaboration** across Defence, and also with external partners across government (PAGs), industry, or international allies and partners. This goes beyond traditional hierarchical approaches to ‘command’ and ‘control’ to reflect the growing need for Defence to operate in settings where it cannot compel or necessarily even influence other actors.
- **Sharing insights and information and being willing and able to learn and adapt** to enable Defence to better enact lessons from itself, from its adversaries and from those with whom it collaborates. This is essential to continuously adapt and refine ways of thinking and working, and C2 processes.

Evolving the enterprise to cope with complexity

To cultivate C2 as a capability fit for the complexity of the FOE, much of the literature and many experts argue that the wider Defence enterprise is going to need to change – both in terms of its formal structures and less tangible aspects of its institutional culture. Chapter 3 explores these two aspects:

- **Applying established change management frameworks** from academic and corporate literature may enable Defence to better design, plan, communicate, ‘sell’ and implement necessary changes to organisational structures, even if the new structures are controversial in some quarters. Such frameworks can serve as a blueprint or guide for conceptualising change and how to instigate and sustain the necessary adjustments across the C2 enterprise, helping minimise any barriers and opposition. Equally, it must be recognised that many transformation programmes within Defence (or analogous organisations) fail, and so the lessons from past initiatives must be learned.
- **Leveraging good practice in enabling cultural change** is similarly essential to help change the less tangible, normative aspects of Defence and its institutional culture. The relevant section also discusses why this is a more difficult task, and how some of these obstacles can be overcome.

The chapter concludes that neither organisational nor cultural change alone is likely to be sufficient: both will be necessary to achieve the C2 capabilities that the team believes will be needed in the future.

Integrating technology to enable the C2 enterprise

The final section of the paper, Chapter 4, looks at the challenges of effectively leveraging the new and emerging technologies that will underpin C2 systems in the future. It first discusses the challenges of digital transformation. It then discusses how, upon identification, Defence might go about better and more rapidly integrating new technologies alongside existing ways of working and legacy technical systems to create the successful socio-technical conditions for a transformed approach to cultivating C2 as a capability.

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Abbreviations

ABF	Australian Border Force
ADF	Australian Defence Force
AI	Artificial Intelligence
BLCM	Burke-Litwin Change Model
C2	Command and Control
C5I	Command, Control, Communications, Computers, Cyber and Intelligence
CDDO	Central Digital and Data Office
CP	Concept Paper
DAD	Disciplined Agile Delivery
DARPA	Defense Advanced Research Projects Agency
DCDC	Development, Concepts and Doctrine Centre
DCP	Defence Command Paper
DLODs	Defence Lines of Development [see TEPID-OIL]
DOD	Department of Defense (US or Australia)
Dstl	Defence Science and Technology Laboratory
EUD	End-user development
FOE	Future Operating Environment
GSP	Global Strategic Partnership
IOPC	Integrated Operating Concept
JCN	Joint Concept Note
LeSS	Large-Scale Scrum
MBC	Maritime Border Command
MOD	Ministry of Defence
NAO	National Audit Office
NATO	North Atlantic Treaty Organization

RAND Europe

NZDF	New Zealand Defence Force
PAG	Partners Across Government
PESTLE-M	Political, economic, social, technological, legal, environmental, and military
PLAN	People's Liberation Army Navy
RAN	Royal Australian Navy
RAS	Robotic and Autonomous Systems
RQ	Research Question
SAFe	Scaled Agile Framework
SASC	Strategic Analysis Support Contract
SCO	Strategic Capabilities Office
SLIM	Scrum Lean In Motion
SNCO	Senior non-commissioned officers
SQEP	Suitably qualified and experienced personnel
TEPID-OIL	Training, equipment, people, infrastructure, doctrine, organisation, information, and logistics [DLODs]
UK	United Kingdom
UKRI	United Kingdom Research and Innovation
US	United States

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In addition, the team would like to thank all those who participated in the seminar on C2 Capability in the Future on 4 October 2023 in Shrivenham and virtually. Discussions during that seminar were based around an initial draft of this paper and have been incorporated into this version of the paper as appropriate.

Finally, the team are 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

1.1. Background and purpose

Effective and resilient Command and Control (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.¹ So too do the types of operations that the military are expected to undertake, the political, legal and ethical constraints that are placed on decision making, and the threats, technologies and human factors that influence approaches to C2.²

According to the UK Ministry of Defence (MOD), C2 is the ‘pre-eminent Joint Function’ and ‘critical to enabling joint action’.³ Ensuring that C2 systems and organisations remain fit for purpose in the face of changing operational demands is thus essential to maintaining the advantage of the UK and its North Atlantic Treaty Organization (NATO) Allies over any competitor. To this end, Development, Concepts and Doctrine Centre (DCDC) is conducting ongoing analysis through an initiative known as Project Mimisbrunnr that aims to inform thinking about C2 in the future, including a planned update to JCN 2/17: *Future of Command and Control*.⁴ For continuity, and in consultation with DCDC, the research team has chosen to use the understanding of C2 as shown below.

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 (2017).

To support this effort, DCDC asked the Strategic Analysis Support Contract (SASC) to produce four exploratory papers to:

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

¹ Von Clausewitz (2006).

² See Black et al. (2024) for more information about the evolving character of warfare and the implications for C2 systems in the future.

³ Commander Joint Forces Command (now UK Strategic Command), quote. in JCN 2/17. UK Ministry of Defence (2017).

⁴ Other Joint Concept Notes (JCNs) tackle the related topics of human–machine teaming (JCN 1/18), information advantage (JCN 2/18) and multi-domain integration (JCN 1/20). See UK Ministry of Defence (2018a), (2018b) and (2020b).

- Explore Defence integration with partners across government (PAGs) and international allies and partners to deliver decision advantage from 2030 onwards; and
- Research innovative approaches and understandings of the Integrated Operating Framework.⁵

The two previous papers in the series concerned the following:

- Concept Paper (CP) 1, *Grappling with Complexity*, explored how the complexity of the future operating environment (FOE) beyond 2030 is likely to shape the requirement for a different approach to C2 in the future. It provided a baseline of understanding to inform subsequent papers, which each explore specific aspects of C2 in the future in more detail.⁶
- CP2, *The Defence C2 Enterprise*, focused on the resulting opportunities, challenges and dilemmas for the design of the future Defence C2 enterprise, with input from across the Global Strategic Partnership (GSP).⁷

The next section describes the purpose and aims of this document, CP3. The series will conclude with CP4, which will examine in more detail some of the key enablers for future C2 capabilities (e.g. technology, people, etc.) and draw together the implications of all four papers for UK MOD and NATO.

1.2. Paper 3: Conceptualising C2 as a capability

This paper focuses on the importance of understanding C2 as a socio-technical capability that must be proactively and coherently cultivated and maintained across Defence, rather than – as is the present approach – achieved via a set of mostly uncoordinated individual activities. This entails Defence thinking more holistically about the various elements that constitute C2, spanning the Defence Lines of Development (DLODs).⁸ This necessitates an understanding of the evolving requirements for – and interdependencies between – C2-related people, enterprises and organisations, processes and technology. In other words, this paper seeks to explore how Defence should adopt a different approach to developing and maintaining its C2 capability to meet the complex challenges it is likely to face in the future.

1.2.1. Research questions

The research questions (RQs) provided by DCDC for this paper are as follows:

- **RQ1: Coping with complexity.** How might we improve and speed up continuous learning and development, so that we are able to track changes in the environment better, and rapidly adapt our C2 capability to ensure it remains fit for purpose, over both short time frames (e.g. during an ongoing crisis) and longer time frames (i.e. responding to strategic shifts)? How do we learn better from others, even potentially from our adversaries?

⁵ As outlined in the Integrated Operating Concept (IOpC). UK MOD (2020a).

⁶ CP1 is referred to in footnotes as Black et al. (2024).

⁷ CP2 is referred to in footnotes as Lucas et al. (2024a).

⁸ The Defence Lines of Development (DLODs) are a shorthand reference to all of the various activities that take place across the lifecycle of a capability. The eight activities included are training, equipment, people, infrastructure, doctrine, organisation, information and logistics, often summarised with the acronym TEPID-OIL.

- **RQ2: Barriers & opportunities.** What are the primary opportunities for and barriers to change that need to be addressed across a series of areas?
- **RQ3: People.** What are the primary and relevant inherent and future desired properties for individuals potentially involved in C2 activities (based on factors such as current incumbents and future intake)? How might the inherent properties be impacted by predicted changes in C2 (and hence what mitigations may be needed) and how might future desired properties be best achieved?
- **RQ4: Enterprise.** How should Defence develop its C2 capability differently to ensure that the effectiveness of the whole becomes, and remains, sufficient to achieve future objectives?
- **RQ5: Technology.** How might we better exploit the potential for improving technology support? Can we improve C2 capability development by ensuring that ‘proper’ socio-technical systems design and development practices are executed based on latest good practice guidance? If so, what has previously prevented this occurring, and how might any barriers to improvement be addressed?

1.3. Methodology

This paper relied extensively on internal workshops, as well as targeted literature reviews. Following consultations between RAND Europe and DCDC, the full GSP team then held a series of internal workshops to discuss the questions and how they might best be addressed. This included leveraging the diverse areas of expertise across the team, ranging from scientific expertise to organisational change management. Building on the findings from the comprehensive literature review conducted for Paper 1, team members then conducted a series of targeted literature searches to inform their allocated area of research.⁹

Following the completion of this research, the full GSP team conducted another round of internal workshops to ensure shared understanding and make a final determination about areas of focus for the research paper. At this stage, members of the research team not belonging to RAND Europe (i.e. those from the University of Exeter or Aleph Insights) contributed written inputs for their allocated area of research. The RAND Europe team then consolidated and streamlined these inputs into a single paper.

That draft version of the paper was then provided to external participants at a hybrid seminar hosted by the DCDC team at Shrivenham in October 2023. This brought together experts from across NATO. Those discussions provided additional input that subsequently shaped and informed the final version of this paper.

1.4. Structure of the document

This paper is structured as follows:

- **Chapter 2** discusses how Defence can better enable its people to cope with complexity, including through conceptualising C2 as a socio-technical system (addressing RQ1 and RQ3).

⁹ For more detail about the literature review conducted for CP1, please see Black et al. (2024).

- **Chapter 3** presents models for how Defence might achieve transformation, in terms of both its organisational structures and as an institution, to better facilitate C2 (addressing RQ2 and RQ4).
- **Chapter 4** discusses how new technologies might be integrated into C2 in future (addressing RQ5).
- **Chapter 5** sets out conclusions and next steps, including areas to explore in the fourth CP.

A full bibliography is also included, along with a list of workshop participants as an annex.

2. Enabling people to cope with complexity

The future C2 systems required by both the UK and other countries to cope with increasingly complex operating environments, as identified in CP1, will need flexibility and adaptability.¹⁰ This paper series has identified the importance of conceptualising C2 as a socio-technical system, as well as the need for dedicated learning and development activities across the entire Defence enterprise and with partners, CP2 highlighting the need for soft and technical skills and CP1 outlining the need for complexity and systems thinking.¹¹ This chapter delves into each of these areas in turn.

