



ALL THE GEAR AND NO IDEA

HOW TO ADDRESS THE POOR APPLICATION OF
HIGH-QUALITY ANALYSIS FOR LONG TERM
STRATEGY DEVELOPMENT AND DECISION MAKING
IN UK DEFENCE

MARK WORKMAN





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ALL THE GEAR AND NO IDEA

HOW TO ADDRESS THE POOR APPLICATION OF HIGH-QUALITY ANALYSIS FOR LONG TERM STRATEGY DEVELOPMENT AND DECISION MAKING IN UK DEFENCE

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EXECUTIVE SUMMARY

This paper argues that a paradigm shift is needed in the way that UK defence thinks about unknown and unknowable futures. Specifically, it asserts that the UK Ministry of Defence (MOD) should augment its legacy decision support tools with 'deep uncertainty' approaches. This would enable it to shift from static state to dynamic portfolio stress testing, to enhance cross-stakeholder transparency and understanding of uncertainty through novel visualisations, and to integrate more diverse insights in the red teaming of portfolio performance in possible futures. The paper applies a use case of strategy design and decision making around climate. However, the insights are equally relevant to other domains. It first outlines the characteristics of climate risks that challenge the traditional risk assessment methodologies that have a significant impact on planning and doctrine. It argues that two key foundations would need to be present for MOD to conduct the appropriate analysis in this future environment: first, an understanding of the deeply complex and chaotic characteristics of the future operating space; and, second, the acceptance and progressive integration of decision-making systems that account for these characteristics.

It contends that the MOD is currently at a halfway point in this journey, having accepted the first premise but not acted upon the second. The paper examines the MOD's recently released *Future Operating Environments 2040 (FOEs 2040)* and its 7th Edition of *Global Strategic Trends (GST7)*, as evidence of this position. It highlights how these documents showcase that there is a deep understanding of the complexity of future operating environments in the MOD's long-term strategic visions, but that this sits alongside a deference to a 'predict and act' mindset that does not enable effective decision-making in these operating environments. This leaves MOD decision makers with no clear prescription as to how to apply these comprehensive pieces of analysis and how to structure decision spaces in circumstances of deep uncertainty. It proposes that the prescription for this already exists in the form of decision making under deep uncertainty (DMDU) approaches that have a firm conceptual and practical grounding in case studies across multiple domains, but that are highly attuned to existing practices within the military. The paper concludes that the integration of these methods in a more systematic way is not only a mission critical requirement for MOD but is also achievable within its existing culture and mechanisms.

1. INTRODUCTION

The world is growing less predictable and more complex. The ability to design long term strategy is increasingly challenging. Defence organisations are struggling to develop decision making systems suited to this era of complexity. They are not alone in facing this issue. In recent years, this challenge has led to poor preparedness and handling of crises has across sectors including finance (e.g. the impact of complex derivatives and inflationary forecasting),² health (e.g. Covid-19 pandemic preparedness),³ energy (e.g. forecasts for economic competitiveness and net zero planning),⁴ trade (e.g. around supply chain planning for crises ranging from the Panama Canal to the Strait of Hormuz),⁵ and geopolitics (e.g. around the rules-based global order).⁶ Although wait-and-see approaches to recent geopolitical events – such as the blockage of the Strait of Hormuz – have been prudent, they also generate risks of paralysis at the operational and strategic levels.

“How you think matters more than what you think.”¹

Philip Tetlock

Within this backdrop, this paper argues that a paradigm shift is needed in the way that UK defence thinks about unknown and unknowable futures. Specifically, it asserts that the UK Ministry of Defence (MOD) should augment its legacy decision support tools with ‘deep uncertainty’ approaches, in order to: (i) enable it to shift from static-state portfolio stress testing to dynamic stress testing; (ii) enhance cross-stakeholder transparency and understanding of risk through novel visualisations; and, (iii) integrate more diverse insights in the red teaming of portfolio performance in possible futures.

The paper applies a use case of strategy design and decision making around climate. Yet, the insights are equally relevant to other domains. It first outlines characteristics of climate risks that challenge traditional risk assessment methodologies which, in turn, have a significant impact on planning and doctrine. It argues that two key foundations would need to be present for MOD to operate in this future operating environment:

- I. An understanding of the deeply complex and chaotic characteristics of the future operating space; and,
- II. The acceptance and progressive integration of decision-making systems that account for these characteristics

¹ Quoted in Brand, S. (2009) 124

² Silver, N. (2015) 576; Bernanke, B. (2024)

³ UK Covid-19 Inquiry (2024)

⁴ Adolfsen et al. (2022)

⁵ Raval, A. (2025)

⁶ Roos, G. (2026); Carney, M. (2026)

The paper argues that the MOD is currently at a halfway point in this journey, having addressed the first premise but not the second.

In Section 3 (MOD Responses: Understanding without Application), the paper examines the MOD's recently released *FOE 2040* as well as its keystone *GST7* publications, as evidence of this halfway position. It highlights how these documents showcase that there is a deep understanding of the complexity of future operating environments in the MOD's long-term strategic visions. This aligns well with the complexity and future challenges that climate change will bring, as characterised in Section 2 (Characteristics of Climate Risks and Implications for Strategic Planning). This stance, however, sits alongside a deference to a 'predict and act'⁷ mindset that does not enable effective decision-making in these operating environments. This leaves MOD decision makers with no clear prescription as to how to apply these comprehensive pieces of analysis as well as how to structure decision spaces in contexts of complexity and deep uncertainty.

In Section 4 (Deep Uncertainty Approaches: Flipping the Analytical Construct), the paper proposes that the prescription for this already exists in the form of decision-making under deep uncertainty (DMDU) approaches that have a firm conceptual and practical grounding in case studies across multiple sectors. It further highlights how these approaches are highly attuned to existing practices within the military. Enhancing this process, it argues, would provide the MOD with more effective systems for:

- I. Enacting transparent, dynamic exploratory approaches to stress testing of portfolio robustness across a range of possible futures;
- II. Facilitating cross-functional visibility of the performance of technology, research and strategy portfolios via stakeholder-relevant execution metrics - both across and beyond the MOD;
- III. Hardwiring interdisciplinarity and reduce blind spots in MOD process through the convening of multi-function dialogue spaces that enable a plurality of insights to systematically interrogate portfolio performance; and,
- IV. Facilitating a culture of anticipatory governance commensurate with the extensive uncertainty prevalent in the dynamic and complex operating environment facing decision makers.⁸

Section 5 (Conclusions and Recommendations) concludes that the integration of these methods in a more systematic way is not only a mission-critical requirement for MOD but is also achievable within its existing culture and mechanisms.

