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The Exoskeleton Force

The Royal Navy in the Indo-Pacific Tilt

Sidharth Kaushal, John Louth and Andrew Young



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Contents

Executive Summary	v
Introduction	1
I. The Strategic Logic of Denial and the Indo-Pacific Tilt	5
The Strategic Rationale for a Denial-Oriented Approach	5
‘The Melians’ Revenge’: The Future Operating Environment and UK Options	9
The Intersection Between Prosperity and Strategy: The Domestic Rationale for a Policy of Enablement	15
Team UK and the Commercial Challenge	18
II. The Military Component and the Royal Navy’s Role	21
The Demand Signal: What Makes an Effective 21 st -Century Anti-Access System?	21
A Diverse Range of Effectors	25
Sustainment and Replenishment	27
Mobility	27
Grey-Zone Capability	28
The Royal Navy’s Possible Offer to Regional Partners	29
III. Missions and Capability Requirements	41
Conclusion	43
About the Authors	45

Executive Summary

The Indo-Pacific tilt announced as part of the UK's 2021 Integrated Review will present the Royal Navy with both challenges and opportunities. On the one hand, reinforcing stability in a region that will likely be central to the global economy is an understandable and desirable aim. On the other, the Integrated Review and the Defence Command Paper also commit the bulk of the Navy's warfighting assets to Europe. Combined with the challenges of permanent sustainment at reach, this is likely to ensure that the Royal Navy's presence in the Indo-Pacific remains a light footprint in terms of naval platforms. The question that naval planners will need to answer, then, is how power can be generated in the absence of mass.

This paper, the product of a work stream conducted by the Royal United Services Institute (RUSI) and the Royal Navy Strategic Studies Centre (RNSSC), provides one prospective framework through which the Navy's activities in the Indo-Pacific can be structured: assured sovereignty. The output reflects the proposal that RUSI generated from this process as one strategic option for debate. The paper has been informed by reviews of strategic documents such as the Integrated Review, the Defence and Security Industrial Strategy (DSIS) and the Defence Command Paper, secondary literature, interviews with subject matter experts, and a workshop run by RUSI and the RNSSC on the Indo-Pacific tilt. The authors' propositions are:

- The very same anti-access capabilities that enable the People's Liberation Army Navy to hold the stronger US Navy at bay can also be a force multiplier for smaller regional powers in the Indo-Pacific that may need to assert their own sovereignty vis-à-vis a more powerful China. This also fits well with the broader hedging strategies that many powers in areas such as Southeast Asia are pursuing (balancing China without directly allying with the US), as it holds out the possibility of deterrence with a sovereign capability.
- A series of technological trends associated with the so-called Fourth Industrial Revolution will make power projection increasingly difficult for larger actors.
- Although the effectors associated with an anti-access system for smaller regional powers are increasingly affordable in terms of their unit costs, factors such as development, production at scale, networking and developing the corporate knowledge needed to operate them in a combined arms approach still require partner support.
- If the Royal Navy chooses to act as an enabling force (supporting anti-access bubbles), it can indirectly constrain China without direct confrontation on a scale that would require the presence of significant UK regional forces.
- Moreover, an approach geared towards supporting local anti-access capabilities could serve as a point of strategic synthesis, aligning the goals set in the Integrated Review with the commercial and defence industrial aims laid out in documents like the DSIS by accelerating work in areas such as autonomy and additive manufacturing.

While the support of local partner anti-access capabilities is not a strategy per se and would be a subcomponent of a wider, whole-of-government approach, it is the authors' contention that it represents the most viable means of using the UK's military instrument in the Indo-Pacific to deliver strategic effect. In effect, it would see the Royal Navy become what one defence expert has described as an 'exoskeleton force' – a force multiplier for local actors with regional mass.

Introduction

AN IMPORTANT FEATURE of the UK's 2021 Integrated Review was the tilt towards the Indo-Pacific.¹ The announcement that the UK would seek to maintain a forward and persistently engaged presence in the region was of particular significance to the Royal Navy, given the region's maritime character. The Navy will maintain a littoral response group east of Suez, along with, initially, two forward-deployed offshore patrol vessels. Despite this commitment, as well as the dispatch of HMS *Queen Elizabeth* and its carrier strike group (CSG) to the Indo-Pacific on its maiden voyage, the Integrated Review and the Defence Command Paper also underscored the primacy of European security. The UK has committed its carrier strike capability, around which the Royal Navy is effectively structured, to the NATO Readiness Initiative, meaning that for the foreseeable future the Royal Navy will likely not field significant mass in the region. The key question for the service to contemplate as it seeks to meet the objectives set by the Integrated Review, then, is how to deliver strategic effect without mass.

This question is of great significance given the likely crucial economic and geopolitical heft of the Indo-Pacific going forward. The region will host three of the world's four largest economies by 2030 (if the US is excluded from the definition of a regional nation). It will also be the central stage for a range of powerful maritime actors, not least of which will be the People's Liberation Army Navy (PLAN), which became the world's largest navy in terms of numbers of hulls as of 2021.² Backed by a potent and growing reconnaissance strike complex, the PLAN stands a realistic chance of achieving maritime preponderance within the first island chain and projecting power across the wider Indo-Pacific beyond the next decade. It is thus possible that when the Royal Navy operates in the Indian Ocean, it will do so in proximity to China's planned CSGs, or its recently expanded Marine Corps, which was explicitly built for expeditionary purposes and not cross-strait contingencies.³ Although the UK's interests in the region are multifarious – ranging from commercial imperatives to more geopolitical ones – contributing to constraining an actor that the Integrated Review identified as being a systemic competitor is likely to be one goal. Yet without credible regional combat mass, the question of how the UK intends to do this remains.

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1. HM Government, *Global Britain in a Competitive Age: The Integrated Review of Security, Defence, Development and Foreign Policy*, CP 403 (London: The Stationery Office, March 2021). The term 'Indo-Pacific' is generally considered to encompass the Indian Ocean and the Western and Central Pacific.
 2. Office of the Secretary of Defence, 'Military and Security Developments Involving the People's Republic of China 2021', Annual Report to Congress, 2021, p. 48.
 3. Ministry of Defence, *Defence in a Competitive Age*, CP 411 (London: The Stationery Office, March 2021), pp. 21 ff; George Allison, 'UK Commits Carrier Strike Group to NATO Readiness Initiative', *UK Defence Journal*, 18 February 2020, <<https://ukdefencejournal.org.uk/uk-commits-carrier-strike-group-to-nato-readiness-initiative/>>, accessed 3 June 2022.

This paper seeks to lay out a framework by which the Royal Navy might contribute to the UK's stated national objectives. The authors' key hypothesis is that the UK can reinforce the regional status quo without maintaining a major commitment of forces by reinforcing the capacity of regional partners to develop their own anti-access/area-denial (A2/AD) bubbles.⁴ The same capabilities that enable the PLAN to hold the US Navy at arm's length can also enable smaller and mid-sized regional actors to constrain China's freedom of action.⁵ Enabling partners to compete, constrain and fight in contested littoral areas, then, is an economy-of-force way in which the UK can influence dynamics in a region where it lacks mass. If this approach were adopted, it could act as a capstone concept not only for the Indo-Pacific tilt but also for the future evolution of frameworks such as the AUKUS (Australia–UK–US) security partnership. As AUKUS evolves from a narrow focus on the delivery of nuclear-powered attack submarines (SSNs) to Australia, it could come to embrace two additional functions. The first would be reinforcing Australia's own capacity to constrain the freedom of action that a larger regional maritime power enjoys in Australia's immediate vicinity.⁶ The second, more expansive, aim might be to create exportable capabilities in tandem with AUKUS partners which could stiffen the deterrents of smaller nations in areas such as Southeast Asia without committing to direct military support and the political constraints that this entails. In effect, then, the aim of exporting anti-access bubbles might become the capstone aim around which the partnership evolves. This is not necessarily the only means by which the UK can contribute to regional balancing dynamics, but it is potentially an approach through which the Royal Navy can deliver the most significant strategic effects.

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4. An anti-access/area-denial bubble is an area, typically in the vicinity of a state's own territory, within which expeditionary air and maritime power can only be deployed at immense risk. Typically, it is comprised of a network of relatively cheap asymmetrical capabilities such as cruise missiles, ballistic missiles – to attack infrastructure supporting power projection – and diesel electric submarines; that said, the concept itself is platform-agnostic. See Andrew Krepinevich, Barry Watts and Robert Work, 'Meeting the Anti-Access Area Denial Challenge', Center for Strategic and Budgetary Assessments, 2003.
 5. On this subject, see Elbridge A Colby, *The Strategy of Denial: American Defense in an Age of Great Power Conflict* (New Haven, CT: Yale University Press, 2021), pp. 79–97; Michael Beckley, 'Balancing China: How to Check Chinese Military Expansion in Asia', Harvard Kennedy School Belfer Center, November 2017, <<https://www.belfercenter.org/publication/balancing-china-how-check-chinese-military-expansion-east-asia>>, accessed 2 June 2022.
 6. On the use of an anti-access approach in Australia's own vicinity, see Hugh White, *How to Defend Australia* (Carlton: La Trobe University Press, 2019). The question of whether Australia can rely exclusively on anti-access capabilities, as suggested by White, has been the subject of intense debate: see, for example, James Goldrick and Euan Graham, 'A Fortress Without Water Supply: Hugh White's "How to Defend Australia"', Australian Strategic Policy Institute, 18 July 2019, <<https://www.aspistrategist.org.au/a-fortress-with-no-water-supply-hugh-whites-how-to-defend-australia/>>, accessed 6 July 2022. This said, it is less contentious that an anti-access capability – even if nested within a wider capability suite – can provide at least part of the solution to the challenge posed by China, raising the cost and military risks of conflict and denying any chance of a quick, costless victory.

This paper will examine the following questions:

- What would it take to develop national anti-access systems in the Indo-Pacific?
- What specific strengths does the UK have as a partner with which to develop this capability?
- How would an imperative to build capacity in this area shape the activities of the Royal Navy and Royal Marines assets devoted to the Indo-Pacific?

The time horizons in which this paper's propositions are situated are the next decade and beyond – during which time regional stability may become increasingly contested. This contestation could occur either if China does surpass the US in many key categories of national power or, as some have argued, if China's growth slows to a point where its leaders view their window of opportunity to change the regional order as closing. As such, the paper's propositions are grounded in capacities and capabilities that the Royal Navy might generate during this timeframe if reinforcing regional actors' capacity for denial is made the capstone objective for the Navy in the Indo-Pacific.

The paper is structured around three chapters. Chapter I addresses the strategic rationale for the approach being suggested. Chapter II addresses questions of what a 21st-century anti-access system requires to function and where the Royal Navy can add value in developing one with partners. Chapter III offers preliminary suggestions for the question of what the impact on Royal Navy activity in the region and its capacity requirements would be if the Navy opted for an approach to its Indo-Pacific commitments that has denial at its core.

I. The Strategic Logic of Denial and the Indo-Pacific Tilt

AN APPROACH CENTRED around denial can provide a link between the stated regional objectives of the Integrated Review and the UK's capabilities. This chapter outlines the rationale for such an approach.

The Strategic Rationale for a Denial-Oriented Approach

The UK's stated objectives in the Indo-Pacific region, as laid out in the Integrated Review, could reasonably be summarised as the maintenance of the status quo and the enhancement of the UK's role as a commercial actor and a net security provider. Strategically, the Indo-Pacific is home to one of the two nations with the comprehensive suite of national capabilities needed to fundamentally shape the international order. Though deemed a systemic competitor rather than a threat in the vein of Russia, the People's Republic of China (PRC) will play a role in international politics in the decades to come that is substantially greater than that of its smaller Eurasian partner.⁷ While this is not necessarily an unalloyed problem – and the Integrated Review articulates a desire to find areas of cooperation with China – it does complicate the strategic landscape. The possible emergence of a hegemon other than the US in the Indo-Pacific, which is likely to represent well over 40% of global GDP at market exchange rate by 2030 and contains the majority of the region's manufacturing potential, could presage a partially closed economic order in the region – and this tends to be an eventual foreign policy pursuit of illiberal hegemons when they seek to achieve regional hegemony.⁸ Should China come to assert a dominant influence over both the region's middle powers, such as Japan, and its smaller ones, it would have the geopolitical heft to erect such an order if it chose. A tendency towards closed regional economic and political blocs could also intensify competition for natural resources in areas such as energy and critical minerals, given that nations which do not rely heavily on global financial and trade flows across regions have incentives to view resource access in mercantilist zero-sum terms. Of course, it is entirely conceivable that, as some have argued, a rising China would not seek to overturn an economic and political order that it has benefited from, but will merely seek a more influential role within it.⁹ For a mercantile nation like the UK, however, the challenge is

7. HM Government, *Global Britain in a Competitive Age*, p. 22.

8. On the region's economic potential, see Oliver Tonby et al., 'Asia's Future is Now', McKinsey Global Institute, July 2019. On the historical tendency for illiberal hegemons to seek closed regional economic orders, see Steven E Lobell, *The Challenge of Hegemony: Grand Strategy, Trade, and Domestic Politics* (Ann Arbor, MI: University of Michigan Press, 2005).