2.1. Strategic capability management of C2 as a socio-technical system

JCN 2/17 frames C2 as ‘a dynamic and adaptive socio-technical system’.¹² Previous CPs have highlighted the importance of adaptability, but clearly clarifying what it means for the C2 enterprise to exist as a socio-technical system is core to realising the successful management of C2 as a capability. Socio-technical systems, as the name suggests, consist of both social and technical subsystems; these often have divergent and sometimes conflicting characteristics.¹³ Given these differences, it is often necessary to consider each of these areas in isolation, as well as their interactions with one another, when considering how aspects of C2 systems might be designed in the future. To this end, socio-technical system design aims to ensure that both aspects are considered together, as the system’s success requires mutually reinforcing interactions between its subsystems.¹⁴

Despite the apparent ease of recognising this requirement, achieving true integration is often highly challenging. Social and technical systems are often artificially separated or siloed in ways that prohibit or impede the necessary levels of integration and interdependence.¹⁵ To remedy this, one author has proposed moving beyond the ‘social’ and ‘technical’ binary by using a hexagonal framework that represents socio-technical systems through six interconnected components: goals, people, processes and procedures, culture, technology, and buildings and infrastructure.¹⁶ Still, ensuring the chosen approach enables integration rather than siloes will remain a challenge.

¹⁰ Black et al. (2024). While this paper focuses on the UK’s particular needs and context, it is important to note that other countries’ C2 systems are likely to be changing as well to meet this requirement.

¹¹ See Lucas et al. (2024a), Sections 3.1.2 and 3.1.3; Black et al. (2024).

¹² UK Ministry of Defence (2017).

¹³ Fischer & Herrmann (2011).

¹⁴ Baxter & Sommerville (2011); Abbas & Michael (2023); Fischer & Herrmann (2011).

¹⁵ Alter (2015); Abbas & Michael (2023).

¹⁶ Davis et al. (2014).

Overcoming this barrier therefore requires the strategic management of C2, as well as the consistent treatment of C2 as a socio-technical capability. In addition, as CP1 argues, it is critical to remember that C2 is a complex, adaptive system with components that will vary and change over time.¹⁷ This necessarily entails that, rather than seeking a particular fixed end state, C2 systems will require a combination of dynamic and adaptive processes based on clear objectives and guiding principles.¹⁸

This perspective aligns with models of socio-technical system development: Fischer & Herrmann, for example, propose an approach for the continuous adaptation and evolution of socio-technical systems within an environment known as meta-design.¹⁹ Meta-design is based on the principle that it is impossible to predict all of the future uses and issues of a system during its development phase: actors within the system may experience mismatches between their requirements and the assistance provided by the system during use. Consequently, a philosophy composed of guiding principles shapes acceptable procedures, which are constructed through a mix of empiric and theoretical insights.²⁰ The system, then, is iteratively improved through collaboration.²¹ Extending design methodologies like Fischer & Herrmann's to the C2 enterprise could therefore work to address the inherent changeability of C2.

On the whole, ensuring that C2 remains a socio-technical system requires strategic management of both the social aspects of the enterprise – human capital, suitably qualified and experienced personnel (SQEP), process and procedures, organisational culture – as well as its technical components. Addressing both aspects, and ensuring that they are mutually reinforcing, is required to design and maintain an enterprise system that is prepared for unexpected changes and seeks to adapt. This requires a comprehensive, strategic approach to managing the capability. Subsequent sections of this chapter will discuss some of the approaches that may be beneficial for managing the social aspect.

2.2. Persistent learning and development at all levels

C2 already requires the ability to work with a diverse range of individuals, across not only all three services, but the whole of the Defence enterprise.²² These systems will need to be coordinated within technical systems and environments which, as highlighted above, are increasing in complexity.²³ Further, it is also likely to require the use of multiple technologies and platforms, both to analyse the FOE as well as to communicate instruction and guidance across multiple geographic locations and domains. Therefore, as the strategic situation evolves and adapts to emerging events and power dynamics, so must the skills and capabilities of all C2 practitioners. This is true for a wide range of skills, including both technical skills and 'soft' skills, such as people management and communication.²⁴ As the FOE continues to change, personnel

¹⁷ See Black et al. (2024) for a lengthier discussion of the changes likely to face C2 systems in the coming years.

¹⁸ Black et al. (2024).

¹⁹ Fischer & Herrmann (2011).

²⁰ Fischer & Herrmann (2011).

²¹ Fischer & Herrmann (2011).

²² See Lucas et al. (2024a) for more discussion of the definition of the Defence enterprise and the importance of whole-of-society approaches to C2.

²³ DCDC Canberra Workshop, June 2023; DCDC Shrivenham Seminar, October 2023.

²⁴ See Lucas et al. (2024a) for more extensive discussion of the importance of training soft skills across the Defence enterprise to facilitate future C2 systems.

will need to continually revisit their training and education across all of these areas in order to ensure that it remains up to date and fit for purpose.

The challenge facing the MOD is the need to develop individuals who can facilitate a C2 capability that is flexible and adaptable to changes in the strategic or operational situation. It must function effectively in response to a short-notice crisis (e.g. the evacuation of Kabul in 2021), but also be responsive to longer-term strategic shifts (e.g. the shift of Defence's primary focus away from counterinsurgency and counterterrorism back to competition between peer or near-peer state actors). As section 2.1 outlines, however, while technology will be a key enabler in this process, it is only one part of the socio-technical system. In fact, C2 is likely to remain a human-led endeavour for the foreseeable future, particularly in the UK and other like-minded countries, due to regulations around the ethical use of AI. Technological innovation is therefore best viewed as an enabler rather than an end in itself or a distraction from the other elements of capability needed to address the complex problems of C2 on future operations. However, as individuals within C2 systems need to be able to use the necessary technologies at the appropriate times, having the requisite ability and expertise across multiple technology areas will also be a key enabler for designing and executing C2 systems in the future.

2.2.1. Education and training across all levels

Education and training will be critical to developing personnel who are able to work in C2 systems that can effectively deal with the emerging strategic and operational challenges of the FOE. It is important that this does not solely aim to develop these skills at just the senior levels of an organisation or unit. Personnel involved in decision making, or providing options to senior leaders, will need to apply similar thinking approaches as their commanders, but at a level appropriate for their role, rank or experience.

This is often where difficulties arise, as junior military leaders are not always provided with the support and appropriate education and training to contribute to decision making in complex environments or situations.²⁵ Much of the early training given to military personnel is aimed at supporting their work in the tactical and operational environments. They are prepared to deal with what the Cynefin framework would refer to as 'simple' situations: identify and analyse the immediate threat or challenge and make quick decisions, which can often have significant and impactful consequences for themselves, as well as others.²⁶ Expertise in core military skills, such as tactical or operational planning and decision making, as well as an understanding of specific military capabilities and resources are vital for the application of military effects.

However, as CP1 identifies, the FOE means that Defence is increasingly likely to require decision making under conditions of complexity. In order to ensure that personnel across Defence are equipped to deal with the challenges of decision making in such situations, continuous education and training across a variety of areas are needed to provide personnel with the knowledge, skills and experience to cope and adapt to a changing operational environment. Further, opportunities and incentives for such an approach to learning need to be woven into career development pathways. Box 2.1 highlights one potential approach to this: the New Zealand Defence Force (NZDF) leadership training model, which segments clear training objectives

²⁵ For more discussion about what these areas of education and training might be, see Black et al. (2024) and Lucas et al. (2024a).

²⁶ Lindsay & Woycheshin (2014). For more discussion of the Cynefin framework and other approaches to understanding complicated or complex situations, please see Black et al. (2024).

based on rank in order to ensure officers' complex command skills are developed alongside their tactical and operational planning abilities.

Box 2.1 New Zealand Defence Force leadership training model

The NZDF has developed a leadership training framework that articulates the leadership requirements and expectations for each rank level. The overall aims are to develop officers and SNCOs who can deal with the uncertainty of modern warfare and to help leaders transition more smoothly into new roles.

- Lead Self: Initial training.
- Lead Teams: Officer Cadet and Corporal.
- Lead Leaders: Captain/Sergeant.
- Lead Systems: Major/Staff Sergeant.
- Lead Capability: Lieutenant Colonel/Warrant Officer.
- Lead Integrated Capability: Colonel/Command Warrant Officer.
- Lead Defence: Colonel and above/Strategic Warrant Officer.

All the training up to and including 'Lead Leaders' is run by the individual services, and in most cases is incorporated as modules within existing promotion courses. From Lead Systems the training is run in less formal, tri-service settings, with an emphasis on self-reflection and network-building. Course places are also allocated to other government agencies who work regularly with the NZDF, which aims to help build understanding between NZDF personnel and the other public-sector agencies they regularly work with.

Source: Lindsay & Woycheshin (2014).

2.2.1. Teaching systems thinking to cope with complexity

Education and training in systems thinking can help military leaders make more informed decisions, mitigate unintended consequences, better allocate resources, and enhance the overall effectiveness of military operations.²⁷ Systems thinking is particularly valuable in contemporary and future operations, which involve high levels of complexity and uncertainty.²⁸ CP1 discussed how systems thinking aims to comprehend the organisation and connections among various components to form a unified whole.²⁹ In a future operating environment that is complex and uncertain, systems thinking can enable organisations to 'adapt, survive and grow' in changing situations, and identify how all personnel can best contribute towards the desired outcome.³⁰

To lead effectively, officers and senior non-commissioned officers (SNCO) need to understand a) the impact that their decisions may have on other units, assets or actors, and how they can effectively contribute towards the overall mission, and b) the impact on the external operating environment and the myriad other

²⁷ See Black et al. (2024) for a more detailed discussion of systems thinking and its importance for C2 systems in the future.

²⁸ See Black et al. (2024) for more information about the value of systems thinking in the FOE.

²⁹ Black et al. (2024).

³⁰ Wisecarver et al. (2022).

actors and socio-technical systems therein.³¹ This is particularly important in multi-domain activities, where leaders must consider operational impacts across all military domains (land, air, maritime, cyber and EM, and space), as well as the broader political, economic, social, technological, legal, environmental and military (PESTLE-M) landscape. The traditional military career pathway, however, often does not expose officers and SNCOs to situations where they are expected to deal with the operational or strategic level, or learn and think in detail about non-military areas, until they are in mid-career roles. Many are also unlikely to have experience working with or supporting PAGs in the early stages of their careers, so are less likely to appreciate non-military policy objectives and operational aims, or even the terminology used across different parts of government.

It is crucial to acknowledge the limitations of both theory and data, and approach the application of such methods with humility, iteration, learning and pragmatism. CP1 recommends taking a more deliberative and adaptive approach, which involves engaging various stakeholders in co-design, utilising insights from multiple disciplines and knowledge sources, and incorporating flexibility into analytic and decision-making processes to improve them over time based on feedback.³² Extensive opportunity to practice and train also offer the opportunity to learn from mistakes in a low-stakes environment.

2.3. Collaboration and cooperation

As identified in CP2, definitions of the Defence enterprise, as well as the Defence C2 enterprise, will likely fluctuate, requiring military operations to be multi-domain.³³ Additionally, requirements to support PAGs adds a further element of complexity. This approach requires all C2 practitioners to have an appreciation of the capabilities of the other Services across both traditional and novel domains, as well as understanding the needs, preferences and cultures of other government agencies, and international partners and allies. Further, it is important to understand the hierarchies and structures by which other organisations operate to better understand their ways of working and how Defence can work to better accommodate them.

2.3.1. Working across Defence

The UK Government's Defence Command Paper (DCP) refresh has placed emphasis on the need to be able to conduct 'joint and all-domain [operations], underpinned by data and information', in response to the assessed challenges, both now and in the coming decades.³⁴ As mentioned above, a key element of modern Western warfare is the ability to operate in a multi-domain environment.³⁵ The C2 of this approach requires two critical elements from headquarters staff:

- **Deep subject-matter knowledge** of both their parent service's domain operating capabilities and limitations (for example, a naval planner must be able to understand a particular warship's operating constraints) and the operational requirements of their own trade, such as intelligence,

³¹ See Black et al. (2024) for a longer discussion about the ways in which personnel can better understand the impact of their decisions both on the overall mission and on the operating environment.