⁷ An approach is based on analysts generating best guesses of the future and then designing a strategy to act in that future. Uncertainty is locked-in on that best guess via sensitivity analysis.

⁸ In other words, governance that is inclusive and collaborative, future facing, proactive, iterative, outcomes based and experimental. See Aczel et al. (2022); McLaren & Workman (2020).

2. CHARACTERISTICS OF CLIMATE RISKS AND IMPLICATIONS FOR STRATEGIC PLANNING

Climate and environmental change represent fundamental drivers for human vulnerability, reductions in societal resilience, and intrastate and interstate conflict, with violent and non-violent outcomes. As highlighted in countless scholarly studies and acknowledged in multiple UK government policies and strategies, including the most recent Strategic Defence Review 2025, this will have impacts across the UK national security agenda.

Given this, it is important to understand how the security sector and military might engage with climate-impacted futures being anticipated. The security risks associated with climate change are diverse, wide-ranging, interconnected and complex. Climate risks are multifaceted and multidimensional, involving both rapid and slow onset disasters. These impact at local and global scales, with short-, medium- and long-term implications. Climate risks can therefore be characterised as:

“Nearly all modelling of future climate risks assumes that climate impacts are proportional to their drivers. Yet, there are non-linear changes in environmental and climate variables that are not captured in models.”

- **Increasing:** The physical risks and socioeconomic impacts of climate change are increasing across the globe.⁹ Climate-related risks to human and natural systems will be greater in a scenario of 1.5°C average global temperature than they are at present, and even greater at 2.0°C.¹⁰ Nationally Determined Contributions (NDCs) submitted as part of the UNFCCC COP process suggest that we are locked into a 2.7+°C future.¹¹ The potential for an explosive, exponential growth in climate impacts is therefore highly probable in a climate-impacted future.
- **Non-Linear:** Nearly all modelling of future climate risks assumes that climate impacts are proportional to their drivers. Yet, there are non-linear changes in environmental and climate variables that are not captured in models. Examples include weather extremes and responses from human and natural systems.¹²
- **Context-dependent:** The impacts of climate change are context-dependent, as some societies have the capacity to adapt to significant levels of stress, while others can suffer severe impacts from lower levels of stress.¹³

⁹ Woetzel et al. (2020)

¹⁰ IPCC, (2018)

¹¹ UNFCCC (2021)

¹² Ebi et al. (2016)

¹³ IPCC (2014)

- **Networked and emergent:** Climate risk is transmitted across time and space due to the linked nature of climates across the world, as seen in cross-boundary teleconnections such as the El Niño–Southern Oscillation (ENSO). Climate risk can be transmitted across sectors and international boundaries.¹⁴ Large-scale climatic events may occur simultaneously and the combination of polycentric interacting processes can result in extreme impacts.
- **Cascading:** Climate risks have multiple direct and indirect pathways that cascade through complex social–ecological systems.¹⁵ Risks to one sector or one region can cascade across networks and regions. The mechanisms of transmission include flows of material, movement of people, and economic and trade links.¹⁶
- **Compounding:** Climate risk accumulates, leading to the gradual build-up of disaster risk in specific locations. This is often due to a combination of processes – some persistent and/or gradual – such as inadequate water management, land use changes, and rural-urban migration. These interactions can affect any region or, indeed, any generic exposure or vulnerability.

These characteristics by themselves represent a ‘wicked problem’, due to their innumerable causes, constant morphing, and lack of clear solution.¹⁷ The future may be dominated by factors that are very different from current drivers and hard to imagine based on today’s experiences. In this context, it might be comforting for defence to think that it can find some silver bullet, AI-based probabilistic model that can chart the likelihood of a specific event occurring or the outcome of a specific decision. However, such thinking ignores the implications of climate risk characteristics for analysis. Climate change has uncertainties that are ‘deep’.¹⁸ In such contexts, either analysts do not know or the parties to a decision cannot agree on:

“The future may be dominated by factors that are very different from current drivers and hard to imagine based on today’s experiences.”

- I. What conceptual models can describe the relationships that exist across key driving forces that will shape the long-term future;
- II. What probability distributions should be used to represent uncertainty around key variables and parameters in the mathematical representations of these conceptual models; and/or,
- III. How to ascribe value to the desirability of alternative outcomes.

¹⁴ Liu et al. (2015); EEA (2017)

¹⁵ Challinor et al. (2018)

¹⁶ Adger et al. (2009)

¹⁷ Camillus (2008)

¹⁸ Lempert et al. (2013) 2-3

While any expert might express their uncertainties as probabilities, the range of these probabilities over a group of experts is ineffective because the upper and lower elicitations will infer that almost anything is possible. Furthermore, some uncertainties are too great to build a ‘useful’ model to simulate system behaviour.

Despite this, the climate policy and consultancy community tends to fall back on analytical constructs that are underpinned by probabilistic assessments and circular reasoning. This is prominently demonstrated in the use of data modelling tools that simultaneously characterise possible climate futures whilst generating solutions to those futures; the analytical equivalent of marking one’s own homework.¹⁹

“The characteristics of climate risk challenge not only the physical systems and infrastructures through which defence achieves its objectives, but also the conceptual architectures through which it seeks to define its objectives and strategies.”

For defence, these contexts generate a doubly wicked problem. The characteristics of climate risk challenge not only the physical systems and infrastructures through which defence achieves its objectives, but also the conceptual architectures through which it seeks to define its objectives and strategies. This problem is not unique to defence but extends across (and undermines) the institutional silos that characterise current operating models within government and beyond.