9. See, for example, Alistair Iain Johnson, 'China in a World of Orders: Rethinking Compliance and Challenge in Beijing's International Relations', *International Security* (Vol. 44, No. 2, Autumn 2019), pp. 9–60.

that laid out by the British diplomat Eyre Crowe, who, when discussing a rising Germany at the turn of the last century, noted that the country's intentions could not be forecast or shaped in the long term by Britain, but its ability to act on its potentially most worrisome future intentions could. Put simply, the UK has strong incentives to hedge against the worst-case outcome.¹⁰

China, broadly speaking, has pursued two major strategic ends over the last two decades. In its region, it has shifted from attempting to blunt the effects of US preponderance to slowly supplanting it. The military component of this is a People's Liberation Army (PLA) and PLAN that are capable of both holding the US at arm's length and overmatching regional powers. Although not sufficient to produce hegemony, the ability to defeat any combination of regional powers is a prerequisite for it. To this end, the PLA has generated a long-range strike capability spanning missiles such as the DF-21D anti-ship ballistic missile and DF-17 hypersonic missile system, as well as the network of space-, air- and sea-based assets needed to cue them in. In tandem, the PLAN has gradually built a 'high-low' mix that involves a large number of green-water assets, such as the Type 054 frigate and the Type 056 corvette, as well as a growing blue-water capability that includes China's aircraft carriers and its large Type 055 cruisers.¹¹ Longer-range and more capable assets can execute missions such as those geared towards 'forward edge defence' (a term that entered China's lexicon in the 2015 edition of the PLA textbook *The Science of Military Strategy*), which entails contesting parts of the Western Pacific and Indian Ocean beyond the first island chain.¹²

The second strategic end pursued by China has been building networks of influence further afield. This, as yet, primarily geo-economic approach has involved the purchase of access to critical resources on the basis of long-term contracts, as well as the infrastructure to transport those resources. For example, China is currently a primary producer of 19 of the critical minerals deemed economically vital by the US, and 23 of those similarly identified by the UK.¹³ The country's investment in port infrastructure across the Indo-Pacific also means that it is a primary operator of 16 of the world's 20 globally most active ports. China accounts for roughly 40% of the world's merchant shipbuilding, and has the world's largest state-flagged merchant marine.¹⁴ In effect, then, China is gradually shedding the legacy of a continental strategic culture and building seapower – a more comprehensive set of capabilities than naval power more narrowly

10. Henry Kissinger, *Diplomacy* (New York, NY: Simon and Schuster, 1994), pp. 236 ff.

11. For an overview of China's rise as a naval power, see Sidharth Kaushal and Magdalena Markiewicz, 'Crossing the River by Feeling the Stones: The Trajectory of China's Maritime Transformation', *RUSI Occasional Papers* (October 2019).

12. Xiao Tianliang (ed.), *The Science of Military Strategy* (Beijing: National Defence University Press, 2015), pp. 345 ff.

13. Anthony H Cordesman, 'The Other Side of Chinese Sea Power: "White Area Warfare"', Center for Strategic and International Studies (CSIS), 4 April 2022, <<https://www.csis.org/analysis/other-side-chinese-sea-power-white-area-warfare>>, accessed 5 July 2022.

14. *Ibid.*

defined.¹⁵ In the context of an integrated global economy, this might be relatively unproblematic; after all, China still has to use this seapower to sell goods to markets primarily in Europe and America. However, in the context of regionalisation and competition for market and resource access – which Chinese policymakers and scholars write at length about – this represents a possible risk.¹⁶ If China achieves regional hegemony, its trade profile could well shift to one in which both internal consumption and regional trade in an increasingly large Indo-Pacific market were its primary growth drivers. This would make a great deal of economic sense given the future market share of the region and would also shield China geopolitically from needing access to Western markets. Europe and America would then shift from being core Chinese markets to competitors for market access and resources. The same seapower that currently facilitates trade would serve to constrain the freedom of action of Chinese competitors. Access to critical resources such as cobalt (currently mined primarily in Africa) could, for example, be constrained by a PRC that chooses to prioritise its own domestic producers of high-tech products, and which could enforce this through a veritable monopoly along the length of the supply chain, from mines to ships and ports.

While China's military footprint beyond its immediate environs remains limited to missions other than war (counter-piracy, for example), this could change should the country alter the strategic geography in its immediate vicinity, freeing up capacity for power projection. It is noteworthy that the PLAN Marine Corps, along with its associated enablers, such as the Type 075 amphibious helicopter carrier, is explicitly designated as being primarily a means of supporting expeditionary missions and not Taiwan contingencies, for which the PLA Ground Force will still handle amphibious operations.¹⁷ Moreover, at least some of the facilities that China has built may be dual-use – particularly as port visits of Chinese submarines to nations such as Sri Lanka have already been occurring for years.¹⁸

The PRC is also in the process of constructing a more explicitly military network of overseas bases, with its base in Djibouti likely to be followed by a larger facility elsewhere in Africa.¹⁹ The missions that the PLA can undertake overseas have not been clearly articulated, but a combination of stated Chinese concerns regarding resource access, the regionalisation of Chinese trade and the PRC's long-term relationships with a number of regional autocrats

15. On the distinction, see Andrew Lambert, *Seapower States: Maritime Culture, Continental Empires and the Conflict that Made the Modern World* (New Haven, CT: Yale University Press, 2018).

16. On this, see Jennifer Lind and Daryl G Press, 'Markets or Mercantilism? How China Secures its Energy Supplies', *International Security* (Vol. 42, No. 4, Spring 2018), pp. 170–204.

17. Yuan Huazhi, 'Creating a Strategic Dagger that Can Fight and Win', *People's Navy*, 15 June 2018; Dennis J Blasko, 'The PLA Army Amphibious Force', China Maritime Report No. 20, US Naval War College, April 2022.

18. Shihar Aneez and Rangar Sirilal, 'Chinese Submarine Docks in Sri Lanka Despite Indian Concerns', *Reuters*, 2 November 2014.

19. Michaël Tanchum, 'China's New Military Base in Africa: What it Means for Europe and America', European Council on Foreign Relations, 14 December 2021, <<https://ecfr.eu/article/chinas-new-military-base-in-africa-what-it-means-for-europe-and-america/>>, accessed 15 August 2022.

could, viewed in conjunction, suggest that power projection will represent a means of assuring privileged access to and control over critical parts of global supply chains.²⁰

While the rise of China need not necessarily represent a threat to the UK's core national interests, this assumes the maintenance of a regional balance of military power within the Indo-Pacific, for as long as there is such a balance in the region, any attempt to close off large sections of the world economy by China is unlikely. As regional preponderance within its immediate environs is a prerequisite to more ambitious aims elsewhere, precluding the likelihood of the PRC achieving this level of preponderance becomes a natural UK policy objective – even if the UK does not wish to directly confront the PRC.

Notably, in wishing to constrain the PRC without direct confrontation, the UK aligns with a number of regional powers. Malaysia and Singapore (UK partners in the Five Power Defence Arrangements), as well as Indonesia, have over the last decade engaged in military modernisation and reinvigorated their security ties with the US, partially with a view to coping with the security challenges posed by China, but have also maintained cordial diplomatic and security ties with China. This approach has broadly described the posture of other regional actors such as South Korea and even Vietnam, despite the latter having been more vocal in its opposition to Chinese policies within Southeast Asia than most of its neighbours.²¹ Most of the PRC's smaller neighbours wish to maintain a form of armed neutrality with regard to China whereby they can secure their freedom of action vis-à-vis their larger neighbour without necessarily becoming party to the incipient bipolar competition between China and the US. By contrast, China's more militarily and economically powerful neighbours, including Japan, India and Australia, are taking more explicit – though still cautious – steps towards constraining the PRC. If the UK wishes to build a network of regional partnerships, it will need to navigate a course between confronting the PRC and engaging with it, both because of the material limitations of the UK's own regional presence and because the appetite of a number of regional players for direct participation in constraining coalitions is limited. In effect, the assurance of sovereignty appears to be an overarching strategic aim within the region, with nations aiming to deliver capabilities sufficient to deter encroachments on their sovereignty.

The UK therefore must contend with the question of how to constrain the PRC without confronting it – at least in the immediate term – and how to accomplish this with what will be, militarily, a limited regional presence. The answer that this paper proposes with regard to the military component of this policy conundrum is that the UK and key regional partners can leverage a series of shifts in the character of war at sea that make it possible for smaller states to exact a punishing toll on larger rivals, especially near their own territory. In many ways, this mirrors the way in which the PLA initially sought to leverage cheap, asymmetrical tools to hold the US at arm's length. Anti-access strategies have appeal for smaller states for a number

20. On Chinese concerns regarding resource access, see Lind and Press, 'Markets or Mercantilism?.'

21. See, for example Bibek Chand, Zenel Garcia and Kevin Modlin, 'Southeast Asian Hedging and Indo-Japanese Strategies for Regional Balance: Managing China's Rise', *Journal of Indo-Pacific Affairs* (Vol. 1, No. 2, Winter 2018), pp. 23–48.

of reasons. They are less platform-centric than power projection, and given the asymmetries involved, are typically an appealing way for a smaller power to offset threats without becoming reliant on partners. This was, for example, the basis for Singapore's 'poisoned shrimp' strategy for deterring larger neighbours, as well as aspects of Taiwan's Overall Defence Concept.²² The UK can add value as a regional partner if it can, to paraphrase George Kennan, strengthen natural forces of resistance through the ability to export anti-access bubbles in the region.²³ The Royal Navy will be at its most valuable as an instrument of national power if it can present itself as a partner of choice for the export of anti-access capabilities.

'The Melians' Revenge': The Future Operating Environment and UK Options

A number of factors have combined to strengthen the hands of smaller states – a phenomenon that scholars such as T X Hammes have described as 'the Melians' revenge'. First, a series of interrelated technological trends hold the promise of rendering A2/AD strategies increasingly viable.²⁴ The ability to hold ships at risk with A2/AD capabilities is not new – and the risks posed to ships by a range of assets from diesel electric (SSK) submarines to ground-launched missiles in the context of littoral warfare has already been well documented.²⁵ This challenge will be enhanced by trends in areas such as lethal autonomy, scalable manufacturing and the potential for increased lethality to be incorporated into smaller devices. In the area of autonomy, improvements in on-board processing power are making it cheaper to manufacture a range of small, cheap fire-and-forget weapons that can designate certain targets autonomously.²⁶ To be sure, weapons capable of designating targets in complex environments are by no means so cheap as to be expended lightly – but they are exponentially cheaper than their targets, and their unit

22. On the poisoned shrimp strategy, see Stephen Kuper, 'Taking a Closer Look at Singapore's "Poisoned Shrimp" Defence Doctrine', *Defence Connect*, 11 February 2020, <<https://www.defenceconnect.com.au/key-enablers/5555-taking-a-closer-look-at-singapore-s-poison-shrimp-defence-doctrine>>, accessed 10 July 2022. For a discussion of the Overall Defence Concept, see Lee Hsi Min, 'The War in Ukraine and Taiwan's Defensive Planning', RUSI Adversarial Studies Seminar, 1 July 2022, <<https://rusi.org/events/open-to-all/war-ukraine-and-taiwans-defensive-planning>>, accessed 10 October 2022.

23. Office of the Historian, 'PPS/13 Report by the Policy Planning Staff', 6 November 1947, <<https://history.state.gov/historicaldocuments/frus1947v01/d393>>, accessed 7 October 2022.

24. T X Hammes, 'The Melians' Revenge: How Small, Frontline, European States Can Employ Emerging Technology to Defend against Russia', Atlantic Council Issue Brief, June 2019, <<https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/the-melians-revenge-how-small-frontline-european-states-can-employ-emerging-technology-to-defend-against-russia/>>, accessed 10 July 2022.

25. Milan Vego, 'On Littoral Warfare', *Naval War College Review* (Vol. 68, No. 2, Spring 2015), pp. 7–39.

26. T X Hammes, 'Technological Change and the Fourth Industrial Revolution', in George P Schultz, Jim Hoagland and James Timbie (eds), *Beyond Disruption: Technology's Challenge to Global Governance* (Stanford, CA: Hoover Institution Press, 2018), pp. 37–74.

costs are low enough to permit their procurement in numbers by smaller states.²⁷ Moreover, against certain targets, such as static infrastructure or major warships with large radar cross-sections, cheaper capabilities with limited on-board sensor suites may genuinely be capable of autonomous target classification. This both drives down effector costs and lessens the burden of developing a sophisticated kill chain for states that may not have the capacity to do so. Systems such as the US Navy's Slocum glider can provide persistent underwater surveillance of a battlespace at unit costs of roughly \$100,000.²⁸ As the Islamic Revolutionary Guard Corps (IRGC) has recently illustrated, similar assets can be repurposed as unmanned torpedoes to target ships in port.²⁹ Similarly, the Houthi missile campaign against Saudi Arabia has been prosecuted with UAVs which cost a fraction of the capabilities needed to defeat them.³⁰ Two even more capable autonomous technologies, the Israeli Harpy loitering munition and the UK Brimstone missile (which has an anti-ship variant), cost around \$100,000 and \$200,000, respectively.³¹ At the higher end of the capability mix, larger unmanned assets such as unmanned underwater vehicles (UUVs) and more capable high-speed missiles have costs in the millions, which does not make them expendable but is still a fraction of the cost of power projection capabilities. The containerisation of both UAVs and missiles such as the Russian Klub-K or the Chinese YJ-18 illustrates, moreover, the relative ease with which these technologies can be integrated into non-military assets or dispersed in littoral spaces.³²

The cost of such assets is likely to be driven down further by trends in areas such as additive manufacturing, which substantially reduces the human input required to design specific components. As one engineer working at the China Aerospace Science and Industry Corporation (China's major state missile manufacturer) noted:

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27. On the need to avoid exaggerations regarding the subject of expendable capabilities, see Justin Bronk, 'Swarming Munitions, UAVs and the Myth of Cheap Mass', in Justin Bronk and Jack Watling (eds), *Necessary Heresies: Challenging the Narratives Distorting Contemporary UK Defence* (Abingdon: Routledge, 2021), pp. 49–60.
 28. Ari Daniel Shapiro, 'Remotely Piloted Underwater Glider Crosses the Atlantic', *IEEE Spectrum*, 26 February 2010, <<http://spectrum.ieee.org/robotics/industrial-robots/remotely-piloted-underwater-glider-crosses-the-atlantic>>, accessed 10 July 2022.
 29. H I Sutton, 'New Iranian Weaponized Underwater Drone', 16 March 2022, <<http://www.hisutton.com/Iran-IRGC-Weaponized-UUV.html>>, accessed 10 July 2022.
 30. Ian Williams and Shaan Shaikh, 'The Missile War in Yemen', CSIS, June 2020, pp. 1–10.
 31. On the Harpy, see David Axe, 'Take a Look at Russia's New "Suicide Drones"', *National Interest*, 9 November 2021, <<https://nationalinterest.org/blog/reboot/take-look-russias-new-suicide-drones-195929>>, accessed 10 October 2022. On Brimstone, see House of Commons Defence Committee, 'Operations in Libya', HC 950, Ninth Report of Session 2010–12, 8 February 2012.
 32. *Global Security*, 'Klub-K Container Launched', <<https://www.globalsecurity.org/military/world/russia/club.htm>>, accessed 10 July 2022.