³² Black et al. (2024).

³³ Lucas et al. (2024a).

³⁴ UK Ministry of Defence (2023b).

³⁵ More discussion of the need for integrated operations across Defence is included in Lucas et al. (2024a) and Black et al. (2024).

logistics, artillery or signals. In an integrated operating environment, this applies not only to UK capabilities or limitations in a particular domain, but also those of Allies and partners.

- **Domain and trade-specific expertise** must be applied in a multi-domain environment, so that they can ensure that units and assets from different services can operate together seamlessly. For example, developing an amphibious expeditionary capability requires more than obtaining amphibious landing ships, landing craft and helicopters. It requires commanders across all three services to understand threats, operating environments, and the different command responsibilities at sea and on land.³⁶

This requirement underlines the importance of multi-domain awareness amongst military personnel. Soldiers, sailors and aviators must understand each other's needs and incorporate this knowledge into planning and decision making. This is a challenge that can only be addressed through consistent education and regular multi-domain exercises, as well as ensuring that single services include modules on multi-domain operations in their training syllabuses to expose service people to multi-domain operating considerations early in their careers.

2.3.2. Working with partners across government

Defence has identified a need to work closely with PAGs, namely other departments and agencies, to protect the UK's national interests and the country's economic and industrial resilience.³⁷ This includes in core capability areas, such as aerial surveillance, maritime security operations and land-based warfare, but also more widely as a contributor and enabler for wider government initiatives. These areas include cyber defence, activity in the space domain, economic security and responses to climate change events.³⁸

To perform this role effectively, Defence must start with an improved understanding of approaches and cultures within other departments and agencies, including viewing these as independent and complex adaptive systems. Defence personnel should be trained to learn how to navigate and influence these systems, to allow for an integrated approach that develops and delivers both military and non-military effects.³⁹ There are considerable cultural and organisational barriers, as highlighted in CP1.⁴⁰ These include cultural clashes around the perceived militarisation of civilian policy problems, ethical concerns about Defence approaches, and confusion around military planning and C2 structures.⁴¹

Multiagency or interagency headquarters of task forces are one means that other countries' militaries often use to bridge this gap. While multi-domain operations normally focus solely on the three traditional domains, a multi-agency headquarters approach can assist with developing co-operation and understanding between the military personnel and the government agencies that they are supporting. In the particular example below (Box 2.2), drawn from Australia's Maritime Border Command (MBC), such a unit is led and run by the military, though their purpose is to support all-of-government operational responses. While this does illustrate one means by which military leaders and PAGs can collaborate to provide support for

³⁶ Mosley (2012).

³⁷ UK Ministry of Defence (2023b).

³⁸ UK Ministry of Defence (2023b).

³⁹ Black et al. (2023).

⁴⁰ See Black et al. (2024).

⁴¹ Black et al. (2024).

wider national interests, it is certainly not the only model.⁴² Representatives from non-military agencies should also be included on the staff of these headquarters, to allow their agencies' requirements to be considered and understood.

Box 2.2 Australia's Maritime Border Command

The importance of an integrated approach was identified by the Australian Defence Force (ADF) in 2007. The then Chief of Defence Force, Air Chief Marshal Angus Houston, highlighted the need to integrate agencies who have recurring and major roles in response operations in the operational planning process. Houston's key direction was that representatives from other departments or agencies were to contribute as part of the headquarters staff – not just as liaison officers. This approach was realised through the Maritime Border Command (MBC), a multi-agency headquarters run in partnership between the Australian Border Force (ABF) and the ADF. The command is responsible for coordinating an all-of-government approach to illegal maritime activity in Australian waters, and coordinates responses using both federal and state government agencies. The MBC is commanded by a two-star admiral, who is also sworn in as an ABF officer.

Source: Houston (2007); Australian Border Force (2023); Australian Government: Defence (2023).

2.3.3. Working with international allies and partners

Interoperability becomes more complex when C2 systems are required to facilitate cooperation between the Armed Services of multiple countries. The UK Government has identified a geographically broad range of defence partnerships to maintain or develop. These include existing European and Middle Eastern relationships, building on existing cooperation in Asia, and improving ties with Latin America.⁴³ While some of these relationships are in their initial stages, or could be classed as aspirational, the variety and range of nations listed potentially provides significant C2 challenges for the MOD.

Though NATO has common doctrine which all Allies can use (and which is also used by the non-NATO Five Eyes nations and other partners), not all future partners will be familiar with it; additionally, it is arguably not suited to the complexity of the FOE. A lack of common doctrine or standard operating procedures, language barriers, different headquarter structures and functions, and unfamiliar assets and equipment will all add further complexity to C2 systems involved in multi-national operations. Additionally, different levels of technological sophistication across allies and partners creates additional challenges in seeking to identify ways of working and approaches. The UK MOD and Armed Forces will therefore need to prepare in advance how it will work with new partners to adopt common terms and understandings to facilitate cooperation.⁴⁴

⁴² See UK Ministry of Defence (2017).

⁴³ UK Ministry of Defence (2023b).

⁴⁴ The soft skills discussed in CP2 will also be a key enabler for such relationships. See Lucas et al. (2024a) for more details.

2.4. Sharing lessons and information

A key component of all these types of collaboration will be sharing information and lessons across similar organisations. Members of the research team pointed out that, while there are certainly case studies of organisations identifying problems with an existing approach, this is often not a cut-and-paste model. Instead, to implement successful change, organisations often need to learn from a broad approach before focusing in on what is necessary for that specific organisation.

Therefore, Defence should seek to continually identify and learn lessons from both its own efforts as well as those of other countries, including like-minded allies and partners as well as adversaries. For partners and allies, in particular, this can entail sharing lessons identified, both good practices and failures, and seeking insight from individuals across a variety of organisations. Even when security requirements pose an obstacle, such challenges can often be overcome through declassification of these studies or indirectly through abstraction techniques.

2.4.1. Understanding what success looks like

To facilitate sharing lessons and good practices, it will be important to understand what ‘good’ or ‘successful’ practices look like in the first place.⁴⁵ Otherwise, UK Defence may learn the wrong lessons, both from its own experiences and from the experiences of its partners and allies, as well as its adversaries. This also enables UK Defence to set goals and benchmarks based on that understanding.

To effect the necessary changes to C2 systems, defining ‘good’ will be necessary across multiple time frames, as well as the strategic, operational and tactical levels.⁴⁶ This is particularly true given the trade-offs discussed at length in CP2: determining the appropriate levels of different characteristics, such as low observability and connectivity, or balancing between securing and sharing information with allies and partners will require a shared understanding of the desired end state on any given operation. Understanding what success looks like is made easier by having a clear vision for and theory of change (see Section 3.2.1); however, this will also require clear intermediate benchmarks and metrics to move beyond the tick-box exercise of tracking inputs and processes to fully understanding outputs, as well as their link to strategic outcomes.⁴⁷

Such benchmarks and metrics may also be of utility when making trade-offs with regard to finite resource (whether financial, human or other).⁴⁸ All of the lines of effort discussed in these CPs, be they about investing in technology or in personnel, will require dedicated funding. Without a clear plan and set of objectives, arguing for the allocation funding will be difficult, if not impossible; further, it will be difficult to demonstrate the utility and importance of the funding that Defence is receiving.⁴⁹ However, as discussed in Section 2.1, objectives and plans will also need to be sufficiently flexible to adapt to changing circumstances.

⁴⁵ DCDC Shrivenham Seminar, October 2023.

⁴⁶ Lucas et al. (2022).

⁴⁷ Kezar & Eckel (2002).

⁴⁸ NATO STO (2020).

⁴⁹ Prtak (2019).

2.5. Conclusion

As C2 is fundamentally a socio-technical system, personnel will make up a key component of C2 networks in the future. Therefore, ensuring that they are empowered and able to cope with complexity is a key priority for Defence. Research conducted for this paper suggests a wide range of methods for encouraging this, including persistent learning and development at all levels, including teaching systems thinking; encouraging collaboration and cooperation across Defence, but also with PAGs and international allies and partners; and, perhaps most importantly, sharing information and lessons as part of that cooperation to enable learning.

3. Evolving the enterprise to cope with complexity

The challenges of introducing sustained changes to complex organisations, such as Defence, are well documented. There is also an extensive literature available on methods for creating large-scale organisational and institutional change, if primarily focused on private-sector organisations or civilian agencies within government, as opposed to the military.⁵⁰ However, the literature contains no silver bullets: this remains an area in which there is limited consensus, and a need for solutions that are tailored for the characteristics of particular organisations. Therefore, while this chapter proposes some frameworks that might be useful, Defence will need to carefully consider how it can best approach these changes while recognising progress made so far and continuing to operate.

Still, attendees at the two DCDC seminars held for this study agreed that major changes are needed to the Defence C2 enterprise, if it is to deliver a novel future approach to C2 that reflects the complexity and challenges of the FOE.⁵¹ This need for transformation of the wider C2 enterprise goes beyond questions about the design and configuration of future headquarters, or empowering different units or echelons (issues of more granular detail that will be discussed in CP4). Instead, research and expert engagement for this study emphasises the need to evolve the Defence enterprise to support continuous learning, adaptation and the cultivation of C2 as a capability in its own right.

This need for reform to the wider enterprise applies in terms of evolving not only its structures and processes, but also many of the less tangible assumptions, norms and traditions that exist across the C2 workforce.⁵² In accordance with the academic literature on this topic, Table 3.1 breaks down these two areas for change to the enterprise into organisational structure(s) and institutional culture(s).

Table 3.1 Key areas for change to help Defence cope with complexity

Category	Definition
Organisational structure(s)	Hierarchies, people and policies that more formally represent the culture and identity of an institution
Institutional culture(s)	Norms, traditions, assumptions and uncodified practices that reinforce an organisation's identity and ways of working

Source: SASC research based on Bopape (2021), Keup et al. (2001) and Ramaley (2002).

⁵⁰ See Lucas et al. (2024a) for discussion as part of CP2 and Ogden et al. (2024) for a more detailed overview of the literature on organisational change management.

⁵¹ DCDC Canberra Workshop, June 2023; DCDC Shrivenham Seminar, October 2023.

⁵² DCDC Canberra Workshop, June 2023; DCDC Shrivenham Seminar, October 2023.

Some observers have argued that military organisations change more slowly than other organisations. This is partly due to their hierarchical nature and inherent low tolerance for risk given the threat of violence; it may also reflect the fact that characteristics such as stability, robustness and certainty have historically been seen as key to operational success (and thus also career progression).⁵³ While stability, robustness and certainty may have been key attributes of Defence's effectiveness, they also have the potential to prevent the implementation of the types of changes that seem to be necessary to achieve a modernised approach to C2 fit for the FOE.⁵⁴ Further, these very characteristics may impede success for operations taking place in the dynamic and complex environment likely for future operations.

Rapid, transformational change can certainly take place in military organisations; however, often this only occurs in response to an externally imposed shock (e.g. the pressures of a major war, such as has most recently galvanised rapid innovation in Ukrainian C2, or the reorganisation of American intelligence services and creation of the Department of Homeland Security following the terror attacks of 11 September 2001).⁵⁵ However, such changes often come at a significant price and may have unintended negative side effects if not managed carefully. Furthermore, in the absence of systemic shocks, some experts have argued that organisational change may be most likely to happen incrementally, rather than all at once.⁵⁶ This creates challenges for achieving the kind of large-scale, sustained and widespread change that is arguably needed for reforms to take hold and be effective.⁵⁷

This chapter will therefore first talk briefly about proposed frameworks for changing structures in large organisations. It will then describe some findings on changing institutional culture.