The starting point for redressing this issue is not to seek a more refined solution but to gain a better understanding of the nature of the uncertainty space. Increasing the understanding that decision makers have around possible climate-impacted futures and climate risk solution-sets would, in turn, enhance their ability to choose and apply appropriate sets of decision support tools for the types of decisions they will face. As seen in Figure 1, as the extent of uncertainty increases towards the ‘deep uncertainty’ that characterises climate risk, there are implications for the types of decision support tools capable of generating relevant insights commensurate with the extent of uncertainty.²⁰

¹⁹ European Commission (2021)

²⁰ See also Courtney et al. (1997); Dorsser et al. (2018); Bevan (2022)


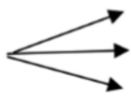
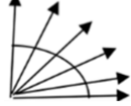
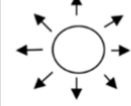
	Level 1	Level 2	Level 3	Level 4 (deep uncertainty)		
				Level 4a	Level 4b	
		A clear enough future	Alternate futures - with probabilities	A few plausible futures	Many plausible futures	
Complete determinism						
	Deterministic projection based on trend extrapolation.	Probabilistic projections in which all uncertainties are presented and measured by probabilities.	Coherent view of possible futures with explicit reference to the likelihood of these futures through expert judgement.	Multiple views of possible futures without the ability to be explicit on the likelihood of these futures.	All kinds of possible futures - unknown systems & unknown outcomes.	
Types of insights that decision support can generate that are commensurate with the extent of uncertainty						Total ignorance

Figure 1. The spectrum of uncertainty and implications for analytical insights for decision support. *Source:* Image adapted from Marchau et al. (2019, 9), licensed under the terms of the Creative Commons Attribution 4.0 International License.

Take the example of rolling a normal, six sided dice. A ‘clear enough future’ is akin to rolling the dice on a flat surface on Earth. If we rolled the dice hundreds of times, we could work out that the likelihood of rolling a number is one in six. Now imagine rolling the dice on a flat but uneven surface on a boat instead. Depending on the environmental conditions – from the severity of weather conditions rocking the boat to the shape of the uneven surface on which the dice was being rolled – working out that likelihood isn’t as simple. We are presented with alternative and plausible futures, but ones where we can still create some form of probabilistic projection. Now imagine rolling the dice on the International Space Station (ISS). Not only would you be unable to say what face the dice had landed on, but you would find it difficult to get people to agree on whether the dice had landed at all, or whether it was even possible for the dice to land.

This is akin to a scenario of deep uncertainty. In this context, it makes no sense to take the probabilistic model that we would use to predict the outcome of rolling a dice on a flat surface on Earth, and apply that model when rolling a dice on the International Space Station. In fact, using those calculations to guide our predictions would lead to misguided conclusions.²¹

“it makes no sense to take the probabilistic model that we would use to predict the outcome of rolling a dice on a flat surface on Earth, and apply that model when rolling a dice on the International Space Station.”

²¹ See Workman et al. (2024) for an explanation of the underpinning tenants of deep uncertainty.

In *GST7* and the *FOEs 2040*, the MOD tells us that our understanding of the possible futures that exist is similar to our understanding of the possible outcomes of rolling a dice on the ISS. Having set this context, however, it then analyses that future of deep uncertainty future through a system that is designed to predict the outcomes of rolling a dice on a boat. If these analyses are used by decision makers, it creates a danger that they will choose courses of action that do not work or that make things worse.

It is important to note that *GST7* and the *FOEs 2040* are not anomalies. This approach to futures is representative of a mindset that pervades national security decision making. This mindset tends to privilege deterministic, optimised and technocentric models. As highlighted in Table 1, this approach may be acceptable in ‘complicated systems’. However, it is maladapted for ‘complex systems’ defined by deep uncertainty, complexity, non-linearity and emergence. Given that such complexity tends to prevail in contexts of climate risk, the use of traditional policy decision support tools and mindsets represents a critical risk vector for stakeholders across the national security community, from policymakers to operational planners and analysts. This is not a new risk. The climate sector’s inability to understand the implications of operating in deeply uncertain and complex environments has been a major cause for concern for some time, with persistent evidence that strategy development approaches are not fit for purpose.²² This risk was glaringly revealed by the erratic early management of the Covid-19 pandemic.

“Enabling the security sector to better manage possible climate-impacted futures, therefore, requires not simply enhanced models but also a more consistent embedding of a ‘complexity mindset’.”

This inability extends throughout the private sector, non-governmental and governmental organisations. For example, HM Treasury uses ‘Cost Benefit’ rather than ‘Risk Opportunity Analysis’ for various assessments of financial value, despite the fact that the former model does not sufficiently consider future optionality and irreversibility. This competency gap – both in terms of knowledge and systems – reduces organisations’ ability to apply relevant expertise, choose appropriate decision support tools, and communicate deep uncertainty, complexity and

emergence amongst decision makers and wider societies. Although many in the climate and consultancy sector have developed climate analysis and solution sets for complex systems, these can still generate fragile outcomes. Enabling the security sector to better manage possible climate-impacted futures, therefore, requires not simply enhanced models but also a more consistent embedding of a ‘complexity mindset’.

²² Workman et al. (2020 & 2021); Pitman et al. (2022); Mazzucato & Collington (2026)

<p>Complicated Systems</p> <ul style="list-style-type: none"> • Characteristics include: nested components; the ability to use reductionist thinking - as the behaviour of each component is understandable independent of the whole; and, probabilistic predictions of risk. • Underpin traditional decision support tools, whereby all relevant knowledge is gathered into a single package that, once validated, can be used as a surrogate for the real world (i.e. a consolidative model). • Assumes a single relevant decision maker, well-understood behaviour and the convergence of stakeholder objectives. • A familiar and orthodox system for the policy and consultancy community, and the preferred tool of corporations and policy makers. • Develops a culture of ‘predict then act’ decision making whereby a best guess of the future is made and a plan designed for that future.
<p>Complex Systems</p> <ul style="list-style-type: none"> • Characteristics include: a large number of interacting components; non-linear, aggregated activity; and, a tendency to exhibit hierarchical self-organisation. • Requires the use of models within an exploratory framework that map assumptions onto consequences without privileging any one set of assumptions; such as Robust Decision Making (RDM). • Allows for stakeholders to have a diversity of priorities, goals and values underpinning their decisions. • Embraces irreducible uncertainty regarding the consequences of audience actions. • Supports iterative problem-solving and a ‘deliberation with analysis’ culture of decision making rather than predicting unknown and unknowable futures.
<p>Additional Implications</p> <ul style="list-style-type: none"> • Transparency should underpin every aspect of any analytical process. • Mixed parametric and qualitative methods should be applied in designing strategies, as: <ul style="list-style-type: none"> • There will be a temptation to use the outputs of data-driven tools to provide definitive options for choices; but, • The use of a wider set of tools will enable decision makers to explore uncertain futures and complex interactions between variables for any given strategy.²³ • Modelling tools should be used to explore the ways that strategies could be designed to achieve stated stakeholder objectives, rather than to confirm the realisability of stated plans.²⁴ This enables better exploration of high dimensional, deeply uncertain futures. • New but well-established mechanisms for organisational governance are liable to be required to support these requirements within some organisations.²⁵

Table 1. Summary of complicated and complex systems and the implications on decision support tools and organisational governance.