It takes about one to two months for dozens of technicians and workers to manufacture a gas rudder (used on a cruise missile) with traditional machining methods because it involves a succession of processes like casting and welding. ... But now, with 3D printing technology, a handful of workers can make a rudder within a week. The 3D-printing-enabled procedure can save us a great deal of labor, time and cost.³³

New forms of explosives such as aluminium nano-fibre, which burns at several times the rate of conventional TNT, can further enhance the capabilities of relatively small munitions. While both small and large actors can take advantage of this, larger actors attempting power projection will need bigger vessels such as amphibious assault vessels, which will be vulnerable to these assets. Such smaller munitions thus confer greater advantages to a party seeking to frustrate and harass – typically the weaker side.

Cheap capabilities will likely form part of a combined arms approach alongside more expensive effectors such as hypersonic glide vehicles, and quasi-ballistic missiles can pose a complex challenge for sea-based air and missile defences. These missiles fly on unconventional trajectories and exploit the gaps between air defence systems and ballistic missile defence systems due to their flight altitudes. While only a select few nations can manufacture these capabilities, North Korea's fielding of an analogue to the Russian Iskander as well as a hypersonic glide vehicle (with the latter likely procured from China) and Saudi Arabia's procurement of a DF-21C from the PRC suggest that a number of states can afford the unit costs of the systems themselves, if not the costs of development.³⁴ While they are too expensive to be purchased in numbers by most nations, limited numbers of such capabilities can be held in reserve by small states, enabling them to pose significant risks to disproportionately valuable platforms such as the PLAN's aircraft carriers or amphibious helicopter carriers. One might consider how Ukraine has recently judiciously used its arsenal of Tochka-U short-range ballistic missiles against key targets while generally relying on more expendable assets.³⁵

Moreover, systems such as ballistic and quasi-ballistic missiles may well be substantially cheaper than hypersonics. Studies, including many conducted by the PLA, suggest the importance of coordinating cheap assets and more exquisite ones – for example, by using expendable decoy

33. See Matt Kremenetsky, 'China's Largest Missile Maker Using 3D Printing to Accelerate Production', *3DPrint.com*, 24 March 2022, <<https://3dprint.com/289915/chinas-largest-missile-maker-using-3d-printing-to-accelerate-production/>>, accessed 2 July 2022.

34. Ralph Savelsberg and Tomohiko Kawaguchi, 'North Korea's Hypersonic Claims Are Credible, Exclusive Analysis Shows', *Breaking Defense*, 16 February 2022, <<https://breakingdefense.com/2022/02/north-koreas-hypersonic-missile-claims-are-credible-exclusive-analysis-shows/>>, accessed 2 July 2022. On the Saudi DF-21C, see Sebastien Roblin, 'How Did Saudi Arabia Build its Missile Force?', *National Interest*, 24 November 2021, <<https://nationalinterest.org/blog/reboot/how-did-saudi-arabia-build-its-missile-force-195563>>, accessed 2 July 2022.

35. David Axe, 'Ukraine's Missiles Are Blowing Up Russian Supply Hubs – Some Inside Russia', *Forbes*, 27 June 2022, <<https://www.forbes.com/sites/davidaxe/2022/06/27/ukraines-missiles-are-blowing-up-russian-supply-hubs-inside-russia/?sh=6293a6aa41cb>>, accessed 15 August 2022.

cruise missiles to force a defending picket to expend its interceptors, before conducting a strike with an anti-ship ballistic missile or hypersonic glide vehicle. As such, states looking to erect anti-access bubbles will likely aim to create a 'high-low' mix of capabilities.³⁶ However, the use of more expensive systems implies two bottlenecks: the initial costs of research; and the C4ISR needed to coordinate these systems at theatre ranges. These are areas in which partners can make crucial contributions.

In a similar vein, a number of states are investing in heterogeneous air defence systems. For example, Vietnam currently fields the Russian S-300P and Israeli SPYDER surface-to-air missile systems and will likely incorporate the Indian-made Akash-2 into its air defence suite.³⁷ It also fields a range of surface search sensors, including the Ukrainian-made Kolchuga passive sensor and the Russian Monolit-B.³⁸ The ability to coordinate systems is critical to the task of delivering an integrated air or naval defence, which necessitates a means of creating a recognised air picture among heterogeneous systems. Other areas in which states with credible air defence suites may need to invest in the future, in terms of the platforms at their disposal, include the creation of early-warning systems – this includes early-warning radar but also encompasses areas such as SIGINT (signals intelligence) and other forms of intelligence-gathering that can play an outsized role in maintaining the alertness of a system.³⁹ Network creation, then, may represent an important niche for partners to fill in the area of air defence.

Soft capabilities in areas such as cyber-penetration of key systems can also represent an area of vulnerability for the operators of large platforms. For example, following an accident aboard the *Arleigh Burke*-class destroyer the USS *John S McCain*, an investigation into whether the event was caused by a cyber attack was carried out by the US Navy. While the accident was probably not caused by a cyber attack, the fact that the hypothesis warranted an investigation is

36. Toshi Yoshihara and James R Holmes, *Red Star Over the Pacific: China's Rise and the Challenge to U.S. Maritime Strategy* (Annapolis, MD: Naval Institute Press, 2018), pp. 220–40.

37. Richard A Bitzinger, 'Vietnam Modernizes its Military with a Wary Eye on China', *World Politics Review*, 7 June 2022, <<https://www.worldpoliticsreview.com/articles/30588/in-modernizing-its-military-vietnam-keeps-a-wary-eye-on-china>>, accessed 10 July 2022.

38. *Global Security*, 'Kolchuga Passive Early Warning Radar', <<https://www.globalsecurity.org/military/world/ukraine/kolchuga.htm>>, accessed 10 July 2022; *Navy Recognition*, 'Vietnam People's Navy Deploys Bastion-P Mobile Coastal Defense Systems in Drills', 17 August 2016, <<https://www.navyrecognition.com/index.php/naval-news/naval-news-archive/2016/august-2016-navy-naval-forces-defense-industry-technology-maritime-security-global-news/4277-vietnam-peoples-navy-deploys-bastion-p-mobile-coastal-defense-systems-in-drills.html>>, accessed 10 July 2022.

39. For example, SIGINT can play a critical role in identifying launch orders for missiles and thus putting an air defence system on alert. In the context of sea denial, one might consider the role that cryptanalytic organisations such as the German B-Dienst played in Second World War sea denial operations off Norway, and in the subsequent U-boat struggle: see Iain Ballantyne, *The Deadly Trade: The Complete History of Submarine Warfare from Archimedes to the Present* (London: Weidenfeld and Nicolson, 2008), pp. 337 ff.

illustrative of the potential of cyber capabilities.⁴⁰ While they are hardly a silver bullet and often have to be used judiciously, cyber capabilities require fewer overhead costs than physical assets and may thus represent a means of disrupting the operation of large platforms. In conjunction with other capabilities such as navigational jamming and electronic warfare, cyber capabilities can substantially hinder the freedom of movement of a stronger force without necessitating large-scale investment in physical platforms.⁴¹

This is not to say that large assets are defenceless – for every tactical move, there is a countermove. Electronic countermeasures can limit the utility of loitering munitions and cruise missiles, for example. The USS *Mason* appears to have dealt handily with a Houthi cruise missile attack in 2016 using a combination of hard and soft kill capabilities.⁴² The point, however, is that a multiplication of the low-cost attack vectors by which power projection assets can be attacked raises the chances of successful penetration of those assets' defences. Moreover, if a capability is cheap enough to be expended, the number of leakers needed to achieve a disproportionate effect is a fraction of the number of munitions used. For example, although Saudi air defenders have been quite effective at engaging Houthi drones, those UAVs that have penetrated the defences have damaged disproportionately expensive assets, such as the radar systems of Patriot batteries.⁴³

Low cost also enables a threat to be made persistent, which raises the odds of a successful attack over time as factors such as crew fatigue set in. The recent sinking of the Russian cruiser *Moskva*, which was well equipped to deal with the anti-ship cruise missile (ASCM) threat, stands as a possible example as it may well have been caused by a lack of crew alertness. This would mirror events such as the sinking of HMS *Sheffield* and the USS *Stark* incident during the Falklands War and the Iran–Iraq Tanker War, respectively.⁴⁴

Finally, it might be considered how capabilities that can be readily countered on an individual basis can form a much more complex challenge when operating in tandem. A vessel that has expended interceptors dealing with low-cost munitions may, for example, be highly vulnerable to a missile strike. Or, in the subsurface domain, a UUV acting as a decoy could draw the fire of an

40. Sam LaGrone, 'Navy "Orion Hammer" Investigation into USS John McCain Collision Has Turned Up No Evidence of Cyber Attack', *USNI News*, 25 August 2017, <<https://news.usni.org/2017/08/25/navy-orion-hammer-investigation-uss-john-mccain-collision-turned-no-evidence-cyber-attack>>, accessed 10 October 2022.

41. On jamming and electronic warfare, see Andreas Turunen, 'The Broader Challenge of Russian Electronic Warfare Capabilities', in Jeffrey Mankoff (ed.), 'Improvisation and Adaptability in the Russian Military', CSIS, April 2020, pp. 13–21.

42. Sam LaGrone, 'USS Mason Fired 3 Missiles to Defend from Yemen Cruise Missiles Attack', *USNI News*, 11 October 2016, <<https://news.usni.org/2016/10/11/uss-mason-fired-3-missiles-to-defend-from-yemen-cruise-missiles-attack>>, accessed 1 March 2022.

43. Williams and Shaikh, 'The Missile War in Yemen', p. 21.

44. Sam La Grone, 'Attack on the USS Stark at 30', *USNI News*, 17 May 2017; John Ezard, 'Officers Dismissed Radar Warning of Exocet Attack on HMS Sheffield', *The Guardian*, 26 September 2000.

opponent's submarine and thus force it to reveal its own position to a nearby SSK submarine. In effect, then, the evolution of anti-access capabilities does not spell the end of power projection and may not deter a nation that is determined to bear costs to achieve its political ends, but it will rob a country of the opportunity to wage decisive and low-cost wars aimed at presenting the regional order with a *fait accompli*. This has been successful for the defensive planning of nations such as Finland and Sweden vis-à-vis Russia, and the USSR before it. At a minimum, the proliferation of these capabilities will lower the chances of strategically successful predation by major powers.

That said, while developments in the area of A2/AD can favour smaller powers, there remain issues that such powers cannot resolve independently. The first is the question of supply: even if cheap in terms of unit costs, complex weapons are the products of a manufacturing process that is difficult to replicate in smaller nations, and they incorporate a number of subcomponents that cannot be readily manufactured in many places. To use an example, while cruise missiles are individually relatively cheap – at least in comparison to most means of intercepting them – they depend on electronic components which come from a handful of nations.⁴⁵ This is true even of Russian missiles, many of which use Western components.⁴⁶ As the export of these components becomes increasingly controlled, this could create supply bottlenecks. Second, while it is a viable option to generate very cheap capabilities comparable to the Houthi UAVs in order to prosecute attacks on static targets, most consumers would require a degree of reliability in their platforms, coupled with the ability to perform tasks against dynamic or complex targets. Effectors that have these characteristics – such as the Brimstone missile, with its dual-mode seeker and capacity for autonomous classification, or the air-launched SPEAR 3 – do not have especially high unit costs, but do involve substantial development costs.⁴⁷ Finally, there is the question of replacement at scale – something that will be critical to a level of conflict that may involve very high rates of expenditure. While processes such as automated assembly and additive manufacturing can accelerate future production, adopting new practices at scale may require initially capital-intensive investments in industrial capacity. The ability to resupply stocks of capabilities at scale, already a challenge, will likely remain a critical issue to resolve.⁴⁸

A further consideration is that combining the disparate pieces of an anti-access system into something more than the sum of its parts requires the soft components of combined arms warfare. Networking assets in a way that allows them to deliver combined effects and generating

45. Maxim Starchak, 'Missed Targets: The Struggles of Russia's Missile Industry', CEPA, 27 June 2022, <<https://cepa.org/missed-targets-the-struggles-of-russias-missile-industry/>>, accessed 10 July 2022.

46. *Ibid.*

47. See, for example, *Navy Lookout*, 'Putting the "Strike" in Carrier Strike – the SPEAR 3 Stand-Off Weapon', 17 January 2021, <<https://www.navylookout.com/putting-the-strike-in-uk-carrier-strike-the-spear-3-stand-off-weapon/>>, accessed 10 July 2022.

48. Alex Vershinin, 'The Return of Industrial Warfare', *RUSI Commentary*, 17 June 2022, <<https://www.rusi.org/explore-our-research/publications/commentary/return-industrial-warfare>>, accessed 10 October 2022.

the human capital needed to operate in tandem with a range of newly available enablers is a task in itself. To take an example from the UK context, while the use of a range of autonomous capabilities is central to both the Royal Navy and Royal Marines' future operating concepts, generating a force that can leverage these assets is a task that has necessitated an ongoing process of experimentation as well as work on an appropriate concept of operations – all of which is highly resource-consuming.⁴⁹

The availability of anti-access capabilities, then, only partially removes the requirement for partner involvement. Although partners' direct involvement in defending smaller partners may be less important, it will be critical for creating the industrial and informational enablers needed to build an anti-access system in the first place. It is within this context that an indirect approach to constraint may offer the greatest purchase.