3.1. Frameworks for creating meaningful organisational change

As part of this study, the research team reviewed a broad range of literature concerning existing practices for large-scale change to organisational structures, both in the public and private sectors. One oft-repeated recommendation among both the research team and in workshops held for this paper was to make use of established frameworks for organisational change to guide the design and implementation of change programmes at all levels of the C2 enterprise.⁵⁸ Such frameworks set out a desired end state and provide comprehensive guidance, as well as bringing some level of evidence base, prior testing and good practice⁵⁹ that can aid with securing buy-in from relevant stakeholders. The next two sections provide examples of such frameworks that different members of the GSP consortium identified as potentially being of interest to Defence. However, it is important to note that any framework will likely need to be adjusted to fit the unique context of Defence. Further, DCDC seminar participants argued that, rather than focusing on

⁵³ Hasselbladh & Ydén (2020).

⁵⁴ Nemeth & Dew (2023). For more information about the complexity of the FOE and the requirements that imposes for Defence, please see Black et al. (2024).

⁵⁵ DCDC Shrivenham Seminar, October 2023.

⁵⁶ Nemeth & Dew (2023).

⁵⁷ Nemeth & Dew (2023).

⁵⁸ DCDC Shrivenham Seminar, October 2023.

⁵⁹ DCDC Shrivenham Seminar, October 2023.

which framework is the best, Defence may be best suited by simply picking a framework and adjusting as they proceed, based on the adaptation and learning discussed in Section 2.3.2.⁶⁰

3.1.1. Agile frameworks

One group of frameworks for thinking about effective, sustained change in large, complex organisations is known under the label ‘agile’. Agile frameworks conceptually emerged from software development, an industry that emphasises the importance of rapid iteration, testing and end-user feedback. Industry leaders released the Agile Manifesto in 2001, which highlighted in its principles how ‘agile processes harness change for the customer’s competitive advantage.’⁶¹ These ideas have since become scaled and exported beyond software development, through the proliferation of a range of frameworks that aim to provide a collection of organisational and workflow patterns that enable organisations to scale agile practices.

Adapting such frameworks to Defence could provide a range of benefits for C2, namely balancing flexibility and speed of use with the need for structure, discipline and governance. Additionally, they can support Defence in mitigating the effects of the First Law of Cybernetics by enabling better access to the variety of nuanced responses required in a complex and dynamic environment.⁶² To this end, such frameworks provide a range of possible lessons and modifications upon which Defence can draw as it considers how to pursue the sorts of changes that may be necessary to empower C2 in the future. It is worth noting, however, that these frameworks will need to be adapted to the specific needs of Defence to avoid imposing excessive or irrelevant requirements.

Perhaps the most popular agile framework currently in use is the Scaled Agile Framework (SAFe), an overview of which is shown in Figure 3.1.⁶³

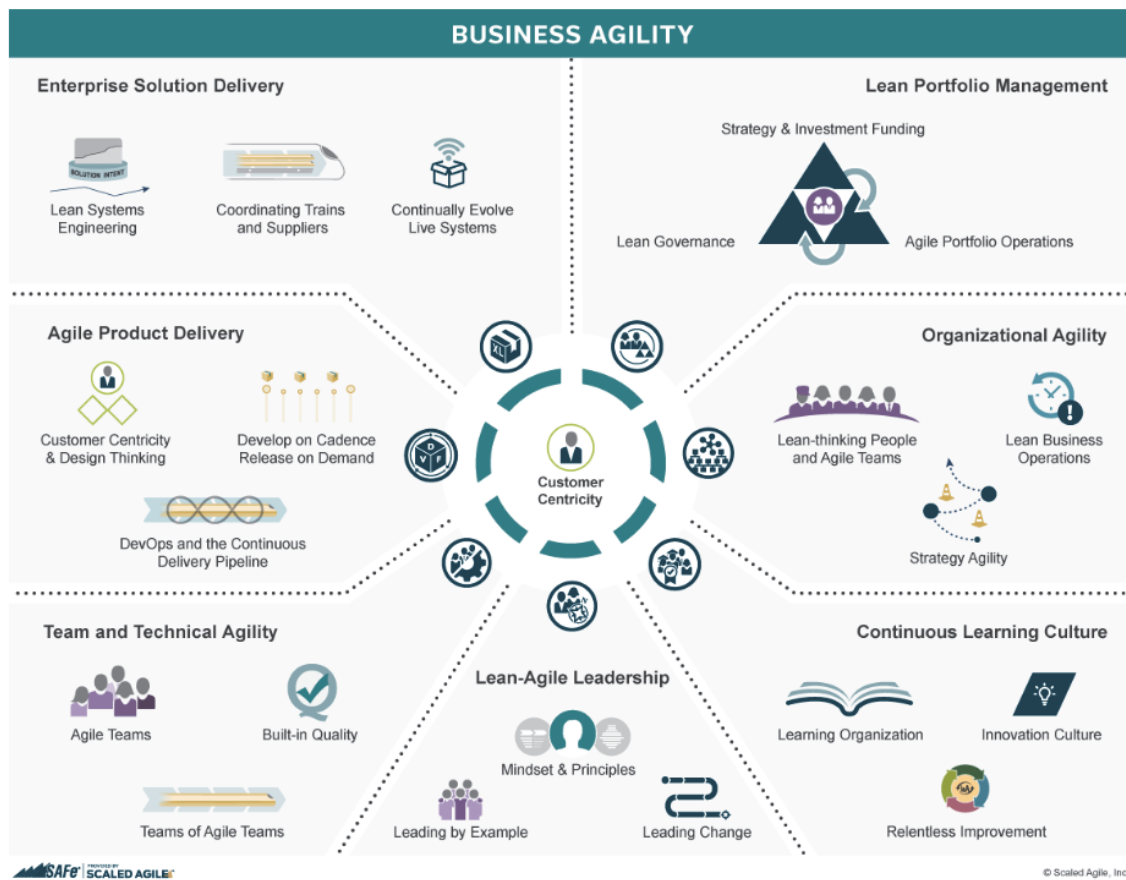
⁶⁰ DCDC Shrivenham Seminar, October 2023.

⁶¹ Beck et al. (2001).

⁶² Boisot & McKelvey (2011) in Black et al. (2024). CP1 contains a longer discussion of the First Law of Cybernetics.

⁶³ Agile (2022).

Figure 3.1 Overview of the SAFe framework



Source: SAFe studio (n.d.).

Many of the points raised in the SAFe framework echo points raised in CPs 1 and 2, as well as elsewhere in this third paper. The importance of organisational agility and agile product delivery, for example, were raised in CP1 as a necessity to respond to the increasing complexity of the FOE.⁶⁴ CP2 already discussed at length the need for continuous learning and adaptation in Defence, a theme touched on again in Chapter 2 of this document.⁶⁵ CP2 also discussed the need for aspects in the team and technical agility area: fast-paced teams of high-quality individuals, potentially operating in a more matrixed manner than traditional defence hierarchies.⁶⁶ Chapter 4 of this paper will discuss the importance of cultivating Defence leadership that communicates a clear vision, communicates throughout the organisation, and incentivises a mindset and principles conducive to the desired end state, enabling staff to act as effective enablers and participants in change. Certainly, some aspects of the SAFe framework may need to be altered to apply specifically to Defence; understanding how to define the ‘customer’ at the centre of the model, for example, would be a key consideration should Defence decide to adopt a framework such as SAFe originally designed for use in the private sector. Despite the need for modifications, however, SAFe still provides a potential framework that Defence could use to guide and communicate the rationale for the types of changes required for Defence’s C2 capability to remain effective into the future.

⁶⁴ For more detail, see Black et al. (2024).

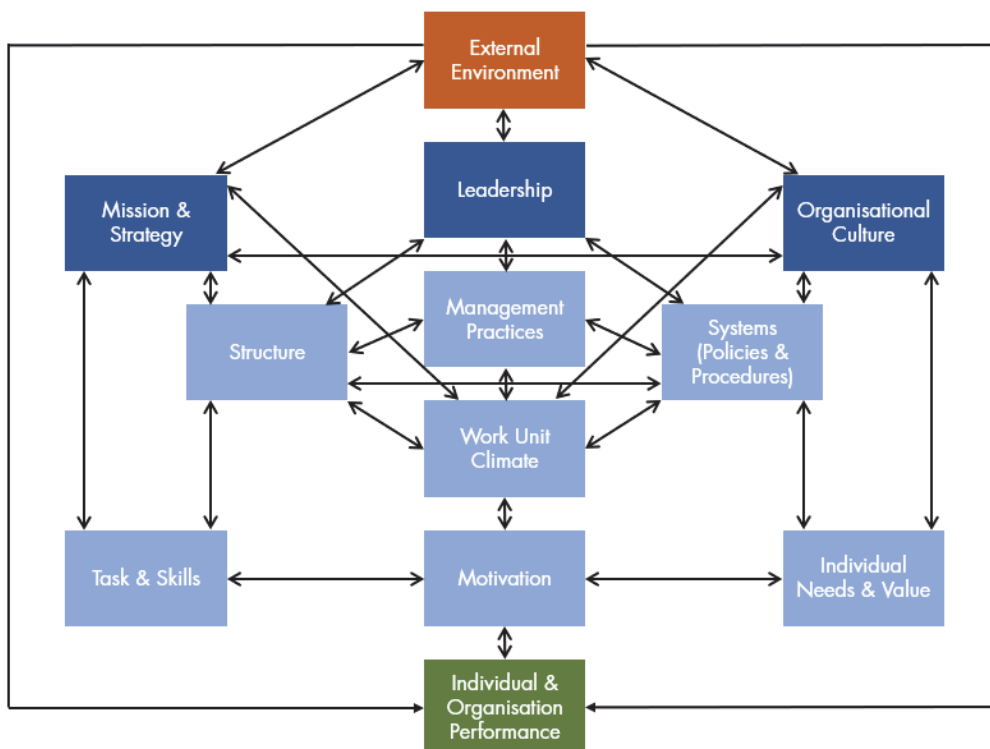
⁶⁵ For more detail, see Lucas et al. (2024a).

⁶⁶ For more detail, see Lucas et al. (2024a).

3.1.2. The Burke-Litwin Change Model

While agile frameworks were identified by members of the GSP consortium as a potentially suitable option for Defence, they are far from the only option. A recent RAND report on changes to be made to the Defence enterprise to enable the Capstone Concepts considered several possible approaches to organisational change management and proposed that, of the examples considered, the Burke-Litwin Change Model (BLCM) might be the most appropriate. The twelve key drivers identified in the BLCM are included in Figure 3.2.

Figure 3.2 The Burke-Litwin Change Model



Source: Ogden et al. (2023).

While not all BLCM factors are discussed within existing literature on future C2 processes, there is still a great deal of overlap between the key enablers that both bodies of research identify. Of note, the BLCM makes an important distinction between internal and external factors, primarily due to the degree of control that can be exerted over them; this will be an important factor for Defence who, as CP2 discusses, will often be required to collaborate with organisations over which it does not have command or control, as well as be influenced by those same organisations in return.⁶⁷

3.1.3. Choosing a framework for Defence

Both the SAFe framework and BLCM could provide the conceptual basis for implementing change towards new organisational structures for C2 in the future. Although SAFe holds the largest market share of applicable frameworks, a range of competitors exists, such as the Large-Scale Scrum (LeSS) and Disciplined

⁶⁷ For more information about the applicability of the BLCM to Defence, see Ogden et al. (2023).

Agile Delivery (DAD), which make up the ‘big three’ of frameworks.⁶⁸ While these dominate the market, a wide range of smaller models, such as Sam Laing’s Scrum Lean In Motion (SLIM), Ron Quartel’s FAST Agile, John Kotter’s XLR8 and consultancy-sourced models from McKinsey, Accenture and Korn Ferry, all provide similar services.⁶⁹ While each model provides unique approaches and methodologies, their commonalities offer insight into some of the characteristics of successful structural change: for example, all of these models emphasise the significance of agility and lean principles, highlighting the requirement for continuous learning, experimentation and enhancement to remain competitive in a changing environment.