²³ Gambhir et al. (2019)

²⁴ Mercure et al. (2019)

²⁵ Aczel et al. (2022)

3. MOD RESPONSES: UNDERSTANDING WITHOUT APPLICATION

Elements of this new paradigm are apparent in the planning assumptions of the Strategic Defence Review 2025 (SDR).²⁶ Similarly, the National Security Strategy 2025 observes that there is a new era of “radical uncertainty” with an increase in “transactionalism” in international relations.²⁷ In such contexts, decision support approaches adopted by the MOD and associated agencies will need to enable agile, flexible and robust long-term planning and decision making. At present they do not. This is an age-old problem manifested in the works of many strategic thinkers, from Sun Tzu to Carl Von Clausewitz. Indeed, Von Clausewitz himself placed significant emphasis on the risks of what he termed *Methodism*, in which people act in accordance with pre-established patterns. We reframe situations in our mind so that we can find commonalities with previous events we have experienced. This results in us making simplified conclusions about complex and context-specific problems. Over time, we denude our ability to operate effectively in complexity as we defer to choosing stock responses from a narrow cache of preferences, in ways that impose crippling conservatism on our decisions.²⁸

The MOD finds itself in this very situation today. It has recognised the new high dimensional, dynamic and deeply uncertain paradigm within which strategies need to be developed. Yet, it has not accepted and integrated the decision-making systems that account for these characteristics. Rather it has deferred to a ‘predict and act’ mindset that does not enable effective decision-making in these operating environments. ‘Predict and act’ approaches can lead to better decisions in principle. These decisions, however, fail to deliver in practice because of the inability to accommodate for complexity in decision analysis and strategy development processes. In other words, even when decision makers understand that the operating environment is increasingly complex and uncertain, their decisions within that are likely to be rooted in doctrine and experience derived from operating environments with entirely different characteristics that we presently find ourselves in.

“even when decision makers understand that the operating environment is increasingly complex and uncertain, their decisions within that are likely to be rooted in doctrine and experience derived from operating environments with entirely different characteristics.”

²⁶ Ministry of Defence (2025)

²⁷ Cabinet Office (2025) 14, 18

²⁸ Leonard (2001)

The potential for failure in this context is self-evident. As an example of this, in 2021 *The Integrated Review of Security, Defence, Development and Foreign Policy* placed significant emphasis on the need to “tilt to the Indo-Pacific”, with significant underlying implications for its European posture.²⁹ In this vision, the Indo-Pacific represented the centre of gravity for economic stability and for competition, including in the form of “regional militarisation, maritime tensions, and a contest over the rules and norms linked to trade and technology”.³⁰ Underpinning this was the sacrosanct belief that the “United States will remain the UK’s most important strategic ally and partner” based on a relationship of “common values – a shared belief in democracy, the rule of law and fundamental freedoms”.³¹

Such predictions were logical when viewed through the lens of trends-based analysis. However, within a year of this, Russia had launched a full-scale invasion of Ukraine. Within three years, Hamas had launched the most significant assault on Israel in a generation, triggering a conflict that consumed British foreign and defence policy for the following years. Within five years, the US undertook unilateral invasions of Venezuela and Iran with the explicit goal of regime change in contravention of international rule of law, creating economic shocks that have reverberated throughout the global economy.

“The tendency for poor predictive insights within military analysis has a rich history.”

Though the implications of these events are still being played out, they demonstrate the uncertain world that decision-makers in the defence and security community must grapple with. The tendency for poor predictive insights within military analysis has a rich history. In 1945, months before the US denoted two atomic bombs over the Japanese cities of Hiroshima and Nagasaki, Admiral William Leahy advised President Harry Truman on the impracticability of the atomic bomb project, noting: “This is the biggest fool thing we have ever done. The bomb will never

go off, and I speak as an expert in explosives”.³² Prior to Russia’s invasion of Ukraine, various commentators had asserted that drones were too costly and complex to revolutionize warfare. Within one year of the war, they were predicting that drones would define future warfare.³³ Both sets of predictions, whilst wildly different, were rooted in the same principles of trends-based analysis.

The MOD currently finds itself in a halfway position, aware of the deeply uncertain nature of the future operating environment and the significant limitations of traditional foresight methods, but unable to operationalise a more effective decision support

²⁹ Cabinet Office (2021) 60

³⁰ Cabinet Office (2021) 26-27

³¹ Cabinet Office (2021) 60

³² Cerf & Navasky (1998) 271

³³ Kunertova (2023)

system for this context. This is evidenced in two recent strategic planning documents. In September 2024, the MOD's Development, Concepts and Doctrine Centre (DCDC) released *GST7*.³⁴ Touted as a landmark publication, it offers foresight analysis from a thematic and geographic perspective.

GST7 offers five scenarios that describe illustrative pathways into a future world order. These scenarios are influenced by six global key drivers of change, connected in turn to twenty-two trends that can be observed today and that, it claims, are likely to shape the coming decades. The analysis concludes that, taken together, these drivers represent a complex set of dynamics which serve to influence, counteract or accelerate each other, often in unexpected ways. *GST7* is therefore designed to portray a future strategic context for those involved in developing long-term plans, strategies, policies and capabilities in the MOD and wider government. It advocates that describing the key drivers of change and illustrating alternative outcomes helps to test assumptions and prepare for an uncertain world. It is an enormous catalogue that is designed to ensure that decision makers avoid falling back on preconceived ideas and assumption with a fixed prediction or a single 'type' of future.

In March 2026, after its evolution from DCDC to Defence Futures, the organisation published the *FOEs 2040*.³⁵ This document is branded as an evidence-led assessment that explores how global drivers, disruptors and actors – as characterised in *GST7* – may shape the increasingly complex, competitive and technologically-driven world in which defence may need to operate. Echoing *GST7*, it recognises the uncertainty of long-term assessments. However, it builds on *GST7* by setting out a range of plausible, evidence-based future operating and engagement spaces. Inherent within the format and purpose of the document is an implicit acknowledgment that a disconnect existed between *GST7*'s vision of deep uncertainty and the insights required for decision makers to deliver strategic planning and force development across defence. In seeking to square this circle, Defence Futures undertook a conceptually paradoxical approach: providing tangible examples around which senior leaders could orient their decisions in response to a deeply uncertain future.