The Intersection Between Prosperity and Strategy: The Domestic Rationale for a Policy of Enablement

The UK rationale for a policy of enablement is that it could act as a point of what the historian Alan Milward has described as 'strategic synthesis': a virtuous feedback loop between a state's internal and external imperatives.⁵⁰ For example, the Reagan administration's efforts to rebuild the 'hollow' US Army of the 1970s were an example of effective strategic synthesis – the effort simultaneously met the imperatives of supporting the newly industrialising 'sunbelt' states of the south and west, and reinvigorating America's conventional defences vis-à-vis the Red Army.⁵¹ A commitment or strategy will be durable to the extent that it is embedded in domestic prosperity initiatives, since a large proportion of the public are likely to back expenditure if they see it serves their own local objectives.⁵²

The Defence and Security Industrial Strategy (DSIS) alludes to some of these objectives, highlighting, for example, the economic and defence potential of dual-capable technologies. Similarly, the DSIS signposts the importance of diversifying the UK's exports beyond the sale of aircraft in specific regions such as the Middle East. The document also signposts the value of a 'Team UK' approach to exporting, aligning UK exports with a wider cross-departmental defence offer.⁵³ This is reasonable – the history of defence exports suggests that partners are generally drawn to engagements that involve more than the export of specific platforms. For example, turn-of-the-20th-century British advisory missions in Japan and the Ottoman Empire paved the way for major arms purchases by both powers because the purchases were part of

49. Author interview with Royal Marines subject matter expert, London, 12 June 2022.

50. Aaron Friedberg, *In the Shadow of the Garrison State: America's Anti-Statism and its Cold War Grand Strategy* (Princeton, NJ: Princeton University Press, 2000), p. 65.

51. Peter Trubowitz, *Defining the National Interest: Conflict and Change in American Foreign Policy* (Chicago, IL: University of Chicago Press, 1998), pp. 169–235.

52. *Ibid.*

53. HM Government, *Defence and Security Industrial Strategy: A Strategic Approach to the UK's Defence and Security Industrial Sectors*, CP 410 (London: The Stationery Office, 2021), p. 30.

a wider offer to deliver force transformation within these nations. This was true in other areas such as the Baltic states during the interwar years, where securing access to the Royal Navy as an organisation was a major driver of states' commercial decisions.⁵⁴ To use a more recent example, Russia's expansion of its influence within African markets has in part been driven by its willingness to use other elements of state power – such as the Wagner Group – to meet partners' security needs, and by the use of its political offices in institutions such as the UN to support their interests.⁵⁵

Achieving the vision of a Team UK approach in the Indo-Pacific will require a definition of precisely what the UK's offer is, and what the roles of specific departments within it should be. In the Indo-Pacific, an approach emphasising denial and assured sovereignty as a capstone concept could form the basis for precisely such a Team UK offer. The components of an effective modern anti-access capability span multiple industrial areas, many of which – as discussed above – often involve dual-use capabilities in their manufacture. Moreover, anti-access strategies primarily deliver value by two mechanisms: direct military cost imposition and buying time for other tools – such as global opprobrium, arms supplies to the target state; and economic costs – to further pressure a larger aggressor.⁵⁶ Building partner capacity for local denial can be linked to a wider offer of indirect support in areas from leveraging international opinion to the imposition of economic costs in areas like shipping insurance, where the UK plays a leading role. Indeed, the UK has demonstrated its capacity for this type of cost imposition in the ongoing Ukraine conflict.⁵⁷ Many of the associated parts of the diplomatic and economic components of a Team UK offer would fall beyond the Royal Navy's remit, though it can support aspects of the offer. For example, there is sound empirical evidence (derived on the basis of the observed correlation between a nation's deployment of power projection capabilities and a subsequent rise in both

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54. See Donald Stoker, *Britain, France and the Naval Arms Trade in the Baltic 1919–1939: Grand Strategy and Failure* (London: Frank Cass, 2003); Sidharth Kaushal, 'Adoption Capacity Theory and Naval Doctrine: A Theory of Success and Failure in Naval Advise and Assist Missions to Modernizing States – China, the Ottoman Empire and Japan', in Donald Stoker and Michael T McMaster (eds), *Naval Advising and Assistance: History, Challenges and Analysis* (London: Frank Cass, 2017), pp. 54–62.
55. On the Wagner Group, see Paul Stronski, 'Late to the Party: Russia's Return to Africa', Carnegie Endowment for International Peace, October 2019, <<https://carnegieendowment.org/2019/10/16/late-to-party-russia-s-return-to-africa-pub-80056>>, accessed 5 June 2022. On the value of institutional offices, see Priyal Singh and Gustavo de Carvalho, 'Walking with the Bear? Russia and the A3 in the UN Security Council', Policy Insights No. 118, Institute for Security Studies and South African Institute of International Affairs, October 2021.
56. On anti-access as a strategy, see Sam J Tangredi, *Anti-Access Warfare: Countering A2/AD Strategies* (Annapolis, MD: Naval Institute Press, 2013), pp. 20–40.
57. See, for example, Andy Bounds et al., 'UK and EU Hit Russian Oil Cargoes with Insurance Ban', *Financial Times*, 31 May 2022, <<https://www.ft.com/content/10372dd3-be3c-42b9-982b-241a38efcc88>>, accessed 5 July 2022. On insurance, see, for example, Oxera, 'International Competitiveness of the UK Maritime Sector', report prepared for the Department for Transport, May 2015, pp. 1–10.

the frequency and level of its bilateral diplomatic exchanges with other nations) that high-cost deployments of capabilities like aircraft carriers can serve as a costly signal of diplomatic intent, even if all parties know these assets will not be used in combat functions.⁵⁸

Furthermore, an emphasis on building networks and exporting knowledge – not exporting platforms per se – could overcome one of the major challenges facing UK defence exports: the cost of platforms. Specific capabilities than can enable A2/AD – for example, radar systems and fire-and-forget missiles, or the network architecture to develop them – are far more viable as exports than platforms.

The production of A2/AD capabilities may well leverage industrial capacities, whose adoption the UK is attempting to generalise. For example, government work on developing an additive manufacturing strategy has resulted in a preliminary aim of accelerating the uptake of this mode of production, with the stated objective of winning 8% of the global share in additive manufacturing.⁵⁹ Thus far, however, most private sector actors are more willing to use additive manufacturing for rapid prototyping than for end-user products.⁶⁰ Similarly, the adoption of automated capabilities will have a range of functions, with many such capabilities being dual-use. As an example, the Chinese military bases a number of its UUVs on models built to fulfil commercial functions such as pipeline inspection. Equally, state interest in commercial providers of automated capabilities has driven their wider adoption within the PRC.⁶¹ Currently, areas of the UK maritime commercial sector – in particular the oil and gas sector – already leverage automation to a significant degree, and this uptake could be accelerated by more widespread military use of autonomous assets. There has historically been a strong state role in the uptake of high-risk technologies, exemplified by the Medical Research Council's support for research on monoclonal antibodies in the 1970s. Defence spending tends to have a particularly strong record in terms of producing both technological spillovers and a 'crowding in' effect; longitudinal data from OECD nations suggests both a positive correlation between defence R&D and private sector R&D in a given technological sector, and a statistically significant correlation with productivity growth, with a 1% increase in defence R&D in a given sector correlating with an 8.3% increase in total factor productivity in related civilian sectors.⁶² In essence, if defence

58. Erik Gartzke and Jon R Lindsay, 'The Influence of Seapower on Politics: Domain- and Platform-Specific Attributes of Material Capabilities', *Security Studies* (Vol. 29, No. 4, 2020), pp. 601–36.

59. Duncan Kelly, 'What's Next for Additive Manufacturing?', AYming, 13 April 2022; <<https://www.ayming.co.uk/insights/opinion/whats-next-for-additive-manufacturing/>>, accessed 7 October 2022.

60. International Trade Administration, 'United Kingdom Industry 2021 Additive Manufacturing', <<https://www.trade.gov/market-intelligence/united-kingdom-industry-2021-additive-manufacturing>>, accessed 10 July 2022.

61. Ryan Fedasiuk, Jennifer Melot and Ben Murphy, 'Harnessed Lightning: How the Chinese Military Is Adopting Artificial Intelligence', Center for Security and Emerging Technology, October 2021, pp. 16–25.

62. Enrico Moretti, Claudia Steinwender and John Van Reenan, 'The Intellectual Spoils of War? Defense R&D, Productivity and International Spillovers', Working Paper 26483, National Bureau of

can build a case for investing in capabilities associated with the Fourth Industrial Revolution – most of which are network-centric and not platform-centric – this will produce wider desired spillover effects.

An Indo-Pacific strategy centred around enabling the assertion of sovereignty could, then, thread together elements of the aspirations set out by both the Integrated Review and the DSIS with wider national objectives. On the one hand, it could help resolve the contradiction of attempting to deliver strategic effect without mass. On the other, it could simultaneously support a wider effort to deliver national objectives. Core partners with which the UK has existing institutionalised relationships may be both consumers of enabling capabilities and partners in their further export. For example, while Australia is a net consumer of enabling capabilities under the submarine programme currently envisioned under AUKUS, it could be a partner in generating export variants of assets such as UUVs or the network architectures that might enable partner A2/AD. Indeed, as a nation that has made more progress than the UK in areas such as hypersonics, Australia would be crucial to generating an export variant of a future hypersonic capability.

This seems an opportune time to address the commercial challenges that such thinking provokes, especially for UK businesses.

Team UK and the Commercial Challenge

First, inasmuch as the Royal Navy's approach to the Indo-Pacific must be nested within a wider strategy that embraces the UK's economic imperatives both within and beyond the region, the conditions for that approach must be set by the state more broadly. The concept of Team UK in the Indo-Pacific region is loaded with commercial assumptions that are broadly ignored by the DSIS and probably not understood by those who drafted the Integrated Review. The first of these is a misunderstanding of the motivations to be found in British boardrooms, especially those within the defence sector.⁶³ The Integrated Review and DSIS both assume that British-registered companies are happy to be configured as constituent elements of a conceptual Team UK. Board directors may well be comfortable with the patriotic intent and will benefit from the commercial branding, but there will soon come a moment when the C-suite needs to see the intended return on investment and the proposed commercial terms and conditions for any sale of long-term licensing of both mature and emerging technologies. This, not patriotism, will be the driver for commercial investment into research, applied research and development. Chief executives are influenced by returns on their employed capital, future market share and project

Economic Research, January 2021, pp. 1–20.

63. The concept of economic imperatives being a tool of state power is a well-trodden theme in the study of international relations. See, for example, John Spanier, *Games Nations Play*, 5th Edition (New York, NY: Holt, Rinehart and Winston, 1984), pp. 249–55.

certainties; an effective Team UK must deal in this currency, not in a loose narrative of collegiate public–private togetherness.⁶⁴

Second, developments in additive manufacturing and sensor effects, for example, offer multi-sector employment possibilities for these technologies. Ever more innovative developments and enhancements will be focused on non-military applications, as there will be better returns for investors beyond the defence market. Defence ministries in the UK and partner nations across the region need to work through technology ownership models that mitigate the risks of technologies being trapped within a defence commercial vortex, denying the originators and owners the prize of commercial exploitation beyond defence systems. It is the century of the innovator, not the bureaucrat, and those who originate disruptive technologies – and own the subsequent intellectual property (IP) – hold the whip hand. Defence departments insisting on the transfer of IP to government ownership on contract award will be thwarted by technologists and researchers not wanting to engage with defence.⁶⁵

Third, and linked to the preceding point, capped profit margins for single-source contracts may prove disastrous. Over the past decade or so in the UK, single-source regulations have capped profits on UK defence purchases to single digits, based on a cost-plus contract model. Very few exquisite, niche technologies will be made available to militaries for a profit of, say, 8%, when inflation is running at 11%. Whilst data is scarce, some analysts and academics believe that target margins for fast 3D printing, self-healing sensor networks and AI-based design and response solutions run at 15–25% of direct costs, and more if background or indirect costs are to be recovered. Defence contracts with typical terms and conditions need to evolve speedily to meet such imperatives.⁶⁶

Fourth, the narratives of the Integrated Review and DSIS, coupled with multiple commentaries since the launch of these documents, are ambiguous as to the manner in which the UK government will fund the development of critical technologies as well as assisting on exports to target nations. This ambiguity is possibly born from an over-exuberance of expectation in what government can achieve or direct. The government has schemes such as the Defence and Security Accelerator, which offers small upfront investments in the development of technologies at lower technology readiness levels (TRLs), but this is marginal compared to the private capital needed to progress technological development. Without a guaranteed sales pipeline, the large prime contractors are often stymied in their ability to take a punt on a technology following governmental signalling of future requirements – the realities of shareholder and investor management make such businesses risk-averse. For many agile small and medium-sized enterprises, investor funds are critical just for the provision of working capital, and the promises of the DSIS appear out of reach. Also, for companies not headquartered in the UK but using the country as a staging post for exports, emerging UK government discussions around a

64. See John Louth and Trevor Taylor, *British Defence in the 21st Century* (Abingdon: Routledge, 2020), pp. 83–101.

65. See Andrew T H Tan, 'Key Drivers of the Arms Trade', in Andrew T H Tan (ed.), *Research Handbook on the Arms Trade* (Cheltenham: Edward Elgar, 2020), pp. 17–38.

66. Confidential author interview with a high-tech defence subject matter expert, 5 July 2022.

refreshed defence offset policy might prove a disincentive to corporate engagement, as the loss of IP and transfer of production techniques to the UK is viewed as unattractive.⁶⁷

Fifth, the vision of the UK as a high-tech armourer of nations in the Indo-Pacific region must account for the fact that the client nation still has a say in what it buys. Two thoughts are relevant here. First, partner nations over the years have been nurtured and ‘parented’ by the US – acquisition decisions for imports invariably have an American entanglement. Second, the defence procurement organisations of overseas powers are often confusing and difficult to navigate for UK businesses, especially those with niche technologies new to the sector. The authors know of one UK defence business which spent millions on attempting to access the Australian market, supported by the High Commission, to little effect, as the needs and ambitions of the Australian Federal Government, individual state governments and the military could not be effectively predicted or reconciled.