The foundation of successful application relies on the MOD committing to implementation, regardless of which of the above frameworks – or others – is chosen. There is also potential for cherry-picking from within these frameworks to construct a C2-specific, unique model; however, moving forward with this approach would require an extensive literature review with a clear definition of the ideal traits of the final model to be used. Still, as participants in the DCDC seminars pointed out, perhaps the best first step is for Defence to commit to a single framework.⁷⁰ Whether or not it chooses to do so, it will be critical for Defence to continue to identify key lessons from across industry, as well as lessons from implementation. This will best enable Defence to develop and adjust an approach that suits its unique needs and context.

In addition to reforming the organisational structures that underpin Defence, there are also strong arguments that institutional cultural change is needed. This provides the glue between the people-centred traits discussed in Chapter 2 and the organisational structural characteristics discussed in Section 3.1. To this end, the next section will explore some of the available approaches to shifting Defence towards a more flexible organisation that attracts, motivates and makes the most of the expertise of the suitably qualified and experienced personnel (SQEP) needed to enable C2 systems in the future.

3.2. Creating meaningful changes to institutional culture

While formal regulations and organisational structures can be altered relatively quickly through legal, regulatory or hierarchical changes, influencing institutional culture can be more complex.⁷¹ Because institutional characteristics are reflected in customs, traditions, ethical standards and culture, they are necessarily less tangible, and therefore difficult to identify and intentionally alter.⁷² This is particularly true for a large organisation such as Defence with numerous time-honoured traditions that are often ingrained in large proportions of the personnel.⁷³ However, among the literature reviewed for this paper and the expert opinions of many of the GSP collaborators and attendees at the DCDC seminar, there was agreement that this is a challenge that Defence will have to tackle in order to enable an effective C2 capability in the future.⁷⁴

⁶⁸ Heusser (2015).

⁶⁹ Heusser (2015).

⁷⁰ DCDC Shrivenham Seminar, October 2023.

⁷¹ DCDC Shrivenham Seminar, October 2023.

⁷² Ostrom (2005).

⁷³ Jepperson (1991).

⁷⁴ DCDC Shrivenham Seminar, October 2023. This argument has been made previously in other RAND papers, including Black et al. (2024), Lucas et al. (2022), Hughes et al. (2023) and Lucas et al. (2024a).

As identified by the research team and in existing literature on change management in large organisations, there are a number of clear enabling factors that create opportunities for instigating and sustaining change. Of these, the team identified five for more detailed consideration here:

1. Defining a clear, compelling and consistent vision for necessary change;⁷⁵
2. Communicating that vision for change to all levels of the organisation;⁷⁶
3. Demonstrating strong commitment and support from leadership;⁷⁷
4. Incorporating change ideals into personnel management decisions to alter incentive structures at all levels;⁷⁸ and
5. Facilitating a culture that creates space to fail and using those experiences to fuel learning.⁷⁹

While these are certainly not the only factors involved in creating cultural change, they appeared most frequently. In some cases, the wording has been altered slightly to allow the discussion of the myriad aspects of cultural change in the most efficient way possible.

Of note, external factors may also play a key role in influencing the direction and pace of changes to institutional culture: unlike organisational change, which is driven entirely from within an organisation, exogenous factors can often impact the personnel entering or working within an organisation, and thus, gradually, the organisation itself.⁸⁰ As the broader geostrategic trends discussed in CP1 continue to impact the context from which Defence recruits personnel, some changes may happen gradually without explicit interference from Defence. While this will likely not happen at sufficient scale or pace to meet the needs of C2 systems in the future, it will be important for those trying to create institutional, cultural change to keep track of those developments, as they may provide opportunities as well as new challenges.

This section will discuss each of these five core enablers of change in institutional culture, providing suggestions and examples for implementation for each in turn.

3.2.1. A clear, compelling and consistent vision for necessary change

For Defence to evolve in a particular direction as a large and complex enterprise with myriad stakeholders, it will be necessary for Defence leadership to identify a clear vision about where C2 is expected to go, and why. Such a vision will require both a compelling case or story, and a compelling purpose or explanation for why these changes are necessary.⁸¹ Particularly for those aspects of institutional culture that require significant effort to change, or those that form a sense of belonging, such a vision is needed to incentivise and direct change efforts.⁸² It can also counter those at all levels of the Defence C2 enterprise who might be sceptical of change or view it as a threat to, for example, entrenched interests or worldviews.⁸³

⁷⁵ Drumm (2018); Keup et al. (2001); Kezar & Eckel (2002).

⁷⁶ Allas et al. (2018); Kezar & Eckel (2002); Ramaley (2002).

⁷⁷ Allas et al. (2018); Kezar & Eckel (2002).

⁷⁸ Kotter (1995); Kezar & Eckel (2002).

⁷⁹ McKinsey (2019); Dougall (2018).

⁸⁰ Peterson et al. (2021).

⁸¹ Ramaley (2002).

⁸² Ramaley (2002).

⁸³ Keup et al. (2001).

CP2 discussed the importance of clearly understanding and communicating the desired change.⁸⁴ Further literature on change management reviewed for this third paper, as well as extended consultation with the GSP, provided additional support for the importance of this enabler. One academic expert, for example, highlighted McKinsey’s indicators for organisational health⁸⁵ as one example of a metric that identifies the importance of a clear strategy, stating that ‘organisational health is composed of two things: the first is how well the organisation aligns around a common strategy. The second is how the strategy translates into the work environment – i.e. how well the organisation executes against its strategy and ambition’.⁸⁶ A clear prerequisite, therefore, is the identification of that strategy and goals, as well as clear benchmarks and metrics to establish progress. This is relevant to the point raised earlier in Section 2.3.1 about understanding what success might look like: a clear vision helps to establish the desired end state, and therefore intermediate achievements can be understood in terms of whether they help to achieve those aims.

Exploring existing literature on agile change management, a lack of guidance and direction emerged as one of the key barriers to change that stall or block progression or transition. For example, a report by the Cabinet Office argued that, with regard to digital change within government, ‘[i]f the delivery implications are poorly understood the level of ambition can be unrealistic from the outset’.⁸⁷ Similarly, a separate National Audit Office (NAO) report (see Box 3.1) diagnosed that one of the most important enablers for implementing digital change was understanding the aims, ambition and risk of the project, which was all too often not the case.⁸⁸

Box 3.1 NAO recommendations for UK government

Understanding aims, ambition and risk:

- Avoid unrealistic ambition with unknown levels of risk;
- Ensure the business plan is fully understood before implementing a solution; and
- Plan realistic timescales for delivery, which are appropriate to the scope and risk of the project.

Source: National Audit Office (2021).

Ensuring a realistic and comprehensive solution, and therefore the necessary changes, is a key step not just at the beginning of a project, but throughout. Plans may need to shift or change as the result of a misunderstanding of the situation, of unforeseen challenges, or in response to new and emerging requirements. Adapting plans to new circumstances is therefore a critical enabler of sustained change.⁸⁹ In addition, campaigns for change often start with early quick wins, but then lag with regard to sustained improvement. Ensuring an iterative understanding of the project aims and ensuring sustained resource allocation and effort over the long term, is therefore key for achieving large goals.⁹⁰

⁸⁴ For more information see Lucas et al. (2024a).

⁸⁵ Organisational health is defined as ‘the way in which you run your organisation to effectively deliver against your performance goals’.

⁸⁶ London, Krishnan & Weddle (2019).

⁸⁷ National Audit Office (2023).

⁸⁸ National Audit Office (2021).

⁸⁹ London, Krishnan & Weddle (2019).

⁹⁰ London, Krishnan & Weddle (2019).

3.2.2. Communicating the vision for change across the organisation

Once the desired change has been mapped, the next challenge becomes making sure that vision is successfully communicated.⁹¹ Clear and persuasive communication is often discussed as an essential ingredient of successful transformation efforts.⁹² Prior research suggests that the communication of a ‘meaningful change story’ has been one-and-a-half times more prevalent in public-sector transformation efforts that were later deemed successful compared to those that experienced delays or failed to meet all of their objectives.⁹³ In the same study, leaders of unsuccessful change efforts were asked to share three things they wished they had focused on more. Two of the most common responses related to communication, first in ‘engaging employees more through two-way communication’ and second in ‘focusing more on engaging the front line’.⁹⁴ For cultural change in particular, a clear, compelling vision not only of what the necessary change will be but also why it is required plays a key role: unlike processes or organisational structures which can (though not necessarily should) be changed in a top-down manner, cultural change in particular requires buy-in from a large number of individuals.⁹⁵

The need for a clear vision is supported by wider evidence from the change management literature, but it is not enough for leaders to simply impose their vision upon an organisation. Two-way, participative communication, in which all personnel have opportunities to share their perspectives and concerns, is crucial.⁹⁶ Not only does involving staff of all levels of seniority help to make sure any transformation effort is as evidence-based and user-centric as possible, but it can also inspire the kind of sustained motivation across the organisation that is key to successful change in the public sector.⁹⁷ In the process of making change, those involved must therefore engage with employees at all levels of the organisation, hear their concerns, explain why changes are being made, and incorporate their feedback in the management of the change. Communicative change efforts are more informed as a result of this engagement, with a greater degree of insight into the key stakeholders, their needs and their response to possible changes. In the absence of this engagement, efforts to change often meet with failure, as is discussed in Box 3.2.

Box 3.2 The importance of communication to avoid failure

The UK’s attempt to merge 46 local fire-control centres into 9 provides an example of the consequences of failing to ensure communication and engagement with those involved in creating change. After the attempt was abandoned at the expense of £469m, the UK NAO evaluated the project to determine why it had failed. They judged that it ‘was flawed from the outset because it did not have the support of those essential to its success – local fire and rescue services’. Little to no communication and engagement with those who would be using the service led to confusion and distrust, highlighting the importance of communication when delivering transformational change.⁹⁸

Source: Centre for Public Impact (2017).

⁹¹ Ramaley (2001); Keup et al. (2001); Kezar & Eckel (2002).

⁹² Keup et al. (2001); Kezar & Eckel (2002); Ramaley (2002).

⁹³ Dillon et al. (2022).

⁹⁴ Dillon et al. (2022).

⁹⁵ Hughes et al. (2023).

⁹⁶ Keup et al. (2001).

⁹⁷ Murphy & Langdon (2017).

⁹⁸ Centre for Public Impact (2017).

Despite an agreement that communication is one key contributor to success, the literature reflects that there are many ways to communicate change and the evidence is varied on the best methods. Additionally, the forms which this engagement will have to take are likely to shift: in future, as discussed in preceding papers, the C2 enterprise will likely need to involve markedly different ways of communicating and making decisions than are practised at present.⁹⁹ How the military manages the transition to newer ways of working will be a crucial challenge to navigate.¹⁰⁰ In practical terms, it may be necessary to offer different teams and groups substantial education and training packages in order to ensure that performance levels are maintained and knowledge and skills refreshed over time.¹⁰¹ Tools honed in the private sector, such as the S-curve method, may provide a valuable method for managing careers and continuing education.¹⁰²

One demonstrated method for using clear communication is to incentivise the benefits of disruptive change, which can be key to the success of lasting transformations.¹⁰³ As evidenced in the change management literature, transformations that create small, motivation-maintaining wins for individuals and teams may be more successful over the long run, as employees get to see the fruits of their labour and the operational benefits that a given change programme – which will inevitably involve some level of disruption and thus frustration in the near term – can bring.¹⁰⁴ Another key method may be recognising and incentivising the progress to achieving certain goals and the value for money or operational benefits of certain changes, using clearly defined metrics and benchmarks.¹⁰⁵ It is worth noting that learning and development, as well as change management, follow non-traditional paths or may not proceed in a predictable fashion.¹⁰⁶ Organising expectations around long-term success and adapting to new challenges of the FOE rather than consistency in performance may be necessary in some cases; similarly, it is important to understand whether the chosen theory of change rests on sequential or cumulative steps, and thus when different benefits, costs and risks might accrue, impacting the perceptions of different stakeholder audiences.