Understanding how this paradox plays out within the *FOEs 2040* provides a useful insight on the inhibitors facing defence as it tries to move towards deep uncertainty mindsets. Over the course of forty pages, the *FOEs 2040* seeks to assess the defence implications of the "five distinct illustrative pathways towards the future world order" laid out in *GST7* and capture "the core commonalities that emerged across all five future worlds".³⁶ In its stated 'purpose', the document actively reinforces the concept of deep uncertainty and implies a possibilistic framework:

³⁴ Ministry of Defence (2024)

³⁵ Ministry of Defence (2026)

³⁶ Ministry of Defence (2026) 8

“A complex set of global dynamics that influence, counteract or accelerate each other is rapidly changing the global security environment. Future Operating Environments 2040 (FOEs 2040) aims to describe these likely characteristics and dynamics. Pinpointing when specific change will emerge in any long-term assessment is, however, invariably problematic. To that end, the purpose of this publication is to offer an overview of tomorrow’s operational and operating engagement spaces and, in addition, offer insights into alternative plausible outcomes.”³⁷

This framework would, if followed consistently, result in the *FOEs 2040* privileging the idea that each imagined combination of issues is just as likely to occur and that no form of weighting should be given as to likelihood of a driver or issue. In contrast with this, the *FOEs 2040* proceeds to arbitrarily categorise its list of issues within a probabilistic framework of “Good bets”, “Probable bets”, and “High impact, low probability bets”.

This approach highlights the ways in which the MOD fails to convert its understanding of deep uncertainty principles into appropriate, possibilistic decision support systems when trying to translate these principles into operationalizable insights. This has potentially significant implications for the quality of MOD decision-making.

Consider, for example, the consolidative ‘predict and act’ approach that has historically underpinned the MOD strategic and operational planning model. Such ‘consolidative approaches’ are rooted in parametric or mental models of how the world works. These models, in turn, are founded on complicated systems thinking whereby the system is comprised of mechanical nested components - see Table 1. In such circumstances, reductionist thinking is possible, as the behaviour of each component of the world is understandable independent of the whole. The contrast to this comes in the form ‘exploratory approaches’, which are founded on complex systems thinking. These approaches advocate that systems are made up of a large number of interacting components, in which aggregated activity is nonlinear and can exhibit hierarchical self-organisation. In such circumstances linking cause and effect is not possible and only tends to be feasible after an outcome.

In the scene setting of *GST7* and the *FOEs 2040*, we find an attempt to impart the principles of exploratory approaches to MOD decision makers. The documents emphasise the need for accommodating chaotic spaces in which outcomes are unknown

“This framework would, if followed consistently, result in the *FOEs 2040* privileging the idea that each imagined combination of issues is just as likely to occur and that no form of weighting should be given as to likelihood of a driver or issue.”

³⁷ Ministry of Defence (2026) 3

and unknowable. However, in seeking to translate the implications of this to decision makers, the documents reinforce a consolidative approach; implying that the world can be viewed as a complicated system with nested components. This reinforces the idea that the behaviours of different components of the world are understandable in isolation and, thus, that reductionist thinking within strategic planning is possible.

As an analogy, imagine a scenario whereby the Army, Navy and Air Force planned an operation completely independently and automatically assumed that the component assets would fit together within an interoperable coherent all-arms doctrinal framework via seamless communication and logistics systems. Extend this further and imagine that the only way each service could plan against the other services' decisions was to make bets on what was 'Good', 'Probable', or 'High impact and low probability' based on the actions of those services in other – highly context-specific conflicts. This planning model would clearly not result in a coherent and interoperable approach.

In being forced to represent the 'complex system' of global security as a 'complicated system', *GST7* and the *FOEs 2040* have implied to decision makers that this kind of consolidative approach is acceptable for strategic planning. This implication does not fit with the realities of modern strategic environment. In complex systems, possibilistic mindsets are needed as small events or interventions can result in massive 'effects'. Consider, for example, how the default of ~6% of US house owners in the US in 2008 resulted a financial recession that wiped \$20Tn of value from the global economy, or how insurgents and specialist teams of conventional armies now tend to operate in fluid and decentralised ways that evolve, interact and generate emergent strategic effects on the shape of the battle space.³⁸

What remains absent from *GST7* and the *FOEs 2040* is an acknowledgment or exploration of alternative tools for converting deep uncertainty mindsets and possibilistic frameworks into practical decision support systems. Instead, the documents root their conceptual credibility in observations surrounding the systematic nature of the research undertaken and the plurality of expertise that was brought to bear on the analysis. This itself is up for debate. Consider, for example, that the documents seek to assess long-time horizons of outcomes and respond to a highly generalised research question. This goal is poorly suited to the use of expert judgement and elicitation that represent key research methods for the publications. Furthermore, by using the *GST7* evidence-base as the foundation for its validation of the implications of *GST7*, the *FOEs 2040* delivers a form of circular reasoning or recursive analysis; akin to the marking of one's own homework found in the climate community's use of data modelling tools.

³⁸ McChrystal et al. (2015) 304

Importantly, although *GST7* and *FOEs 2040* have been produced by teams of analysts, writers and designers, the paradoxes within them are not necessarily representative of authorial failure. These documents are created within an institutional process that inhibits ‘futures’ officials within the MOD from doing anything that could be seen as prescribing policy, solutions and/or interventions. Instead, this process requires ‘futures’ products to be translated by other teams into policy directives and strategic plans. This system results in futures documents that provide an analysis of a problem set without being able to prescribe how the frameworks that underpin that analysis could be harnessed by decision-makers.³⁹ This places futures officials and decision makers in an unenviable position, constantly generating analyses from a multiplicity of approaches, without creating the systems through which these analyses can be effectively integrated and structured during the very decision-making processes that they aim to support.

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Given the vital importance of integrated decision-making in the contemporary geopolitical landscape, the opportunity to amplify the value of these ‘feedstock’ strategic documents should be of interest to the MOD. So what exactly would such a system look like? In what ways can one scaffold a complexity framework approach that serves as an organising construct for decision making? And how can this approach support the development of decision-making mindsets capable of designing strategies that maintain robustness and optionality in conditions of complexity and deep uncertainty? It is to this that we now turn.