This is not to say that Team UK is fatally holed before it sails, but leaders and decision-makers need to understand these five core points and put in place mitigations to manage the risks they pose. One such mitigation could be to explore the role of the British Business Bank in a broad continuum of defence R&D funding and export working capital. Moreover, there could be ‘stages of intent’ triggering payments to industry rather than a full contract award being the sole point of commercial obligations from governments to industry. The UK government could also take an ownership stake in companies most critical to the Team UK concept, especially those operating at the earlier stages of the TRL cycle. In this manner, government would contribute to the critical cash flows of sometimes fragile businesses and benefit from the rewards of ownership as sales mature. As the UK is no longer subject to European state-aid rules, a bespoke settlement for UK-registered businesses in support of government-stated strategic ambitions would seem sensible. In this regard, a flexible future offset strategy that understands the sweet spot between prosperity, technology transfer, exports and long-term commercial needs would assist corporate decision-makers.⁶⁸

As such, there are both opportunities and challenges associated with the commercialisation of Team UK, but the broad aspiration could well be consistent with a denial-oriented approach in the Indo-Pacific.

Having articulated the strategic rationale for a policy of partner enablement, and the imperatives it might create across government, this paper turns now to the military component of this approach. The next chapter elaborates in greater detail the technical requirements of creating an anti-access system that is within the reach of a small state, and what might be the Royal Navy’s role in supporting partner efforts to generate these capabilities.

67. HM Government, *Defence and Security Industrial Strategy*, pp. 61–63.

68. See Ron Matthews and Jonata Anicetti, ‘Offset in a Post-Brexit World’, *RUSI Journal* (Vol. 166, No. 5, 2021), pp. 50–62.

II. The Military Component and the Royal Navy's Role

ULTIMATELY, ANY APPROACH to enabling partners depends on the needs of local states. While the UK cannot shape these requirements, it can anticipate their broad contours. This chapter elaborates on some of the general principles that underpin effective A2/AD for a small or medium-sized power in an Indo-Pacific operating context and identifies areas where the Royal Navy might add value in erecting such a system.

The Demand Signal: What Makes an Effective 21st-Century Anti-Access System?

As discussed, ISR and networks are a more critical bottleneck than effectors for small and mid-sized states seeking to generate localised A2/AD bubbles. A major consideration is that many such nations will not necessarily have access to robust theatre-wide ISR capabilities such as China's Yaogan satellite constellation. Smaller nations will also struggle to field the most sophisticated prompt strike capabilities, such as hypersonics, at scale. The prototyping and R&D costs of these capabilities – which are as high as \$438–\$577 million for 2022 and 2023 respectively in the US Air Force's 2023 budget – are beyond most small powers.⁶⁹ As such, for states other than China and the US, both the C4ISR needed to deliver a credible A2/AD system and the research underpinning some of its more expensive components can only be achieved through partnerships.

The ability to achieve sea denial with a system that does not have expensive nationally owned ISR assets and is primarily comprised of less exquisite effectors, then, will determine whether countries with capabilities short of those of the largest actors in the system can defend themselves, or at least raise the costs of aggression against them to unacceptable levels. Achieving this military end will require first and foremost an assessment of how the principles that underpin an effective A2/AD system can be applied by small and middle powers.

Resilient ISR and Processing Based on Limited Inputs

It should go without saying that any anti-access system is only as good as its capacity to scout targets. The ability to both draw data from multiple sources and fuse it in a tactically relevant timeframe is critical to effective A2/AD. Many existing coastal defence systems, like the Russian K-300P Bastion-P, which is fielded by nations such as Vietnam, provide the ability to cue in missiles based on data from both a brigade's organic Monolit-B radar and off-board sources

69. Department of the Air Force, 'FY2023 Budget Overview', 2021, p. 19.

like the Kamov Ka-31 helicopter.⁷⁰ Similarly, a well-functioning integrated air defence system typically involves a multi-static network of multiple classes of digital radar operating across a broad range of the radar spectrum, allowing the returns to be cross-referenced.⁷¹ However, many relatively small partners need to contend with the high likelihood of having their capabilities suppressed, by both kinetic and non-kinetic means, if they enter into conflict with a peer competitor. To use an example, the vast majority of Ukraine's early warning systems and fixed sites were suppressed by Russian cruise missile strikes in the first days of the conflict.⁷² Early warning systems, which are by necessity large and often fixed, will be particularly vulnerable in the context of adversary air superiority. This is also true, to an extent, of mobile early warning capabilities such as AWACS aircraft, which would likely prove vulnerable to suppression on the ground in the early stages of a conflict. The PLAN, PLA Air Force and PLA Rocket Force can generate significant prompt strike capabilities that will likely make it extremely risky for a traditional component of an A2/AD system such as a Monolit-B radar to light up, for example, and will deny sea space to assets like helicopters.⁷³ Moreover, the communications architecture on which a multi-tiered air defence network might depend is likely to be targeted early in any conflict per Chinese doctrine. However, defenders can still pose a substantial threat to stronger air and naval forces in several ways if their capabilities and tactics are geared to the task. For example, if an air defence network degrades gracefully, it can still generate a 'pop-up' threat to aircraft.⁷⁴ Similarly, forward-deployed passive sensors can allow radar operators supporting coastal defence systems to control their emissions more carefully. A picket of electro-optical sensors on forward atolls, for example, can serve to cue in active radar further behind. Less granular information in areas such as SIGINT and the exploitation of open source data can also be critical to early warning and narrowing the search parameters for defenders in order to enable the conduct of successful engagements – particularly in the context of sea denial. Examples from the wartime success of Operation *Ultra* to the sinking of the *Moskva* illustrate that targeting need not always take place on the basis of track-quality data.⁷⁵ Information

70. Jack Watling, Justin Bronk and Sidharth Kaushal, 'A UK Joint Methodology for Assuring Theatre Access', *Whitehall Report*, 4-22 (May 2022), p. 11.

71. Justin Bronk, 'Modern Russian and Chinese Integrated Air Defence Systems', *RUSI Occasional Papers* (January 2020).

72. Justin Bronk, 'The Mysterious Case of the Missing Russian Air Force', *RUSI Commentary*, 28 February 2022, <<https://rusi.org/explore-our-research/publications/commentary/mysterious-case-missing-russian-air-force>>, accessed 11 July 2022.

73. On the PLAN's strike capabilities and wider blue-water system, see Congressional Research Service (CRS), 'China Naval Modernization: Implications for U.S. Navy Capabilities – Background and Issues for Congress', CRS Report RL33153, 8 March 2022; Sidharth Kaushal, 'The Chinese Reconnaissance Strike Complex: Echoes of Imperial Japan's Strategy?', *RUSI Defence Systems*, 26 April 2022, <<https://www.rusi.org/explore-our-research/publications/rusi-defence-systems/chinas-reconnaissance-strike-complex-echoes-imperial-japans-strategy>>, accessed 10 October 2022.

74. Watling, Bronk and Kaushal, 'A UK Joint Methodology', pp. 10–20.

75. W J R Gardner, *Decoding History: The Battle of the Atlantic and Ultra* (Annapolis, MD: Naval Institute Press, 1999). On the sinking of the *Moskva*, see Helen Cooper, Eric Schmitt and Julian Barnes, 'U.S. Intelligence Helped Ukraine Strike Russian Flagship, Officials Say', *New York Times*,

regarding likely targets and launch vectors is often critical to air defence as well; it was the lack of this intelligence which proved a critical determinant of the failure of Saudi air defenders to meet the attacks on Abqaiq and Khurais, while the more successful exploitation of intelligence in the Ukraine conflict has enabled a more effective defence even in the absence of early-warning systems. Less visible assets can also be used, much as the IRGC used *Saviz* – notionally a civilian ship – to cue Houthi cruise missile attacks in the Bab el-Mandeb.⁷⁶

The question of how to both draw and disseminate data without exorbitant capabilities is thus a pressing one for smaller states. One answer suggested has been to leverage the commercial sector. Private companies such as BlackSky and Airbus now employ constellations that can survey the globe with a daily or higher revisit rate. A recent example of a small state using commercial capabilities would be Ukraine's use of Starlink satellites to support its artillery targeting in its conflict with Russia. Assets with a narrower field of view, such as UAVs, have also seen widespread adoption by a range of nations, and unmanned capabilities can potentially provide a distributed ISR architecture with limited unit costs. However, the companies that operate commercial satellites may well be regulated by the nations in which they are headquartered. Moreover, states acting as facilitators are critical to ensuring that some consumers receive priority access to commercial assets, as the US government's role in the delivery of Starlink to Ukraine illustrates. Most large commercial satellite firms are Western, with the majority being American.⁷⁷ Certain capabilities, such as the close coordination of ELINT (electronic intelligence), synthetic-aperture radar and over-the-horizon radar, would still require state-owned assets, and the tasks of networking and disseminating the data collected still represent a possible bottleneck in capability for smaller states. The effective utilisation of certain capabilities – for example, sensors operating in littoral spaces or more complex anti-access capabilities such as submarines – also involves a significant amount of corporate knowledge.

In the longer term, capabilities that could theoretically disrupt the conduct of reconnaissance and scouting – such as quantum-based radar and computing, and the use of AI to speed up tasks like classification – could also substantially enhance the viability of A2/AD in both the air and maritime domains. Systems reliant on probabilistic reasoning rather than direct observation can make kill chains significantly more resilient under degraded ISR. A model that derives probabilistic inferences from observed patterns – comparable to many used in commercial applications – can also allow a decision to be made on the basis of partial data if parts of a kill

5 May 2022. While the precise nature of the intelligence is unknown, it was probably something short of track-quality data and instead likely narrowed the search parameters for Ukrainian coastal defence cruise missile crews.

76. *Global Security*, 'M/V Saviz – IRGCN Afloat Forward Support Base', <<https://www.globalsecurity.org/military/world/iran/irgcn-saviz.htm>>, accessed 5 June 2022.

77. Therese Wood, 'Visualizing All of Earth's Satellites: Who Owns Our Orbit?', *Visual Capitalist*, 20 October 2020, <<https://www.visualcapitalist.com/visualizing-all-of-earths-satellites/>>, accessed 10 July 2022.

chain have been degraded.⁷⁸ The Royal Navy itself has made strides in this area – for example, using the AI-enabled classification programmes Startle and Sycoia to facilitate cruise missile defence. The integration of this targeting system on a Type 23 frigate would seem to imply that it can be integrated on older platforms.⁷⁹

Another emerging technology to consider is sensors with the potential to track targets with both greater accuracy and fewer emissions than traditional data sources. Quantum radar could further enhance the potential for defenders to engage platforms while remaining hidden. In some areas, the potential of this technology has passed proof of concept. The PLAN has demonstrated the potential for its superconducting quantum interference device – a quantum magnetometer – to generate data on a submarine’s location at distances of up to 6 km, well in excess of a traditional magnetometer.⁸⁰ There are some considerations regarding whether the sterile experimental conditions of the test are comparable to real-world conditions, and whether the requirements of such a system in terms of things like cooling can be met. Nonetheless, the test does illustrate the maturation of quantum technology. As a major investor in quantum technology research – with plans to spend roughly £1 billion across government and industry – the UK’s level of investment compares favourably to that of the US.⁸¹ Similarly, leveraging AI opens the promise of increasingly rapid processing, speeding up kill chains. AI could also enable targeting under degraded conditions through the use of probabilistic reasoning based on pattern-of-life data or more sophisticated data analysis using a missile’s own on-board sensors, the latter already being visible in the case of the US Navy’s Long Range Anti-Ship Missile.⁸² In areas such as the use of AI for more rapid processing, major players like the US and China are arguably in a much more commanding position.⁸³ That said, there remain areas where middle powers can perhaps carve a niche – in particular, specific areas of software (such as Sycoia) and conducting joint training programmes to enable operators to exercise discretion under conditions where they

78. Zoubin Ghahramani, ‘Probabilistic Machine Learning and Artificial Intelligence’, *Nature* (Vol. 521, No. 7553, May 2015), pp. 452–59.

79. Royal Navy, ‘Navy Tests Artificial Intelligence Against Supersonic Missiles’, 29 May 2021, <<https://www.royalnavy.mod.uk/news-and-latest-activity/news/2021/may/29/20210529-artificial-intelligence>>, accessed 5 June 2022.

80. David Hambling, ‘China’s Quantum Submarine Detector Test Could Seal South China Sea’, *New Scientist*, 22 August 2017, <<https://www.newscientist.com/article/2144721-chinas-quantum-submarine-detector-could-seal-south-china-sea/>>, accessed 11 July 2022.

81. Katarzyna Kubiak, ‘Quantum Technology and Submarine Near-Invulnerability’, Global Security Policy Brief, European Leadership Network, 2020, pp. 1–2.

82. Mark Owen, Katie Rainey and Rachel Volner, ‘How AI is Shaping Navy Intelligence, Surveillance, and Reconnaissance’, in Sam J Tangredi and Gero Galdorisi (eds), *AI at War: How Big Data, Artificial Intelligence, and Machine Learning are Changing Naval Warfare* (Annapolis, MD: Naval Institute Press, 2021), pp. 168–82.

83. Nick Wright, ‘Innovation and Great Power Competition’, RUSI Adversarial Studies Seminar, 1 July 2021, <<https://www.youtube.com/watch?v=4N4czSYUHCA>>, accessed 10 October 2022.

must simultaneously rely on enablers but also account for the fact that such systems can be led to make systematic and cascading errors by a thinking opponent.⁸⁴

The critical factor is that the networking and corporate knowledge needed to create a system of systems is likely to become an increasingly valuable asset even as effectors become increasingly accessible. Operator competencies, for example, can be effectively developed through partnerships with institutionally mature actors, and these partnerships are often critical to capability adoption since they enable the diffusion of experientially driven tacit knowledge, which is vital to the effective operation of capabilities.⁸⁵ Partnerships can also lend smaller and middle powers complementarities of scale in other ways. Effective SIGINT, for example, is typically a task that requires deep partnerships, as the UK's own experience shows.⁸⁶ Finally, the gamut of capabilities, from viable passive sensors to effective data networks, needed to disseminate information to capabilities such as AI-driven processing and the incorporation of novel sensors all involve high development costs – though not necessarily high unit costs for finished products. A key policy consideration, should these assets mature, is how to maintain the operational value of disseminating them to partners while avoiding a loss of access to key information. On the other hand, the fact that these assets cannot be sourced from a wide range of actors – unlike, for example, missiles – could render the capacity to share them a key offer to partners.