3.2.3. Demonstrating clear commitment and support from leadership

Another factor that first emerged in CP2 and was subsequently emphasised by consultation with the GSP consortium was the importance of a strong leadership that endorses the direction of change. How leaders manage and coordinate transformational change is clearly a key determinant of success, with leadership being one of the most common enablers of successful organisational change in the literature on change management.¹⁰⁷ Further, trust in leadership was reflected as a key factor to ensure that individuals across

⁹⁹ Black et al. (2024).

¹⁰⁰ DCDC Shrivenham Seminar, October 2023.

¹⁰¹ See Section 3.1, as well as Lucas et al. (2024a), for more specific discussion of the education and training needs likely to enable C2 in the future.

¹⁰² Johnson (2022). See Lucas et al. (2024a) and Lucas et al. (2024b) for a more detailed discussion of potential changes that may need to be made to career paths and career management in Defence.

¹⁰³ For more information about offering incentives, see Section 3.2.4.

¹⁰⁴ Kotter (1995).

¹⁰⁵ Lucas et al. (2022).

¹⁰⁶ Brassey et al. (2019). See Section 3.1, as well as Lucas et al. (2024b) for a more detailed discussion of the need for non-linear career paths and development offerings.

¹⁰⁷ Lewin (1947); Kotter (1995); Rawson & Davis (2023).

the organisation invest in the desired changes.¹⁰⁸ Taken together, this research indicates the importance of clear, trusted and consistent leadership – both military and civilian, in the case of evolving Defence C2.¹⁰⁹

For Defence in particular, it is important to note that consistent leadership may mean having a recognisable person who is continuously in charge, or it may mean messaging and goals that can be relied on across the tenure of different individuals. This idea of continuity, either in leadership or in messaging, has been noted in literature as key for implanting effective change. Leaders who communicate their vision for change can overcome resistance by assuring their followers that the fundamental identity of the organisation will remain intact.¹¹⁰ Highlighting this continuity can reduce uncertainty about the future.¹¹¹ It will be important for Defence to clarify situations that may call for different leadership arrangements, versus those in which strong and consistent messaging may suffice.

Leaders in public-sector organisations face complex mandates, scarce resources, and fluctuating support from political figures. Those with a clear vision, as well as the desire to commit themselves to the change over the long term and persuade others of its worth, appear far more likely to find success.¹¹² GSP research identified several examples of instances where this has been raised as a key enabler, including digital transformation within the UK Government: in its study of the Central Digital and Data Office (CDDO), the NAO found that it ‘relies on sustained support from the centre of government and the continued goodwill of department senior business leaders...to maintain momentum’.¹¹³ Further, the NAO’s report stated that ‘progress on central reforms will depend on significant leadership to gain the support of other government professions.’¹¹⁴ In other words, the collaboration and cooperation discussed in Chapter 2 are also dependent on this strong leadership. It therefore plays a key role across a wide range of challenges.

McKinsey’s research further supports the importance of strong leadership, identifying the management philosophy of a ‘Leadership Factory’ as ‘deriving a competitive advantage from building a strong leadership advantage’.¹¹⁵ This points to the importance of leadership not only to instigate organisational transformation and provide initial guidance, but also to sustain change over longer periods of time. Consistency of leadership may also be an important factor in enabling organisations to build on past successes. However, research has also showed that this is not necessarily a straightforward task, as seniors often overestimate the success of their own leadership activities.¹¹⁶ This therefore points back to the importance of another item discussed in CP2, namely continued communication across all levels of the organisation to understand and assess progress and shifting attitudes over time.¹¹⁷

In terms of leadership credentials, ensuring the participation of those who have successfully led change efforts in other organisations can provide relevant prior experience to future change efforts. For example,

¹⁰⁸ Ramaley (2001); Kezar & Eckel (2002).

¹⁰⁹ Kezar & Eckel (2002); Ramaley (2001); Keup et al. (2001). However, facilitating this may require changes to organisational structures that call for frequent rotation of personnel; hence the importance of addressing both structural and cultural changes rather than one or the other.

¹¹⁰ Venus et al. (2019).

¹¹¹ Venus et al. (2019).

¹¹² Allas et al. (2018).

¹¹³ National Audit Office (2023).

¹¹⁴ National Audit Office (2023).

¹¹⁵ London, Krishnan & Weddle (2019).

¹¹⁶ London, Krishnan & Weddle (2019).

¹¹⁷ Lucas et al. (2024a).

committed leaders were seen as a key enabler for cultural changes in UK police services.¹¹⁸ Ensuring that Defence has leaders with prior experience and education in change management could be a crucial way of successfully designing and delivering the types of changes needed for future C2.

3.2.4. Incorporating change ideals into personnel management decisions

Previous sections discussed the importance of having the necessary SQEP in place; this, however, will require changes in recruitment and retention, as well as incentivisation policies.¹¹⁹ While SQEP must be employed in senior and middle leadership positions from the start, stakeholders at all levels of the organisation are likely to need to have a unique set of skills.¹²⁰ As discussed at greater length in CP2, while this will likely include technical skills and technological literacy to support digital transformation programmes, soft skills will also play a significant role in enabling reforms to the C2 enterprise to be effective.¹²¹ This is particularly true given the likely need for Defence to work with actors that it cannot directly command, control or reliably influence: collaboration and cooperation with PAGs, industry, allies and others will require significant interpersonal skills, cultural awareness and leadership ability.¹²² Further, as Chapter 2 elaborates, this requires continuous learning and development across all levels of the enterprise. In addition to changing recruitment and retention policies to ensure the necessary SQEP is in place, changing incentive structures may be a key enabler for changing behaviour and empowering the appropriate stakeholders across the Defence enterprise.¹²³ Creating incentives that clearly communicate how all personnel can contribute to the desired change, rewarding those who invest and penalising (or, in extremis, evicting) those who resist change, is critical for enabling the type of widespread participation that is needed for change to impact a large-scale organisation.¹²⁴ For example, expansion of the circumstances in which dissent and creativity are empowered within Defence may need to expand to encourage innovation and a diversity of perspectives on how to problem-solve and overcome obstacles to achieving the UK's vision of C2 in the future.¹²⁵ This is likely to be a challenge within the current hierarchical organisational structures and the traditional military workforce management approaches that Defence has traditionally embraced, but it is not impossible. The negative influence of strong hierarchy on creativity may be overcome if leadership within the hierarchy acts in an empowering manner, consistent with the observations of previous sections, rewarding innovation, constructive challenge and creative thinking about shared problems to drive continuous improvement.¹²⁶

¹¹⁸ Martin (2021).

¹¹⁹ UK Ministry of Defence (2023c).

¹²⁰ Lucas et al. (2022). The necessary skills are further explored in CP2, Lucas et al. (2024a).

¹²¹ For more detail, please see Lucas et al. (2024a).

¹²² See Yip et al. (2016) on boundary-spanning leadership, defined as '[t]he capability to establish direction, alignment, and commitment across boundaries in service of a higher vision or goal.'

¹²³ Priebe et al. (2020).

¹²⁴ Kezar & Eckel (2001).

¹²⁵ Lucas et al. (2022).

¹²⁶ Oedzes et al. (2019). See Lucas et al. (2024a) for a more in-depth discussion of the possible need to minimise or alter existing hierarchies.

3.2.5. Creating safe spaces for risk-taking

As is always the case when large changes occur, some changes will more easily be accepted by the organisation, while others will require longer periods of trial and error before they are fully implemented and integrated. Fear of failure and a low appetite for risk frequently plague organisational change throughout the process. However, learning from failure is a key part of the process of innovating, one that occurs frequently in the private sector. This then speaks to the importance of creating room to brainstorm and fail at all levels of the organisation to enable learning, dialogue, iteration of ideas, practice and adjustment to ensure that changes can be fully integrated in a low-stakes setting.¹²⁷

The point about ‘safe to fail’ spaces has been repeatedly made in the context of technology innovation, with individuals often pointing to the example of the US Defense Advanced Research Projects Agency (DARPA)¹²⁸ as well as approaches like chaos engineering.¹²⁹ However, if anything, the need for this in respect of cultural and organisational innovation is arguably greater where the changes involved may be less concrete and require more subtle acclimation than a new piece of hardware. Additionally, any change in one part of Defence may have unintended consequences if replicated without variation in other areas; opportunities for trial and error are therefore important to see what unintended impacts might emerge and if the net effect is beneficial or not.¹³⁰ In turn, a C2 enterprise that facilitates informed experimentation and risk-taking may position the UK to operate more effectively in an FOE marked by complexity and uncertainty. Expanding opportunities for experimentation, as well as safe spaces to fail, would enable Defence to pursue ‘requisite variety’ as a response strategy to complex, multifaceted challenges, and allow it to adapt and innovate at pace in the context of changing external conditions or strategic shocks.¹³¹

Creating designated spaces for such activity is therefore a key enabler both for short-term implementation as well as long-term cultural change.¹³² As mentioned in Section 3.2, this provides opportunities to create and exemplify the smaller pockets of change that demonstrate the utility of wider shifts in institutional culture. Games and simulations can often provide the safe spaces needed for individuals to learn from failure. Therefore, based on their research, the research team offered three examples of possible strategies that may be used to encourage innovation with regard to new organisational approaches: sandpits, sandboxes and prize competitions, which are explored in Box 3.3 below.¹³³

¹²⁷ DCDC Canberra Workshop, June 2023. See Lucas et al. (2024a) for additional discussion of the importance of providing spaces to brainstorm, as well as the learning benefits of failure.

¹²⁸ Wilhelm (2017).

¹²⁹ Herr et al. (2020); Simpson et al. (2021). See Lucas et al. (2024a) for a more detailed conversation about increasing comfort with experimentation.

¹³⁰ C2COE (2021).

¹³¹ Ashby’s Law of Requisite Variety (also known as the First Law of Cybernetics) suggests that ‘the complexity of a control system must be equal to or greater than the complexity of the system it controls’. Ashby (1956) in Black et al. (2024). See Black et al. (2024) for a longer discussion of requisite variety and its implications for C2 systems and organisations in the future.

¹³² See Lucas et al. (2024a) for more discussion of the need to create a culture that embraces risk-taking and experimentation.

¹³³ Of note, this is not intended to be a comprehensive list; approaches such as Microworlds or Wizard of Oz experimentation have already been used in Defence to some success. Additionally, see Lucas et al. (2024b) for a longer discussion about the use of modelling and simulation.

Box 3.3 Sandpits, sandboxes and prize competitions**Sandpits**

Used extensively by UK Research and Innovation (UKRI), among many other organisations, these are workshops around a specific topic or theme of interest into which a range of stakeholders and researchers are invited to brainstorm new research programmes.¹³⁴ These events typically have a set of stages: agreeing scope and language, disseminating expertise, brainstorming and proposal creation. They are often tailored to be well suited to the multi-disciplinary and multi-stakeholder research that the development of sophisticated technical systems would require, including those that enable human-machine teaming.