4. DEEP UNCERTAINTY APPROACHES: FLIPPING THE ANALYTICAL CONSTRUCT

As articulated in Sections 2 and 3, there are some ‘complicated’ situations where we can work out the chance of something happening, and other ‘complex’ situations where we cannot. The *FOEs 2040* and *GST7* frame the future operating landscape as a ‘complex’ situation. However, in trying to translate this into something actionable for decision

³⁹ The merits and demerits of this organisational system are not in the remit of this article. In principle, deep uncertainty approaches require that these analytical functions are brought more closely together. This does not mean ‘analysts making decisions’ but, instead, analysts testing possible policy actions against their analytical frameworks. This jurisdictional shift is liable to require ‘champions’ who can deliver and disseminate the case studies needed for doctrine.

makers, they end up using a consolidative model of analysis that is suited to a ‘complicated’ situation. In doing so, they end up tacitly reinforcing a ‘predict and act’ model for decision making that has consistently failed to deliver success in complex situations. The logic behind this ‘predict and act’ approach is so embedded within Western strategy and policymaking, and is so self-fulfilling in how it is enacted, that it

can be difficult to challenge it or to imagine what an alternative system would look like. However, as this section will highlight, changing this model requires a relatively simple conceptual reorientation of the analytical construct currently being used.

Consolidative, ‘predict and act’ approaches ask the question: ‘What will future conditions be?’ To answer this, they apply models to predict this future and then test how portfolios perform within that prediction. This approach can provide insights for a ‘complicated’ scenario. However, even when it is suitable, it can enable

and embed negative habits within policy and strategy making. Specifically, analysts focus on making accurate predictions and optimising a response to the future that has been predicted. To achieve this, they need to build in information from different sources and stakeholders. Many of those stakeholders already have strategies or capabilities that they want to use, generally because those strategies or capabilities reinforce their perceived relevance. This can encourage stakeholders to advocate for modelling assumptions that will privilege their preferred strategy or capability. This approach also tends to shape ‘black box’ thinking whereby – due to the extensive detail needed to build a ‘model’ – assumptions and uncertainties are hidden from stakeholders.

Decision Making in Deep Uncertainty (DMDU) approaches flip this orthodoxy to work with complexity and uncertainty. Rather than attempting to predict unknowable futures, DMDU approaches assess how a portfolio of decisions or assets perform across multiple possible futures. For example, consider the question of whether to procure heavy lift helicopters. Answering this question would require testing against operational challenges in increasingly hotter climates, accounting for issues ranging from the impact of reduced air density and melting landing pads on a helicopter’s lift capability, to the disruptions to fuel supply chains and the wellbeing of personnel. Yet it would also require testing against operational challenges in scenarios of extreme cold, accounting for issues ranging from conflict potential and risk appetites in the High North, to increased cold extremes resulting from destabilisation of the

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Atlantic meridional overturning circulation (AMOC). Undertaking such testing helps identify issues of resilience and vulnerability in heavy lift capability development and what needs to be addressed to make the capability robust across a range of possible futures. It also helps facilitate adaptive strategies and identify potentials for cross-domain contagion (i.e., where weak signals in one domain generates a disruption in another).

The difference between these two models has already been shown in parametric modelling applied to energy technology portfolios. Consider Figure 2, which shows a consolidative modelling output for carbon abatement by the UK Climate Change Committee's (CCC) 6th Carbon Budget; including bioenergy with carbon capture and storage (BECCS) and direct air carbon capture and storage (DACCS). In its analysis, the CCC notes that it has accounted for "the time needed to scale-up BECCS and its supply chains starting in the late 2020s, the need to demonstrate DACCS in the 2020s for scale-up late in the 2030s, and the new-build market potential for wood in construction".⁴⁰ Similar to rolling a dice on the ISS, these variables are mired in deep uncertainty. Consider BECCS bio-based feedstock usage as just one example. To give a consolidative prediction for the potential increase of this system, we would need to chart the probabilities of different events, emergent properties and feedback loops occurring in:

- I. Every system that bio-based feedstock are influenced by, such as economic markets, global governance, soil fertility, societal norm formation, or supply chain risks;
- II. The interaction between each of these different systems which then enter the overarching bio-based feedstock system-of-systems; and,
- III. The interaction between this bio-based feedstock system-of-systems and every other carbon dioxide removal (CDR) system being charted.

Even if we had the computational power required to achieve this, each of these different probabilities would be reliant on a meta-system that was able to integrate and synthesise the diverse (and often conflicting) ontologies, epistemologies and methodologies that underpinned the data collection and analysis involved. In contrast to this, the CCC's modelling is predominantly based on economic and market modelling that tends to privilege 'cost effectiveness' as a proxy variable for forecasting growth. In this regard, it also treats carbon removal technologies as 'discrete technologies' that can be deployed in isolation.

⁴⁰ Climate Change Committee (2020) 197

To reframe this, the CCC is using the same formative modelling principles that underpinned the consistent growth projections for the VHS video market up until that market crashed. Although the CCC acknowledges that limitations and assumptions exist within its analysis, this does not include in depth acknowledgments of the underlying limitations of consolidative modelling. Moreover, decision makers who view the graph in isolation – a more dominant practice than we may wish to acknowledge – are not provided with insights on either the limitations of consolidative models or the limitations that the CCC *does* acknowledge. Uncertainty has been ‘flattened’.

“the CCC is using the same formative modelling principles that underpinned the consistent growth projections for the VHS video market up until that market crashed.”