A Diverse Range of Effectors

In all likelihood, single vectors of attack are unlikely to work against well-defended forces. Anti-ship missiles, for example, actually have a relatively poor record against alert vessels with hard and soft kill capabilities. Work on the subject of overwhelming the defences of an *Arleigh Burke* conducted by the PLA tends to emphasise the use of missiles of differing speeds on multi-vector axes, effectively saturating the processing and decision-making capacity of the target's systems.⁸⁷ This represents one way in which an opponent can be faced with multiple dilemmas, but by no means the only one.

84. Sam J Tangredi, 'Sun Tzu Versus AI: Why Artificial Intelligence Can Fail in Great Power Conflict', *Proceedings* (Vol. 147, No. 5, May 2021).

85. On tacit knowledge, see Michael C Horowitz, *The Diffusion of Military Power: Causes and Consequences for International Politics* (Princeton, NJ: Princeton University Press, 2010), Chapters 2 and 3.

86. John Ferris, *Behind the Enigma: The Authorised History of GCHQ, Britain's Secret Cyber-Intelligence Agency* (London: Bloomsbury, 2020).

87. Yoshihara and Holmes, *Red Star Over the Pacific*, pp. 220–40.

The combination of aerial threats with other threat vectors could represent one means of presenting a defender with multiple dilemmas. For example, the IRGC has fielded weaponised UUVs capable of acting as long-range self-propelled torpedoes. Coordinating the use of these assets with missiles could be viable in contexts where ships surrender tactical mobility – for example, while in port, or when supporting an amphibious assault or providing air cover to a wider formation. Such capabilities could also augment more expensive subsurface assets such as SSKs, which are fielded by a number of nations in the Indo-Pacific. One could, for example, see an SSK deploying gliders as smart mines, much as Russian *Kilo*-class submarines currently deploy more traditional naval mines. Alternatively, such systems might act as off-board sensors or decoys.

Cheaper, low-flying and slow capabilities like UAVs represent another vector. While probably incapable of doing critical damage to a large vessel, such assets could be used against sensitive equipment such as radar, or could be used as decoys for other assets or to force opponents to expend their magazine. The Houthis and Iranians have demonstrated the utility of UAVs in both functions. Houthi UAVs have on several occasions damaged the radar of Saudi Patriot batteries, opening the way for other assets.⁸⁸ UAVs might also be combined with more complex systems as decoys. During the 2019 attack on Abqaiq and Khurais, UAVs were utilised in tandem with cruise missiles to spread thin the attention of Saudi radar operators.⁸⁹

The combined arms approach adopted by a nation will doubtless reflect its priorities and capabilities. Where partner forces can add value is through the development of capabilities that are fungible across different concepts of operations. Partners add greatest value when they focus on building specialisms that fit within a partner's concept of operations; Iranian support to partners like Hezbollah and the Houthis, for example, has emphasised training in areas such as missile production and cultivating communications networks rather than building force structures as a whole.⁹⁰ Learning, moreover, is a two-way process – for example, during the Vietnam War and in its engagement with Middle Eastern partners, the USSR imparted Soviet air defence tactics, techniques and procedures (TTPs) to partners to good effect, and the Soviet Air Defence Forces were able to absorb many of the lessons learned from these engagements when revising their own doctrine.⁹¹

88. Thomas Gibbons-Neff, 'Houthi Forces Appear to be Using Iranian-Made Drones to Ram Saudi Air Defenses in Yemen, Report Says', *Washington Post*, 22 March 2017.

89. Uzi Rubin, speech given at RUSI Space and Missile Defence Conference 2020, London, 27 February 2020.

90. See Jack Watling and Nick Reynolds, *War by Others' Means: Delivering Effective Partner Force Capacity Building*, Whitehall Paper 97 (Abingdon: Routledge, 2021).

91. Sandia National Laboratories, 'The Development of Soviet Air Defence Doctrine and Practice', Historical Evaluation and Research Division, 1981.

Sustainment and Replenishment

Many anti-access capabilities such as those discussed in previous sections may be viable to produce en masse using relatively non-specialised assets. The systems utilised by the Houthis, for example, relied on a combination of imported guidance kits and bodies produced in relatively ad hoc skunkworks.⁹² Going forward, mass-producing certain munitions may become increasingly feasible; this stems from the fact that key technologies associated with the Fourth Industrial Revolution, including additive manufacturing, should in principle make it viable to repurpose facilities for the production of multiple capabilities and, moreover, may reduce many production costs.⁹³

That being said, manufacturing certain capabilities at scale may prove difficult for some countries, particularly if an opponent chooses to target the state's industrial base. Russia's approach in the ongoing conflict in Ukraine, which has seen it target Ukraine's arms industry, including the Luch Design Bureau that produces the Neptune ASCM, illustrates this. Developing the capacity for replenishment, then, may require either stockpiling or the use of effectors simple enough to be built under contested conditions. Iran has accomplished this in Yemen, and it has become part of an explicit IRGC strategy that has seen the organisation emphasise the creation of simpler variants of most of its capabilities which can be built, with instruction, by less sophisticated partners.⁹⁴ For a partnered approach, developing effectors with unit costs low enough that they can be procured by partners in numbers sufficient for high-intensity combat will likely be the critical factor.

Mobility

Ultimately, in any scenario where an actor is operating in the face of overmatch, there is a reasonable chance that it will face suppression and isolation in the long term. Mobility and the ability to deny an opponent victory in the scouting competition are thus of paramount importance. Indeed, models of salvo competitions suggest that an advantage in tactical intelligence tends to be of greater salience than either offensive or defensive capabilities.⁹⁵ Tactical mobility and, depending on the actor, intra-theatre mobility, are also likely to be critical to enabling capabilities to be positioned at the speed of relevance, which can be critical in competition. In the context of the land domain, one might consider incidents within the Sino-Indian border competition such as the 2017 Galwan crisis or the 2020 Darbuk–Shyok–DBO Road crisis, where the capacity to position and sustain forces on the high ground of the two nations'

92. Rubin, speech given at RUSI Space and Missile Defence Conference 2020.

93. T X Hammes, 'Expeditionary Operations in the Fourth Industrial Revolution', *MCU Journal* (Vol. 8, No. 1, Spring 2017), pp. 97–98.

94. Fabian Hinz, 'Missile Multinational: Iran's New Approach to Missile Proliferation', International Institute for Strategic Studies, April 2021.

95. Kevin G Haug, 'Using Hughes' Salvo Model to Examine Ship Characteristics in Surface Warfare', Master's thesis, Naval Postgraduate School, September 2004.

shared border has typically created conditions that are either difficult or impossible to reverse – meaning that the actor who could move quickest tended to win with minimum violence.⁹⁶

Niche capabilities such as surface connectors, and the TTPs needed to allow them to manoeuvre effectively, are vital to operations in contested littorals.⁹⁷ Concepts such as the US Marine Corps' Expeditionary Advanced Base Operations framework, which rely on enablers that extend the reach and mobility of dispersed forces, can potentially be adopted by larger middle powers like Japan but may well be beyond the reach of some regional powers. Moreover, maintaining a sufficient number of expensive enablers may well prove difficult even for middle powers unless operating in a US-led framework. The capacity to sustain a dispersed force – in terms of both staffing and mobility – will also be a vital determinant of success in contested littorals.

Grey-Zone Capability

Militaries face an inherent trade-off when optimising for a challenge that can in principle take multiple forms. Many of the capabilities needed to contest the 'grey zone' are diametrically different from those that are required in order to deny a stronger rival freedom of manoeuvre above the threshold of conflict. This is due to the fact that asserting political control requires visibility, and many of the asymmetrical capabilities that contest the above-threshold space are survivable and effective precisely due to their ability to remain nondescript. This trade-off between competitive utility and lethality in a conflict scenario is visible in studies contrasting the relative utility of visible assets and less visible ones like SSN or SSGN submarines.⁹⁸ In essence, there is a trade-off between optimisation for high-intensity conflict and the flexibility needed to be capable in less consequential but more likely scenarios.

This generates real-world challenges, as has been seen in the context of nations such as Taiwan that still invest a significant amount of financial capital in capabilities which would not be very survivable in the context of a high-intensity conflict, like the F-16. These assets are crucial to denying the PRC effective dominance in the grey zone, but the costs of both purchasing them and maintaining them represent a real dampener on meaningful adaptation. While challenges in the grey zone may not themselves be meaningful on an individual basis, they can be viewed as tests of credibility.⁹⁹ In certain cases, notably China's island construction in the South China Sea, sub-threshold activities can also have meaningful cumulative effects. Smaller actors are faced with a conundrum, then: the more likely but not totally consequential mission of being

96. Nick Reynolds and Sidharth Kaushal, 'A Military Analysis of the Sino-Indian Border Clashes', *RUSI Commentary*, 2 June 2020, <<https://rusi.org/explore-our-research/publications/commentary/military-analysis-sino-indian-border-clashes>>, accessed 10 July 2022.

97. RUSI Royal Navy Workshop, London, 6 July 2022.

98. Forrest E Morgan, *Crisis Stability and Long-Range Strike: A Comparative Analysis of Fighters, Bombers and Missiles* (Santa Monica, CA: RAND Corporation, 2013), pp. 21–22.

99. Raymond Kuo, 'The Counter-intuitive Sensibility of Taiwan's New Defense Strategy', *War on the Rocks*, 6 December 2021, <<https://warontherocks.com/2021/12/the-counter-intuitive-sensibility-of-taiwans-new-defense-strategy/>>, accessed 10 June 2022.

able to compete in the grey zone requires them to develop capabilities that are incompatible with their defence in wartime.

This potentially represents a niche that partners with large multifunctional capabilities can fill. Capabilities needed to contest in the grey zone, such as surface vessels, can, if committed to presence missions, facilitate a necessary transformation in a partner state's defence posture, as these assets can take on part of a burden that would otherwise have had to have been budgeted and generated from the partner's own resources. Since these capabilities are primarily meant to contest the sub-threshold space, the question of whether they can survive high-intensity conflict is tangential. Forward-deployed assets such as offshore patrol vessels and frigates can, then, have a meaningful effect if assertively used, less because of any direct impact they might have than because of the indirect impact they can deliver. If these capabilities can, in tandem with partners, deliver grey-zone maritime security, they can also facilitate necessary changes by regional partners.

The Royal Navy's Possible Offer to Regional Partners

The Royal Navy could be a crucial partner to nations seeking to develop competencies in the areas listed above. This could be achieved on both a bilateral and a multilateral basis. In the context of established frameworks, such as the UK–Japan bilateral relationship and the AUKUS framework, the UK offers a number of niche capabilities to partners, and there exist a range of collaborative projects in which it is involved, from the Australian SSN project to work with Japan on the Tempest fighter jet.

Within the context of a strategy of denial, the UK would build on these partnerships to engage a second layer of strategic partners, with which the UK may not be as deeply embedded but which may have interests that dovetail with those of both the UK and its regional partners. For example, generating exportable effectors could be made an explicit objective of AUKUS cooperation in hypersonics.¹⁰⁰ Similarly, mooted UK–Japanese collaboration on the future of the Amphibious Rapid Deployment Brigade (ARDB) could expand beyond exercises to include joint experimentation on capabilities and concepts of operations for contesting the littoral that could be applied both by the ARDB and by other regional states with similarly sized amphibious forces.¹⁰¹ Given that the ARDB will be primarily oriented towards island defence as part of Japan's emphasis on building a 'southwestern wall', its mission focus will likely be similar to those of a number of organisations within similarly situated states.¹⁰² Notably, Japan has revised its export guidelines to enable the export of certain anti-access capabilities such

100. On this collaboration, see Aamer Madhani, 'Australia, UK, US Alliance to Develop Hypersonic Missiles', *The Diplomat*, 6 April 2022, <<https://thediplomat.com/2022/04/australia-uk-us-alliance-to-develop-hypersonic-missiles/>>, accessed 10 October 2022.

101. On this cooperation, see Jeffrey W Hornung, *Allies Growing Closer: Japan–Europe Security Ties in an Age of Strategic Competition* (Santa Monica, CA: RAND Corporation, 2020), pp. 15–16.

102. Scott W Harold et al., *U.S.–Japan Alliance Conference: Meeting The Challenge of Amphibious Operations* (Santa Monica, CA: RAND Corporation, 2018), pp. 9–10.

as sensors and missiles.¹⁰³ As such, one might envision coordinated efforts to generate local anti-access capabilities as a potential avenue for bilateral coordination, if policy considerations within both states allow this. The ability to coordinate outreach to non-traditional partners with more established ones can expand the capacity to meet regional objectives – in effect, a ring of traditional partners in the region can act as a force multiplier for UK engagement with the region more broadly. Expanding the remit of frameworks such as AUKUS to encompass coordinated partner enablement beyond their members might also serve to soften diplomatic pushback generated from the perception that such frameworks are exclusive clubs.

In certain capability areas, the UK has no appreciable lead over potential alternatives, either friendly or otherwise. A number of nations can deliver capabilities such as ASCMs, ranging from the Indian BrahMos supersonic ASCM to the Norwegian Joint Strike Missile. Similarly, prospective purchasers can seek a variety of green-water assets – from SSKs to frigates – from alternative sources. This is not to say that the UK cannot find a niche in the region, but effective engagement requires a focused approach emphasising the UK's comparative advantages.