One key benefit of this approach is the endorsement of sandpits by UKRI, meaning that they have high likelihood of achieving funding and external buy-in. As such they are an effective way to encourage consortium-building among partners and to deliver new research and innovation at scale. While some adaptation of this approach may be required for the defence sphere, it is a method for encouraging collaboration between academic researchers, industry and representatives from defence, and hence presents an attractive proposition.

Sandboxes

Used predominantly in coding environments, a sandbox provides a 'safe space' for code development where new ideas can be proposed, implemented and tested. This approach is frequently used across industry; for example, some versions of Windows include sandboxes to enable safe application development.¹³⁵ These have been widely implemented in projects where the potential for code to cause damage to live technical systems can be mitigated by providing an environment which has the same fundamental characteristics of the live environment to test new versions of the code.

The idea of sandboxes can be adapted to the creation of new C2 systems through the provision of application programming interfaces and problem sets that replicate the fundamental aspects of the systems required without revealing the inner workings of those systems. New technologies in computer science could further aid this process, specifically black-box optimisation techniques and synthetic data generation.

Prize competitions

Famously demonstrated by DARPA through its Robotics Challenge¹³⁶ and Grand Challenges, prize competitions offer an opportunity to deliver significant innovations within a specific area of interest within a relatively short time period. The focus on R&D creates a uniquely competitive environment. The large events also offer an opportunity to build a community of interest and practice that can continue to collaborate at a later date.¹³⁷

Source: GSP research.

In addition to offering a safe space in which to experiment and fail within Defence, these approaches potentially offer opportunities to engage with the wider community to tackle shared problems or receive external feedback. Prize competitions, for example, offer a concentrated opportunity to review potential solutions, compare and contrast approaches, and provide feedback.¹³⁸

Benchmarks or well-known case studies might be used to underpin sandboxed test environments or sandpit discussions. In the case of sensitive or classified information, such approaches could be declassified or discussed indirectly through various abstraction techniques.¹³⁹ These can enable new approaches or technologies to be demonstrated on a familiar or set of established case studies for which baseline results are

¹³⁴ UK Research and Innovation (2023).

¹³⁵ Microsoft (2023).

¹³⁶ DARPA (n.d.).

¹³⁷ Davies (2017).

¹³⁸ As one example of this, please see Atkeson et al. (2018).

¹³⁹ Abstraction techniques used for technologically specific approaches include black-box optimisation and synthetic data generation.

known. Examples of this are prevalent in the water industry, for example, where experiments with new algorithms are first tested on a range of established benchmarks before progressing to real-world case studies. Additionally, the availability and transparency of benchmarks allows for rigorous comparison between approaches while also providing confidence to stakeholders, as they can observe the approaches working for problems that have some similarities with their real-world technical systems. So long as the benchmarks have varying levels of complexity and real-world authenticity, this allows for a discussion of the applicability of approaches to real-world problems. In certain areas of technology, for example, publications that have an applied or real-world application often also include performance data on benchmarks as a method for demonstrating the efficacy of the approach on a comparable dataset.

Exercises, simulations and other low-stakes venues will also be key opportunities for practising coordination between parts of Defence or between Defence and external organisations who are not familiar with these different forms of collaboration.¹⁴⁰ Finally, they also provide a means to demonstrate the importance of certain changes to organisations whom Defence can only influence rather than compel, but who themselves also need to adopt new ways of working to enable and enhance future C2 systems in collaboration with Defence. This provides the basis for further capacity-building and/or multi-domain development of new technical systems, approaches or collaboration initiatives in the area of C2.

3.3. Conclusion

To understand how to implement the changes needed across Defence to realise a new vision of C2, the research team explored the relevant change management literature for large organisations both in the public and commercial sectors. This chapter has discussed key enablers that the literature identified for organisational change, including communication of a key vision; committed leadership; incorporating change ideals into personnel management decisions; and creating space to fail.

However, it is important to note that this is a broad literature with lots of different competing solutions, and Defence is a unique enterprise. Any guidance on change management for C2 provided by multi-domain concepts or doctrine should reflect the reality that this will require iteration and testing, and likely involve failures along the way. The priority, then, is to maximise learning from each of these failures, and to ideally do so in a sub-threshold, pre-conflict setting rather than only embracing radical change out of externally imposed necessity during times of open war (such as is currently driving innovation in the Defence C2 enterprise of Ukraine).

¹⁴⁰ Marler et al. (2022).

4. Integrating technology to enable the C2 enterprise

As discussed in CP1 and CP2, technological advances provide both opportunity and challenges from the perspective of evolving C2. The rapid pace of R&D, both within the defence sector and in wider society, has created a range of potential new tools for the military and a potential new set of threats and vulnerabilities for the UK, its allies and its adversaries. These include advances in sensors, information communications technologies, data science, robotic and autonomous systems (RAS), visualisation techniques, artificial intelligence (AI) and other underpinning enablers, such as improved energy sources or materials, all of which could in principle support novel approaches to C2 both for forward-deployed forces and for headquarters at higher echelons.

However, technological advances have also caused new problems, such as a rise in the volume of data available to support decision making, requiring an increased demand for analytical skills – both to identify pertinent information and insights and to understand the benefits, biases and limitations of technologies across the decision cycle. While technology is thus an important enabler of advantage – and a locus for intense competition with the UK’s adversaries – C2 capability must therefore be viewed as socio-technical system that is enabled by and exploits both the technological and the human components. A dynamic and adaptive C2 enterprise is required in order to integrate new technologies to help humans effectively plan and execute multi-domain action while minimising and mitigating the vulnerabilities and dependencies that such technologies can in turn introduce.

While CP4 will delve in more detail into particular technologies of interest to C2 in the future, this third paper will discuss the challenges posed by integrating those new technologies into human organisations. This chapter will first discuss some of the broader challenges of digital transformation, before discussing how useful technologies for future C2 systems might be identified and then how they might best be integrated into existing technical systems and ways of working.

4.1. Challenges of digital transformation

The technologies supporting current C2 organisations are already embedded to an extent in current MOD practices and ways of working. Furthermore, Defence is likely to be left with some of its current legacy technology for years if not decades to come, given constraints on resources and issues such as vendor lock-in and the long lead times associated with major defence acquisition programmes.¹⁴¹ While some of these

¹⁴¹ Retter et al. (2021b).

issues are in the process of being addressed, digital transformation therefore represents not a one-time wholesale shift to ‘novel technologies’, but rather a gradual and continuous absorption of new technologies over time. At the same time, old technologies must be phased out for reasons of safety or obsolescence; the processes for doing so can be quite challenging as well as burdensome.¹⁴²

The requirement for continuous digital transformation has caused problems for adapting new technologies in the past: the NAO found that, as digital transformation has been attempted in UK Government, poor performance can often be traced to legacy technical systems, outdated IT systems and old data.¹⁴³ Such elderly systems threaten to either hike costs or slow down transformation efficiency.¹⁴⁴ The need to phase out older technology, potentially before the end of its life, can also prompt people to ask questions about wasteful expenditure. Repurposing existing technologies, often by combining them with commercially available technology, may be one way to address this issue; an example is discussed in Box 4.1 below.

Box 4.1 Strategic Capabilities Office

As part of its Third Offset, the US Department of Defense (DOD) created the Strategic Capabilities Office (SCO) to repurpose existing technologies for new applications. Then-Director Will Roper described the purpose of the SCO not as replacing organisations like DARPA that do cutting-edge research, but rather to ‘buy them some time to be able to do those next-generation leap-aheads’.¹⁴⁵ This was often done by changing the mission set for a given technology, by integrating existing technical systems to work together, or by drawing on available off-the-shelf commercial technologies. Roper further stated that to ‘innovate with what the military already had’ would be a key step to achieving those next-generation technologies.¹⁴⁶

Source: Pellerin (2016); Grady (2021).

While the pace of technology change creates challenges, however, understanding the continuous nature of technological change also provides opportunities. Literature reviewed for this project argued that, in fact, developing a capability for rapidly integrating new technologies is therefore more important than any single technology. In other words, the capability to smoothly replace a specific legacy technical system had the potential to offer greater benefit than the transformation itself, as that capability would extend into future transformations.¹⁴⁷ This is an argument that has been explicitly extended to C2, with experts arguing that in future conflicts, faster adaptability and agility will lead to significant competitive advantage.¹⁴⁸

This points to the importance of identifying systems for finding and adapting relevant technologies, rather than the development of one exquisite system, which again speaks to the importance of conceptualising C2 technologies as part of a wider socio-technical system and considering issues such as architectures, vendor lock-in, modularity, upgradeability, obsolescence management, intellectual property rights and so on. Additionally, it is important to continuously iterate the processes and technologies that constitute these

¹⁴² See Lucas et al. (2024b) for a longer discussion of phasing out and replacing older systems.

¹⁴³ National Audit Office (2023).

¹⁴⁴ National Audit Office (2023).

¹⁴⁵ Pellerin (2016).

¹⁴⁶ Grady (2021).

¹⁴⁷ National Audit Office (2023).

¹⁴⁸ Mulchandani & Shanahan (2022).

systems in order to continually improve and adapt C2 capabilities. The subsequent sections in this chapter talk about ways in which this change in approach to cultivating C2 as a capability might be accomplished.

4.2. Delineating useful technologies for C2 transformation

Given the rapid proliferation of new technology, clarifying which technologies may provide an advantage for future C2 is an important consideration. As discussed in Section 3.2.5, sandbox test environments may clarify the impact of a new technology and allow for a direct comparison between the new technology and the status quo. Such an approach, however, still suffers from the barrier of initial technology selection: how should the technologies to be sandboxed be identified?

One possible strategy is through horizon scanning, an approach specifically developed to allow for an exploration of the relevance and implications of the identified signals of change, especially within a defence and security context.¹⁴⁹ This approach combines bibliometric approaches with expert engagement, drawing on meta-analysis of literature and resources, scanning of news alerts and social media posts, and continuous and structured expert input. Horizon scanning has a demonstrated capability to assess and explore the implications of future change across the PESTLE-M spectrum and has previously been applied as a method to explore key future technologies.¹⁵⁰

While this approach may provide a holistic picture of future technologies, a simpler strategy would be to simply utilise prior research which has explored this topic.¹⁵¹ CP4 will take this approach, examining the impact of a list of key technologies that have been identified by DCDC as having disruptive potential for future C2. While this may be an efficient method, however, it may miss key trends in technology that methods such as horizon scanning could identify.

4.2.1. A key dilemma: mass versus sophistication

One key question that frequently arises in discussions of defence technology is the trade-off between mass and sophistication (e.g. precision, low observability, range, etc.) when acquiring new technical systems. The paradigmatic assumption has been that while exquisite systems are many times more expensive, they offer a significant enough boost in performance to make this a beneficial trade-off. This assumption was tested through the rise of insurgency in Afghanistan and Iraq and has again been driven to the forefront of discussion by the war in Ukraine. The flexible redeployment of commercial digital technologies such as drones or satellite communications has been a highly successful strategy for Ukraine, in many cases helping to disable Russian exquisite systems (e.g. air defences or naval platforms) for the comparatively low price of hundreds or tens of thousands of dollars.¹⁵² The conflict has also highlighted the increased interconnection between government and civilian services that has assisted military decision making. Private-sector technology such as Amazon Web Services' cloud computing has played a key role in this regard.

¹⁴⁹ Dstl is currently working on developing a process assisted by the development of a toolkit of Methods, Tools and Data to accomplish this task; this includes a spin-off study on their specific application to command, control, communications, computers, cyber and intelligence (C5I).

¹⁵⁰ Rogers (2022).

¹⁵¹ See Bellasio et al. (2021) for an example of this type of study.

¹⁵² Allen (2022).