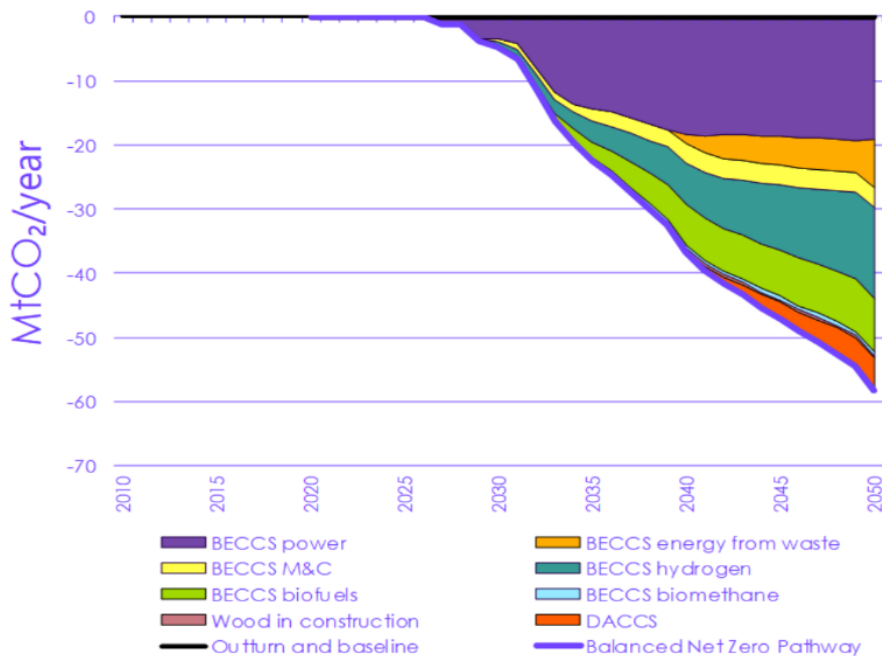


Figure 2. ‘Sources of abatement in the Balanced Pathway for engineered removals’, from the CCC’s 6th Carbon Budget (2033-2037).

Source: CCC (2025) 198. Licensed under the terms of the Open Government Licence v3.0.

Compare this approach with the approach outlined in Figure 3. In this image, carbon removal technologies are not viewed as ‘discrete technologies’. Instead, they are treated as ‘value chains’ that remove more CO₂ from the atmosphere than they emit, when you count multiple stages of the value chain from start to finish. This figure uses the same data that is available to the CCC and tests a portfolio of CDR systems that are accounted for by the CCC. Specifically, BECCS for power at 33 MtCO₂ per year, BECCS for hydrogen at 23 MtCO₂ per year, DACCS at 4.5 MtCO₂ per year, and wood for construction. In contrast to the CCC modelling, this method uses an exploratory multi-

objective analysis of the CDR portfolio. In turn, this helps to build a more systematic picture of the challenges involved in scaling up a UK CDR sector.

This model highlights how external (exogenous) and system-wide (systemic) uncertainties could play out for this CDR portfolio within a single, integrated analytical framework. It accounts for second- and third-order variables, such as the end-to-end land footprint. Importantly, it accounts for the substantial uncertainties surrounding these variables. The land footprint requirement, for example, ranges from 6 to 18 million hectares. Similarly, the technology readiness level implies costs that could range from £25 billion to just under £40 billion per year. These metrics create implications that need to be accounted for in policymaking. The land footprint metric alone strongly suggests that the UK will be importing feedstock, with consequential implications for the UK's trade-balance and the exporting nations food security and ecosystem preservation. Similarly, metrics around the energy required for the CDR portfolio raises questions about the UK electricity grid's capacity to supply enough electricity to support the portfolio whilst also fulfilling the UK's wider energy demands.

Importantly, for those senior leaders influenced by visual data, this DMDU process can be visualised in a way that foregrounds these uncertainties and assumptions. Metrics are annotated with 'more positive' projections at the top and 'least positive' at the bottom for key variables, such as the volume of water required to service the CDR portfolio. Key variables are explicitly indexed, as seen in the indexing of electricity requirements in the Minimum Margin (%) analysis. The figure also enables policymakers to model portfolios against their core criteria for decision making.

In Figure 3, for example, emissions are indexed to zero to see whether the portfolio could meet the 'net zero' outcome whilst still accounting for exogenous and systemic uncertainties, which it does. It also highlights, however, where there are levels of uncertainty that lie outside of the tolerances required for CDR policy to be acceptable on any one metric (as visualised in the greyed-out lines). Although the ability to interpret such visualisations would require some preparation work within decision making communities, this process is a relatively simple one. Furthermore, whilst no modelling system or visualisation is perfect, by embedding the assumptions and limitations of a model within a data visualisation, we get one step closer to more informed decision making or, at the very least, more conscious ownership of the uncertainty space amongst decision makers.

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What would the application of these systems look like in relation to a defence and security example? Consider the following chain of events, relating to a predict and act approach. As noted in the previous section, on 16 March 2021 the *Integrated Review* was published, which contained a significant emphasis on the need for a reorientation to the Indo-Pacific. Two months later, in May 2021, the HMS Queen Elizabeth was sent on its first deployment; a 55,000-mile, seven-month mission to the Indo-Pacific. This course of events suggests that there existed an accepted prediction of the future within the MOD, around which the *Integrated Review* was structured. The deployment of the HMS Elizabeth was then used to persuade external and internal stakeholders both that the risk was worthy of deployment and that an aircraft carrier was the relevant method for managing this risk. This chain of events delivered a circular logic, in which a predicted future and a pre-existing asset were used to validate each other.

This kind of approach can be difficult to challenge, especially when decision makers and wider stakeholders lack insight and transparency around the assumptions and variables that have informed either: (a) the prediction of the future that has been made or (b) the stress testing of the asset as a relevant response that has been undertaken. In this scenario, the foresight model has effectively become the decision maker. The future facing way that parametric and mental modelling is applied in 'predict and act' consolidative constructs makes validation problematic until the assumptions are shown to be invalidated. In the case of the 2021 *Integrated Review*, the merits of the tilt to the Indo-Pacific were (at least partially) undermined by the invasion of the Ukraine by Russia in February 2022, in ways that demonstrated the limitations of the underpinning model and assumptions.

“Risk and decision-making are re-framed by encouraging decision makers to ask: ‘Under what conditions does our portfolio fail to meet different stakeholders’ goals?’ and ‘Are those conditions becoming increasingly evident, to the point where we should adjust our portfolio?’.”