In principle, there are several areas in which the Royal Navy could readily act as a partner of choice. They are:

- Generating the capacity for situational awareness in littoral spaces.
- Conducting product development, in tandem with core partners, to create exportable versions of both relatively cheap unmanned effectors and high-end effectors such as hypersonics.
- Building the organisational capacity to operate a dynamic area denial system at scale.
- A willingness to undertake risks in the grey zone, clearing the way for adaptation by regional partners.

Knowledge Exchange: The Soft Components of an Anti-Access System

A major area for the co-development of capabilities is human capacity, where partners can often deliver valuable assistance. Examples include the history of Soviet and then Russian support to partners developing integrated air defence networks or, more recently, the inclusion of officers from multiple NATO members on the Royal Navy's Submarine Command Course, informally known as 'The Perisher'.¹⁰⁴ A number of complexities in littoral environments make the exchange of tacit knowledge among officers extremely valuable. For example, in littoral spaces the operators of radar have to contend with environmental phenomena such as subrefraction and the presence of emitting civilian electronic equipment.¹⁰⁵ Given the inability of sensors alone

103. *Nikkei Asia*, 'Japan to Enable Fighter Jet and Missile Exports to 12 Nations', 27 May 2022, <<https://asia.nikkei.com/Politics/International-relations/Japan-to-enable-fighter-jet-and-missile-exports-to-12-nations>>, accessed 10 July 2022.

104. Kathleen Hicks et al., *Undersea Warfare in Northern Europe* (Washington, DC: Center for Strategic and International Studies, 2016), p. 34.

105. Vego, 'On Littoral Warfare', p. 22.

to overcome this complexity, operator knowledge is critical. Similarly, managing the spectrum in littoral spaces and operating in the face of adversary attempts to further limit one's ability to maintain situational awareness are tasks that a number of forces, including the US Marine Corps and Royal Marines, are currently grappling with.¹⁰⁶ This offers a chance for co-evolution with partners. Similarly, the operators of submarines and anti-submarine warfare assets in littoral spaces have to contend with a complex acoustic environment and the effects of environmental factors such as bathymetry and the sound velocity profiles of water columns.¹⁰⁷ Nations that have incipient submarine forces may spend a certain amount of time adopting best practices and TTPs.¹⁰⁸ Even the PLAN is partially impacted by this, as suggested by studies which examine the impact on its crews of conducting long submarine patrols – hitherto not a PLAN mission.¹⁰⁹

Equally, partners that are regionally positioned will in many cases have a fuller understanding of both regional dynamics and the broader implications they may have. Leveraging this corporate knowledge is often a net benefit to an extra-regional partner. Consider, for example, the case of the US efforts to support Philippine counterinsurgency efforts during the Huk Rebellion, which allowed figures such as Edward Lansdale to draw from the practices of local troops in order to inform a nascent school of thought regarding counterinsurgency.¹¹⁰ A process of knowledge transfer, then, has the potential to offer mutual benefits.

The 'soft' aspects of capacity-building are an area in which an anti-access force will need to become adept. Tasks such as retaining operational security in an environment where an opponent will enjoy information advantage, exercising tactical mobility and supporting forces in a disjointed littoral battlespace are all exceedingly complex. Generating partner capacity for conducting operations in complex and congested environments could be an area in which the Royal Navy can leverage its institutional experience to effect. Indeed, building institutional capacity has often been one of the more consequential forms of military assistance. For example, the UK's interaction with a reforming Imperial Japanese Navy (IJN) at the turn of the 20th century revolved primarily around supporting the creation of the IJN's naval academy at Tsukiji and introducing standards of training and wargaming into its curriculum.¹¹¹ Not only did this have a

106. Author interview with Royal Marines subject matter expert, London, 6 June 2022.

107. Charles H Sinex and Robert S Winokur, 'The Environmental Factors Affecting Military Operations in the Littoral Battlespace', *Johns Hopkins APL Technical Digest* (Vol. 14, No. 2, 1993), pp. 112–24.

108. Many local nations have relatively young submarine forces. See, for example, James Goldrick and Jack McCaffrie, *Navies of South-East Asia: A Comparative Study* (Abingdon: Routledge, 2012).

109. Chaoqun Hu et al., 'The Self-Perceived Mental Health Status and Factors that Influence the Mental Health of Chinese Submariners in the South China Sea: A Cross-Sectional Study', *Military Medicine* (Vol. 187, No. 5–6, May–June 2022), pp. e696–e701.

110. Max Boot, *Invisible Armies: An Epic History of Guerrilla Warfare from Ancient Times to the Present* (New York, NY: W W Norton, 2013), pp. 400–09.

111. Kaushal, 'Adoption Capacity Theory'.

long-term indirect effect, but it also created a durable institutional link between the two nations that (for a time, at least) provided Britain with both geopolitical and commercial dividends.

The Royal Navy's 'Perisher' submarine course offers a contemporary example of training serving as an alliance asset, as does Fleet Operational Sea Training (FOST). While it is not viable to expand access to these programmes to a wide range of partners without shedding capacity that the Navy needs, one might consider how advisory teams could partially replicate them in host nations. In principle, one might consider ways in which to 'franchise' a programme such as FOST through an approach geared towards engaging officers in a partner nation who will be involved in generating their nation's training regimens. This might mirror the way in which large corporate entities extend their training protocols to a range of local partners. Early engagement with partners might be able to abet a range of functions, including:

- Training needs analysis.
- Scoping studies.
- Course/instructional design.
- Evaluation of partner engagement.

Given that partner engagement tends to be most successful when it is focused, rather than when it entails efforts to share knowledge across the breadth of two institutions, identifying focus areas will be of critical importance. While this is a major function of maritime liaison and assessment (MLAT) teams, expanding the capacity of these teams to engage with the institutions of potential partners in order to better understand the demand signal and the most fruitful areas for resource allocation could be achieved through engagement both with specialists within the wider Navy and with the UK's in-country network – for example, its defence attaché network. As the use of technological aids such as simulators as part of training regimes grows – in turn decreasing the human burdens and capital involved – extending training protocols to partners may become increasingly viable. For example, if simulations of a certain standard are used for specific training functions, this may lessen the requirement to train individual trainers within a partner state, and thus the drain on human capital.

Direct engagement on the development of niche capabilities in areas such as amphibious warfare through entities such as the Royal Marines' Support, Augment, Liaise, Train (SALT) teams can also generate value. There is a proliferation of amphibious ambition in nations which have not previously fielded amphibious or littoral-oriented forces; this includes Japan's ARDB and the Australian Defence Force's re-emerging amphibious capability, but could also pertain to Indonesia's growing ambitions to deliver amphibious operations, the Malaysian Marine Corps, and the Indian military's incipient Army–Navy theatre-level amphibious capability within its Eastern Command.¹¹² Ultimately, the driving impetus behind the proliferation of amphibious

112. Kim Gilfillian, 'Force From the Sea: Australia's Amphibious Capability – An Update', *The Cove*, 3 July 2020, <<https://cove.army.gov.au/article/force-sea-australias-amphibious-capability-update>>, accessed 10 October 2022; Tom Abke, 'Indonesia to Modernize its Marine Corps', *Indo-Pacific Defense Forum*, 10 February 2019, <<https://ipdefenseforum.com/2019/02/indonesia-to->

ambitions is roughly the same in each case: the ability to deploy on and defend far-flung maritime holdings. As organisations that are preparing to operate at a scale more comparable to these nations' level of likely aspiration than that of the US, one might see the Royal Marines and Royal Navy more broadly enjoying opportunities for co-development. Future concepts including the use of auxiliaries to support amphibious operations, supporting operations from smaller vessels and maintaining situational awareness in a contested littoral can be co-developed with partners operating on a comparable scale. The question of scale also matters: LRG (Littoral Response Group) South will likely not be able to engage everywhere while maintaining the capacity to perform other tasks. If, however, a narrow focus on states straddling critical geography such as chokepoints is emphasised for SALT and MLAT teams, and if a sequential order of partner engagement is decided upon early in the decade, this capacity challenge can be overcome. Another means of overcoming the challenge of capacity is a division of labour with other AUKUS members, should partner engagement in support of a strategy of denial be made a key objective of the framework.

Capacity-building in areas such as staffing an operation at scale or generating specific technical competencies represents an area where small numbers of advisers can deliver disproportionate effects. For example, Military Professional Resources Incorporated (MPRI) was able to provide critical support to the Croatian government ahead of Operation *Storm* with a team of 14 advisers, while the IRGC has delivered substantial effects within Yemen with advisory forces initially numbering in the dozens.¹¹³ In each case, success was achieved by focusing on a specific component of planning and delivering force – for example, a component such as the IRGC's support to Houthi missile production, or an aspect of organisation like MPRI's work on planning and staff processes. A second lesson visible from the MPRI case and other 20th-century cases is the way in which individuals with clearances from beyond the military were leveraged: MPRI used retired senior officers, and successful 20th-century advise and assist missions took advantage of private sector actors as well.¹¹⁴ The ability to treat in-country teams as a fixture around which individuals from both within the force and perhaps beyond it can be plugged in – as opposed to a stand-alone solution – is of vital importance to leveraging structures like the SALT teams.

modernize-its-marine-corps/>, accessed 10 October 2022; Zachary Keck, 'Malaysia to Establish Marine Corps and South China Sea Naval Base', *The Diplomat*, 19 October 2013, <<https://thediplomat.com/2013/10/malaysia-to-establish-marine-corps-and-south-china-sea-naval-base/>>, accessed 10 October 2022.

113. On MPRI, see Steven Biddle, *Nonstate Warfare: The Military Methods of Guerrillas, Warlords, and Militias* (Princeton, NJ: Princeton University Press, 2021), p. 240. On Iran, see Farea Al-Muslimi, 'Iran's Role in Yemen Exaggerated, but Destructive', Century Foundation, 19 May 2017, <<https://tcf.org/content/report/irans-role-yemen-exaggerated-destructive/?agreed=1>>, accessed 10 July 2022.

114. Kaushal, 'Adoption Capacity Theory', pp. 30–41.

Exportable Lethality

As discussed in preceding sections, a diverse range of affordable effectors is critical to the functionality of an anti-access system. A range of capabilities such as UUVs and relatively low-cost missiles may be within reach of a number of states in terms of their unit costs, but not necessarily the process of developing them.

Given the emphasis on modular capabilities in the Royal Navy's Maritime Operating Concept, the goal of modularity can be twinned with exportability, with capabilities baselined on how easily they can fit within a partner's system of systems. In many ways the two aims are conterminous – modular systems are by definition capable of being easily integrated into existing architectures. The UK already produces effectors such as Brimstone which are, at least in terms of unit costs, within the reach of many prospective partners. Future work on autonomy might consider how a more diverse range of unmanned effectors – from attritable unmanned aircraft systems and loitering munitions to UUVs acting as smart mines – might be generated by the Navy as a prospective offer to partners.

The Royal Navy might consider how it can work both alone and through frameworks such as AUKUS to develop exportable lethality. It might, for example, widen participation in its autonomous accelerator programmes such as NavyX by creating an analogue to the US Navy 5th Fleet's Task Force 59, in conjunction with its AUKUS partners. The engagement of partners to develop these capabilities could both mitigate the costs of their development and enhance their strategic effect in areas where they are unlikely to be employed by the UK directly. This appears to be the approach of nations such as the US, which is directly incorporating Middle Eastern partners into the 5th Fleet's experimentation with autonomous capabilities. Task Force 59 will incorporate a number of regional partners such as the UAE, with the aim of generating a regional unmanned surface fleet.¹¹⁵ Expanding experimentation in areas such as lethal autonomous capabilities or future tactical fires has pitfalls, not least the fact that it would involve exposing sensitive information to nations that have working relationships with UK competitors. This being said, it also creates a framework for rapid capability adoption by both the UK and partners and creates a basis for removing hesitation to adopt novel capabilities by partners that may regard these assets as untested. Ultimately the triage between the benefits of partnering and concerns surrounding confidentiality will likely surround any effort at partnering – consider, for example, the potential for equipment compromise in the ongoing conflict in Ukraine.

Moreover, to the extent that present UK policy still precludes lethal autonomy, co-development of capabilities with partners more willing to countenance lethal autonomy could create the technical preconditions for its adoption in the UK, should policy shift – even if the assets developed were employed on more restrictive semi-autonomous protocols by the UK itself. There is good evidence to suggest that the co-development of capabilities with partners can provide substantial efficiencies in addition to the ability to influence events beyond the reach

115. Brad Cooper and Peter W Singer, 'Tests in Fifth Fleet a Bridge to the Future', *Proceedings* (Vol. 148, No. 6, June 2022).

of a nation's more direct instruments. To use an example, the intra-war work done by German shipbuilders for the Finnish submarine force helped Germany to retain the knowledge base needed to rebuild its own submarine fleet at scale when it decided to do so.¹¹⁶ Deep engagement can also afford a nation a level of privileged access to information that can be vital to future warfighting concepts. For example, US involvement with Israel's defence allowed senior figures such as General Donn Starry and Trevor Dupuy privileged access to the data gleaned from the Yom Kippur War, which played a major role in shaping the future AirLand Battle doctrine.¹¹⁷ There is, of course, a cost paid in terms of providing access to capabilities to nations beyond the UK's traditional circle of partners, but one might consider that the area of low-cost autonomous capability might in certain respects be less sensitive than some of the more exquisite capabilities fielded by the UK. Moreover, the strategic benefits of providing a capability to a partner may justify the informational risks – a calculus visible in the current Ukraine conflict.