International responses to the rising profile of commercial technology have been varied. The MOD has observed this trend and pushed the consideration of commercial technology in the DCP, which sets out how UK Defence will respond to this changing context.¹⁵³ China’s People’s Liberation Army Navy has also been reported as reconsidering the direction of technological investments, specifically the efficiency of its carrier fleet, as a consequence of the Ukrainian conflict.¹⁵⁴ While the US has repeatedly raised the importance of commercial technology, the DOD has faced internal criticism over lack of adaptability of commercial systems, even when outwardly proclaiming their value.¹⁵⁵ There is no ‘agreement by leadership that this [exploitation of commercial technology] is a priority,’ which, as discussed in Section 3.2.2 of this paper, is a fundamental barrier to successful agile change.¹⁵⁶

For the C2 enterprise of the future to successfully engage with and exploit beneficial emerging technologies, a mix of expendable and exquisite systems will likely need to be explored. Defence will therefore need to carefully consider what it is trying to achieve in different parts of the C2 enterprise, and determine where particular types of systems will be most effective. This then refers back to the importance of benchmarks and metrics, as discussed in 2.4.1, as well as a clear vision for change, discussed in 3.2.1.

4.3. Integrating technology with existing ways of working

As previous sections, as well as the two previous concept papers in this series, have outlined, integrating technology into existing ways of working is not a matter of simply acquiring a technology. Previous reports on UK Government adaptation of technology suggest a need to ‘see technology as part of a service that involves people, processes and systems.’¹⁵⁷ This is important not only in order to better consider the economic case for investment,¹⁵⁸ but also to ensure that the technologies are being implemented in the most effective manner, supported by the necessary changes across all of the supporting DLODs.¹⁵⁹

4.3.1. Investing in C2

In an age of fast-paced technological change, with diverse emerging technologies that can be applied to C2 systems, participants in the DCDC seminar pointed out that there is a temptation to think that Defence can simply purchase a new C2 system – throwing money at the problem.¹⁶⁰ This would involve a one-time procurement of a particular technology or technologies that would enable C2 systems to counter the challenges of the increasing complexity of the FOE, as explored in CP1.¹⁶¹ However, as previous CPs have discussed, seminar participants felt that a single C2 system was not going to suffice in the FOE and that there was no technological ‘silver bullet’ to resolve the issue of the FOE’s complexity; instead, Defence will

¹⁵³ UK Ministry of Defence (2023b).

¹⁵⁴ Allen (2022).

¹⁵⁵ Metha (2022).

¹⁵⁶ Metha (2022).

¹⁵⁷ National Audit Office (2023).

¹⁵⁸ National Audit Office (2023).

¹⁵⁹ Retter et al. (2021a).

¹⁶⁰ DCDC Shrivenham Seminar, October 2023.

¹⁶¹ For more information about these challenges, please see Black et al. (2024).

have to iterate, integrating new technologies as they emerge and evolve, and ensuring that both the human and technological aspects of C2 systems are working together effectively.¹⁶²

This consensus led to an approach that participants referred to as ‘investing in C2’.¹⁶³ This means investing in the R&D that will be crucial to produce the necessary technologies in the 2040 time frame,¹⁶⁴ while also investing the time and resource required to create relationships with private industry, employ appropriate procurement staff, test new technologies with Defence personnel to gain user feedback, and ensure that old technologies are updated or phased out in an efficient manner, as discussed in Section 4.1. This is often referred to as Defence’s ‘absorptive capacity’ for new technologies.¹⁶⁵ The need for a holistic and comprehensive approach to investing in the various enablers of C2 systems speaks to the importance of conceiving of C2 as a capability, and thus having a holistic, long-term and appropriately resourced plan for iterative capability development.

4.3.2. Socio-technical systems and integration of new technologies

Examining C2 as a socio-technical capability can elucidate possible approaches to integrate new technologies. One key approach is an aspect of meta-design that is utilised to create successful socio-technical systems: the application of end-user development (EUD).¹⁶⁶ In software development, the origin of this approach, EUD is framed as the possibility for non-professional developers ‘to create, modify or extend’ software.¹⁶⁷ Extending this approach to the C2 system would involve granting participants in the system increased say in the trajectory of its development. Section 2.3 has already discussed the need for Defence to continually learn lessons from a range of sources. EUD takes this a step further by positioning the ‘owners of problems’ as the problem solvers.¹⁶⁸ Introducing operational EUD, primarily in use cases of new technologies, could act as an instantaneous feedback mechanism – if multiple users or teams prefer to use a new tool in a certain way, this could be rolled out at a wider scale by higher-level leadership. This approach should be qualified with the fact that large-scale and complex domains create high user costs which pose a challenge to EUD and make widespread application to the C2 enterprise unwise.¹⁶⁹ In highly changeable domains, however, EUD can address rapidly evolving requirements more quickly than traditional development.¹⁷⁰ Consequently, successful use of EUD comes down to the targeted identification of specific areas that could best benefit from this sort of methodology, as well as ensuring that any deviation in use still falls within the guidelines set out in the broader meta-design philosophy established for C2.

4.3.3. The importance of exercises and games

As with organisational approaches, exercises and games provide an important opportunity to experiment with, adapt and integrate new technologies and approaches; in particular, they provide an opportunity for end-users to familiarise themselves with how such technologies would integrate into existing technical

¹⁶² DCDC Shrivenham Seminar, October 2023.

¹⁶³ DCDC Shrivenham Seminar, October 2023.

¹⁶⁴ See Fusaro et al. (2022) for a more detailed discussion about the importance of timely investment in scientific and technological R&D.

¹⁶⁵ Raska (2020).

¹⁶⁶ Fischer & Herrmann (2011).

¹⁶⁷ Lieberman et al. (2006).

¹⁶⁸ Fischer et al. (2004).

¹⁶⁹ Fischer et al. (2004).

¹⁷⁰ Fischer et al. (2004).

systems or ways of working.¹⁷¹ Of note, modelling and simulation can also be used in lieu of large in-person exercises to test new technologies and ideas without the expense and logistical challenges of assembling in person.¹⁷² UK allies and partners such as the US have already recognised this in their official strategy documents, describing a need for ‘continuous and iterative multi-domain experimentation to advance [National Defence Strategy] goals’.¹⁷³ Previous research, including RAND research, has identified that one of the key challenges associated with integrating new technologies is a lack of familiarity or understanding on the part of the end-user in terms of what technologies can and cannot do.¹⁷⁴ At times, this may be due to a lack of opportunities for end-users to interact with or learn about the technology, due to operational pressures and manpower shortages. This research further suggested that, in instances when technologies have ‘been successfully adopted it has been done so in an iterative way, providing opportunities for users to adapt and co-develop the capability in a more agile and incremental manner’.¹⁷⁵ Box 4.2 provides an example of an exercise where this has occurred in practice.

Box 4.2 Exercise Autonomous Warrior

The Royal Australian Navy led a two-week exercise involving approximately 40 autonomous systems and technologies, as well as participation by personnel from the US, UK and New Zealand, to test the use of new technologies, including uncrewed and RAS systems, in a multi-domain battlespace. These included technologies specifically for underpinning future C2 systems, including those C2 systems for RAS. Testing and experimenting with how both hardware and software interacted with the human element was a key component of the exercise. The event also represented an opportunity for collaboration with industry.

Source: Defence Media (2022); Felton (2022).

RAND research on this topic has also identified the importance of games and exercises in building individuals’ understanding of, and trust in, key enabling technologies.¹⁷⁶ Without this trust, effective human–machine teaming, and therefore effective and efficient use of technologies, becomes very difficult. Exercises and training therefore offer multiple positive externalities for Defence.

4.4. Conclusion

Technology will play a key role in underpinning C2 systems in the future. It is not sufficient, however, to simply purchase technologies: digital transformation comes with myriad challenges regarding the identification, adaptation and integration of new technologies. In other words, it is not just developing or identifying the technologies, but also a phenomenon known as ‘technology absorption’ that determines whether a country will be able to effectively leverage emerging technologies in its future systems.¹⁷⁷ This section discusses several potential approaches that the research group identified as being useful in achieving

¹⁷¹ Felton (2022).

¹⁷² Schmidt (2019); Nicholson et al. (2022). See Lucas et al. (2024b) for a more detailed discussion of the various uses of modelling and simulation.

¹⁷³ US Department of Defense (2023).

¹⁷⁴ Lin-Greenberg (2020); Retter et al. (2021a).

¹⁷⁵ Retter et al. (2021a).

¹⁷⁶ Retter et al. (2021a).

¹⁷⁷ Raska (2020). Previous RAND reports have further discussed the challenge of improving organisations’ absorptive capacity for change beyond the proposals made here, including Retter et al. (2021a); Kepe et al. (2018); Lucas et al. (2023); and Freeman et al. (2015).

this absorptive capacity; in particular, considering C2 as a socio-technical system, investing resource – including time for iteration, training and games – and delineating key decision points came across as means for ensuring that emerging technologies can be integrated into C2 systems and networks.

5. Conclusion and next steps

Given the requirements of the FOE as discussed in CP1, and the resulting need for Defence to transition to a more dynamic and adaptable C2 enterprise as outlined in CP2, research for this third paper suggests the importance of conceiving of C2 as a capability in its own right. That is, rather than understanding C2 as a static set of individual capabilities or a discrete activity, C2 must be understood as the continuous cultivation and maintenance of a capability across Defence and its external partners. This paper has also suggested several ways in which this might be achieved:

- **Chapter 2 discussed enabling people to cope with complexity** through the consideration of C2 as a socio-technical system that requires strategic capability management. This involves the promotion of continuous learning and development at all levels; teaching systems thinking to cope with complexity; and fostering a new approach to collaboration (beyond just ‘command’ and ‘control’), both internally across Defence as well as with external partners such as PAGs, industry or international allies. This collaboration also includes sharing lessons and information in order to learn from past experience; leveraging these lessons will require exploring, discovering and understanding what ‘good’ or ‘success’ looks like; as well as building in constant feedback cycles of learning to support adaptation.
- **Chapter 3 discussed enabling the Defence enterprise to evolve in order to cope with complexity.** This included both consideration of established frameworks that Defence could use to implement large-scale change to organisational structures, as well as an exploration of key enablers for changing institutional culture and overcoming the inevitable barriers to implementation of any ambitious reforms to the C2 enterprise.
- **Chapter 4 discussed how novel technologies might be best integrated into the future C2 enterprise** to fully enable the C2 enterprise to function in the future as a complex socio-technical system. This emphasised that technology is not itself a ‘silver bullet’, but that cultivating the ability to more rapidly acquire, integrate and field a mix of new technologies (and old) to support rapid capability development – and do so outside of wartime – would be a true game-changer for the C2 enterprise.

CP4 will conclude this series of papers with a more detailed discussion of specific enablers for future C2 systems, with a focus on specific areas of novel technology. It will then present a series of implications for those in Defence tasked with conceptualising and designing the UK’s vision for C2 in the future, drawing on the findings of all four concept papers compiled by the GSP.

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Annex A. Workshop participants

The third expert workshop on C2 in the future was held virtually on Microsoft Teams on 23 October 2023. Attendees at this workshop were as follows:

Table A.1 List of workshop participants

Name	Organisation
David Bryant	DRDC
Ralph Dekker	Ministry of Defence of The Netherlands
Magalena Granåsen	FOI
James Hanson	MOD
Jonas Herkevall	FOI
Jim Hill	Dstl
Marie-Eve Jobidon	RDDC
Johan Ivari	FHS
Dr Per Wikberg	FOI
James Black	RAND Europe
Rebecca Lucas	RAND Europe
Cdr Leif Hansson	DCDC
Peter Houghton	Dstl
Lt Col. Ed Vickers	DCDC
Lt Col. Robert Kace	DCDC