In contrast to the traditional 'predict and act' approaches applied by the *FOEs 2040* and *GST7*, the DMDU model applies an 'Agree on Decisions' exploratory approach. This approach asks different questions. Risk and decision-making are re-framed by encouraging decision makers to ask: “Under what conditions does our portfolio fail to meet different stakeholders’ goals?” and “Are those conditions becoming increasingly evident, to the point where we should adjust our portfolio?” In this scenario, the MOD would test its force structures and equipment portfolios across a range of futures. This could generate any number of different alternatives. Consider again the deployment of the HMS Elizabeth. A DMDU model may have generated the same 'strategy option', but considered it across multiple objectives; such as, redressing risk in the Indo-Pacific and bolstering the US alliance to increase the prospect of a unified NATO response to a

Russian invasion in Europe. DMDU would have also generated a different 'options', such as highlighting the potential for other naval platform portfolios to achieve the same power projection capability as an aircraft carrier with greater resilience to other risk sets. These portfolios would then be tested in an exploratory way across a range of futures. This could include testing against *GST7*'s six global key drivers of change and twenty-two underlying trends. In a DMDU model, however, the concepts within *GST7* and the *FOEs 2040* could be tested in multiple combinations to generate multiple possible futures up to the order to tens of thousands of futures rather than just the five futures outlined in *GST7*.⁴¹

The potential relevance of an 'exploratory' system versus a 'consolidative' system for the MOD is obvious. Taking naval platforms as just one example, such systems would not only support robust analysis of the performance of different naval platform portfolios across multiple futures, but would do so in a way that privileges dialogue between analysts, stakeholders and decision makers. The outcome, in this regard, would be twofold. First, a move from static-state portfolio stress testing to dynamic robustness testing, by examining the vulnerabilities of different portfolios across a range of tens of thousands of possibilistic scenarios. Second, increased transparency between analysts, decision makers and other key stakeholders through an exploratory 'agreeing on decisions' process that integrates diverse perspectives through iterative participatory stakeholder engagement at different stages.

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In a defence context increasingly shaped by the influence of different (sometimes competing) committees and specialists, this system not only helps to mitigate the risk of blind spots and circular logic, but also helps to ensure that the objectives of different key stakeholders are collaboratively integrated into a decision set. This integration is visualised in Figure 4, which shows what the output of an exploratory analysis for a piece of MOD equipment may look like. Highlighted in red is a single option, assessed against execution metrics. In this example, the selected red option represents the most robust option. However, rather than simply providing decision makers with this conclusion, the modelling provides those decision makers with the transparency to understand that its robustness contains a weakness in areas including production and interoperability. This transparency enables decisions that highlight where trade-offs have been made, in ways that enhance transparency.

⁴¹ Page (2019)

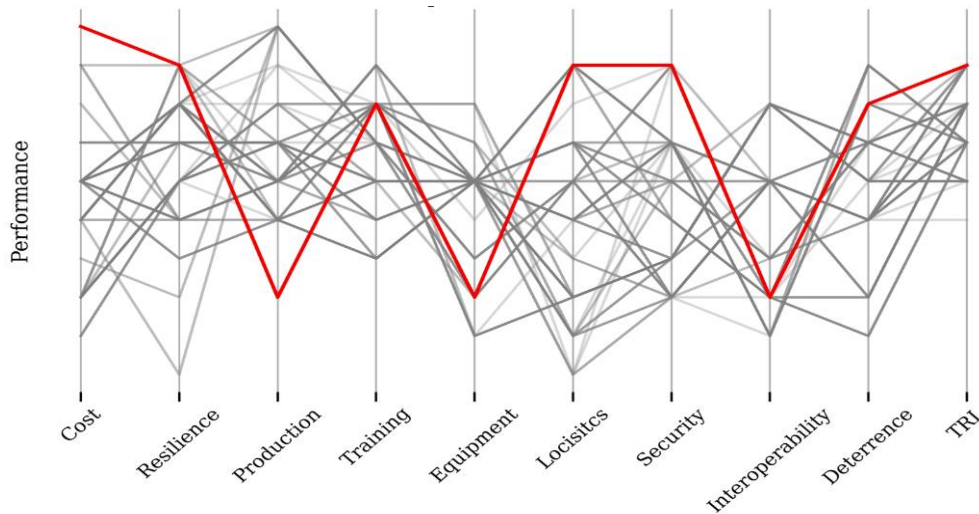


Figure 4. An illustrative multi-objective trade-off plot showing the output of an exploratory analysis for a piece of MOD equipment.

Source: Author's elaboration

5. CONCLUSIONS AND RECOMMENDATIONS

The MOD produces high quality defence publications. An evaluation of *FOE 2040* and *GST7* provides insight as to why this high-quality analysis is so poorly translated into decision making. The MOD is wrong-headed in the way that it thinks about the future because it asks the wrong questions and misapplies its high-quality feedstock analysis. This leads to poorly designed strategies. Given the fragmentation of the rules-based order, the multi-polarity of geopolitics and the emboldening of UK adversaries, the implications of this could not be more salient. In the short-term the UK needs to do more with less, whilst simultaneously accelerating its ability to augment its defence resources for the long term. This makes the need for a new decision-making paradigm all the more pressing.

It is essential that development programmes – across both the MOD and the UK security sector more broadly – are geared towards developing the capacity for deep uncertainty thinking. This needs to permeate into the mindsets, cultures and decision analysis of national security officials. One could make a strong case that the MOD is already well-conditioned to operating within this level of uncertainty, when it is provided the political space and when it applies the relevant resources. Officer training at Royal Military Academy Sandhurst

“One could make a strong case that the MOD is already well-conditioned to operating within this level of uncertainty, when it is provided the political space and when it applies the relevant resources.”

(RMA) and the Field Army encourages challenge functions throughout the Estimate and Orders process. Decision makers – from the operational to strategic levels – have regular experience of high dimensional, complex decision spaces.

Unfortunately, this experience has not led to an organic climate risk capacity. This has removed security officials' capacity, opportunity and motivation to assess climate change's impact on the future operating environment through the lens of deep uncertainty and complexity. In turn, this has inhibited their ability to adopt more robust and resilient decision-making tools. It is essential that the UK national security sector – and particularly the military – have the confidence to engage in this mindset development, by generating a climate risk capacity that is appropriate to the UK's national security culture and operating models.⁴² This internal capacity and competency would enable MOD not only to develop better strategies, decision making and planning, but also to be an informed procurer of contracts and consultancy services. Without this internal capacity, MOD faces the prospect of a dangerous dependency on contractors and consultants.⁴³

This organic capability development would address two core challenges that underpin the UK MOD's current inability to design operational strategies and solution sets that are resilient to possible climate-impacted futures. First, much of the decision support in the consultancy sector and academia is highly flawed and would be inappropriate to apply in the defence sector. Second, given the systemic and cross-cutting nature of climate impacts, MOD must be able to work in concert with external organisations with whom it is not used to working.

⁴² Mazzucato (2021) 248

⁴³ Mazzucato & Collington (2026)

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