Sensors, Networking and Integration

The physical capacity to operate a maritime ISR capability that enables the coordination of effectors is another potential area in which the Royal Navy could contribute to efforts to develop an anti-access capability. Any anti-access system is likely to be only as good as its ability to act as more than an agglomeration of parts. To operate sensors and effectors in a systematic manner requires a capacity for gathering, processing and disseminating data under information-denied conditions. For smaller nations, building networks that are resilient and can support the levels of data latency needed for military functions may entail external support. Most Russian surface-to-air missile and coastal defence cruise missile systems can also plug into fibre-optic networks using field cables, and China uses an extensive fibre-optic network to support the PLA Rocket Force, which controls the DF-21D, making fibre-optic networks a particularly appealing avenue. Iran has funded Hizbullah's fibre-optic cable, which has proven a vital asset with which the group has been able to coordinate command-and-control functions at all levels.¹¹⁸

Flexible and open architecture systems that can integrate data from heterogeneous assets through translation layers might be another area in which partners can add value. At an Alliance level, software systems such as Terma's BMD-Flex have served this function within NATO.¹¹⁹ Nations which need to integrate already heterogeneous capability suites along with new sources of data will require the software to perform a comparable task, though in multiple areas. Should the Royal Navy prioritise fielding open architecture software that can meet this requirement, this would likely have significant appeal to its potential partners.

116. Stoker, *Britain, France and the Naval Arms Trade*, p. 100.

117. Saul Bronfeld, 'Fighting Outnumbered: The Impact of the Yom Kippur War on the U.S. Army', *Journal of Military History* (Vol. 71, No. 2, April 2007), pp. 465–98.

118. Jacquelyn K Davis and Robert L Pfaltzgraff, *Anticipating a Nuclear Iran: Challenges for U.S. Security* (New York, NY: Columbia University Press, 2014), p. 69.

119. *Defense Daily*, 'Lockheed Martin, Terma AS's OA Effort Bringing BMD Capability to European Frigates', 14 January 2010, <<https://www.defensedaily.com/lockheed-martin-terma-ass-oa-effort-bringing-bmd-capability-to-european-frigates-2/international/>>, accessed 10 October 2022.

A third area in which the Royal Navy may present a distinct offer to partners is survivable sensors, particularly in the area of early warning. As discussed earlier, large, expensive early-warning systems on which many anti-access complexes depend may not be very survivable in the face of adversary overmatch. UK capabilities such as CROWSNEST are fit for partners that require mobility and a relatively compact platform.¹²⁰ Similarly, the SAMPSON could in principle function as a shore-based search radar, much as the AN/SPY-6. Experimentation with the integration of towed array sonar on a *Manta*-class extra-large uncrewed underwater vehicle has underscored the potential for distributed assets to feed into a nation's capacity for situational awareness. In effect, repurposing capabilities that the Royal Navy already fields or is likely to field in the foreseeable future for integration with anti-access networks could represent an avenue through which the Navy could reinforce local denial capabilities.¹²¹ The UK is a significant investor in areas like quantum computing and, through frameworks such as AUKUS, will see some multiplication of efforts with partners such as the US and Australia. The ability to disseminate the products of this effort to non-AUKUS partners without fatally compromising proprietary control over technology could be a unique offer that AUKUS members could make to the anti-access capabilities of partner states beyond the immediate framework. Furthermore, there is an additional advantage to the provision of network-related services, rather than effectors: because networks require sustained support, and likely retain some links to the systems of the supporting partner, they become a basis for long-term coordination. Consider, for example, the case of the US contribution to the UK's missile defence early-warning system.

Another way in which local efforts to assure sovereignty can be buttressed is through the integration of security-focused activities and those that are more defence-oriented. A case in point might be the generation of maritime domain awareness. In nations which use both civilian and military agencies in defensive roles (including countries like Vietnam), this requires the dissemination of data beyond the military. In principle, the Royal Navy could seek to expand partners' maritime domain awareness and their potential to integrate a wide range of assets into their command networks. It could, for example, seek participation in the Quad's maritime domain awareness initiative, or could engage partners on a bilateral basis.¹²² This is not an area in which most alternative partners enjoy an obvious advantage over the Royal Navy – quite the contrary, in fact. The Royal Navy already provides a digital backbone to support the efforts of external partner agencies at home through the Joint Maritime Security Centre.¹²³ It also has a

120. On CROWSNEST, see Lockheed Martin, 'Merlin HMM Mk2', <<https://www.lockheedmartin.com/en-gb/products/merlin-helicopter.html#:~:text=CROWSNEST%20uses%20a%20high%20power,surveillance%20for%20the%20entire%20fleet>>, accessed 10 October 2022.

121. *Navy Lookout*, 'Towed Array Sonar Integrated on Royal Navy Experimental Autonomous Submarine', 23 March 2022, <<https://www.navylookout.com/towed-array-sonar-integrated-with-royal-navy-experimental-autonomous-submarine/#:~:text=A%20lightweight%20towed%20array%20sonar,warfare%20and%20underwater%20surveillance%20capabilities>>, accessed 9 July 2022.

122. Zack Cooper and Gregory Polling, 'The Quad Goes to Sea', *War on the Rocks*, 24 May 2022, <<https://warontherocks.com/2022/05/the-quad-goes-to-sea/>>, accessed 10 July 2022.

123. Author interview with subject matter expert, London, 2 July 2022.

degree of experience in exporting this capability in contexts such as anti-piracy missions off the Gulf of Guinea.¹²⁴ To be sure, these contexts are not directly analogous to a combat scenario, but in principle, at least, some of the challenges involved in both moving data at scale and sharing it across a range of agencies (and possibly multiple nations) are challenges that the Royal Navy has engaged with.

Should the Royal Navy maintain a physical presence in the Indo-Pacific region, this force, even if limited, could feed into partners' situational awareness. There is precedent for nations enabling partner states in this manner – take, for example, the way in which the USSR both provided an air defence network to Vietnam during the Cold War and also used its own vessels operating out of Cam Ranh Bay to provide the Vietnamese with data in areas like SIGINT. More recently, one might consider the role of US intelligence during the Ukrainian conflict in supporting actions, including the sinking of the *Moskva*. It is to be presumed, however, that the presence of more exquisite naval assets in the Indo-Pacific will be intermittent, when they are regionally present.

Direct Contestation in the Grey Zone

A major source of imbalance in the force structures of some regional navies has been the need to compete in the grey zone. Though it has often been suggested that defensive architectures based on platforms and not systems are an optimal choice for powers facing the prospect of having to compete with a larger challenger, this has not led to the blanket adoption of these capabilities. Many regional powers such as Taiwan persist with the procurement of more expensive and visible assets such as the F-16 and the *Kang Ding*-class frigate, despite the questionable survivability of these assets in a highly asymmetrical conflict. This is not, however, a reflection of defence pathologies but rather a reflection of the fact that regional players need to balance preparations for a high-impact but relatively low-probability kinetic clash with the need for visible multi-mission platforms capable of performing tasks such as contesting maritime boundaries and air defence identification zones. To be sure, this is not the only reason behind larger procurement projects: countries that will themselves have substantial economic and military heft – such as Indonesia, which is projected to have a GDP comparable to Germany by 2035 – also have other reasons to seek the capacity for regional power projection and more balanced fleets. Nonetheless, for some nations, specifically the region's smaller actors, there are sharp trade-offs between presence and denial.

This represents an area in which the Royal Navy could, with a limited but persistently engaged force, constitute part of a solution to the conundrums faced by smaller actors. A force of several offshore patrol vessels or, in due course, Type 31 or 32 frigates permanently regionally stationed could not contribute to higher-end warfighting functions, but it could support functions comparable to those played by the US and Australian navies when they joined the Royal Malaysian Navy during a standoff with the PLAN and People's Armed Forces Maritime Militia in 2018. The scenarios envisioned are not expected to expand beyond the scope of a

124. NATO, 'West Africa/Gulf of Guinea', <<https://shipping.nato.int/nsc/operations/global-maritime-risk/west-africa-gulf-of-guinea>>, accessed 11 July 2022.

local standoff with, at most, the potential for very limited kinetic clashes, comparable in scale to the Sino-Vietnamese clashes over the Spratly Islands in 1988. The presence of the Royal Navy in these contexts could both complicate the political ramifications of grey-zone activity for an aggressor and, more importantly, reduce the requirement to develop multi-mission capabilities for local partners, thereby indirectly incentivising a shift to an A2/AD posture on their part, which will reinforce the defence-dominated Indo-Pacific environment. To be sure, this implies a level of political risk and, given vessel numbers, would almost certainly have to occur in a multilateral or minilateral context. However, this is also an area in which middle powers can offer something that the US cannot. One of the major challenges that emerged from the West Capella standoff was a perception on the part of Malaysian policymakers that US involvement made the situation more provocative to the PRC than they would have preferred it to be.¹²⁵ By contrast, middle powers, including extra-regional ones such as the UK and France, and regional powers such as India, Australia and possibly Japan, can much more readily support presence missions without situating that support within a wider bilateral confrontation.

The second area of sub-threshold competition in which the Royal Navy could play a more direct role is the provision of information. During the Cold War, architectures for the gathering of SIGINT and ELINT, along with, for example, hydrographic research, represented a distinct UK offer to partners and allies. Today, there are a number of areas in which the Navy can play an important role in gathering information. First, by virtue of their presence, forward-engaged forces such as the Royal Marines' planned SALT and MLAT teams can contribute to the creation of a strategic intelligence picture. This can be at the level of generating political understanding – for example, during the Vietnam War, US military advisers such as Lansdale often provided assessments of the internal dynamics of the country that were proven to be accurate in a number of key cases. In a society in which the military played an outsized role – something that is still true of a number of nations in the region – military points of contact tended to have more direct access to key decision-making nodes. Moreover, the physical gathering of data through activities such as hydrographic and oceanographic research can in a relatively unintrusive way provide partners with an asset that is critical to navigating any potential littoral battlespace. Properly equipped survey ships can also map other objects of interest, such as undersea cables, that are critical to sustaining military communications on island outposts.¹²⁶

125. Euan Graham, 'U.S. Naval Standoff with China Fails to Reassure Regional Allies', *Foreign Policy*, 4 May 2020, <<https://foreignpolicy.com/2020/05/04/malaysia-south-china-sea-us-navy-drillship-standoff/>>, accessed 10 October 2022.

126. It is for this reason that a number of oceanographic survey ships fielded by navies – the Russian research vessel *Yanatar*, for example – carry submersibles to survey cables. See H I Sutton, 'Russian Spy Ship Yanatar Loitering Near Trans-Atlantic Cables', *Naval News*, 19 August 2021, <<https://www.navalnews.com/naval-news/2021/08/russian-spy-ship-yantar-loitering-near-trans-atlantic-internet-cables/>>, accessed 10 October 2022. On the communications on China's island outposts, see J Michael Dahm, 'Inter-Island Communications', South China Sea Military Capability Series, Johns Hopkins Applied Physics Laboratory, 2020.

One might also consider the indirect impact that missions focused on building goodwill can produce in the context of an anti-access approach. It should not be forgotten that political circumstances are the first barrier to the effective employment of forces. Consider, for example, the operational impact of the Turkish government's decision to deny Incirlik to the US in the build-up to the Iraq War. Similarly, we might consider the impact that the denial of overflight rights to Russia had on its attempts to deploy troops to Pristina in 1999. The political conditions within states that dominate key chokepoints and overflight routes are shaped by a variety of factors, many of them beyond the remit of naval policy, including economic diplomacy and foreign policy more broadly defined; however, naval engagement in security beyond traditional defence can at least set the preconditions for subsequent engagement on other matters. It is worth noting, for example, that China's growing security engagement off the Horn of Africa began with counter-piracy deployments. Given the importance of factors such as piracy and illegal, unreported and unregulated fishing in the Indo-Pacific region, coordinated contributions to meeting these challenges by the UK and other middle powers such as Australia and Japan can serve as part of a wider attempt at outreach to states that straddle key maritime chokepoints. The subordination of security provision to a strategy of denial would entail a more focused and targeted emphasis on specific regional concerns – for example, counter-piracy in the Straits of Malacca – so that security aims can be supportive of defence goals rather than detracting from them.

III. Missions and Capability Requirements

A NUMBER OF THE considerations that are attendant on a strategy of denial are policy questions rather than naval ones per se. For example, the question of whether the objective of enablement can be made a core task of AUKUS is likely one to be decided at ministerial level. That being said, the Royal Navy could shape the discussion in several ways.

First, the Navy can study the potential of denial as a capstone concept for its Indo-Pacific engagement and, if it decides on this framework, outline the logic and potential of a strategy of denial to policymakers. It can develop a conceptual framework and attendant missions that it might play in the context of such an approach. Central to any approach would be the Navy's capacity for engagement. The envisioned incorporation of six- to 12-person SALT and MLAT teams within the order of battle of LRG South could be a step in this direction. As envisioned, MLAT teams would play a wider liaison role within the countries in which they are posted, while SALT teams are expected to provide a framework within which specialised support to partners can be offered. What these teams could in principle offer is a framework into which specialist expertise from both the wider Navy and joint force could be integrated as a situation dictates.

In order to meet this requirement, a number of key decisions will need to be made ahead of the mid-2020s. To begin with, given their limited numbers, SALT teams will need to engage partners sequentially rather than in parallel. Considerations of which partners to prioritise will need to be made. MLAT teams can abet this process by helping to assess, among other things, the demand signal from specific nations.

Second, an understanding of how long a team needs to be engaged in-country, and with which parts of a partner force it must interact, will be important – not least because these factors may vary by partner. For example, engaging a peer force like the Japanese Maritime Self-Defence Force would entail a very different set of requirements compared with providing support to a smaller partner.

Third, the question of how to build continuity despite relatively short deployment cycles will need to be addressed. Historically, advisory teams relied on contractors – often retired officers who retained the right of privileged access to information – in order to achieve this continuity. A contractor who can be posted to a country on a multi-year basis can serve as a hub for a team that rotates in and out of that country.

While an enablement-centric approach is not likely to be platform-dependent per se, the diplomatic preconditions for engagement are likely to depend both on persistent presence and on the episodic presence of the Royal Navy's more expensive platforms. There is a rich

body of empirical literature which suggests that, for example, the deployment of aircraft carriers is a strong predictor of levels of diplomatic engagement – independent of whether they are militarily committed to an area. This is effectively because their presence represents a significant signal of diplomatic intent, given the costs of deploying them. The Navy will thus need to consider how to balance the need for periodic deployments comparable to CSG21 with a broader European focus.

Finally, efforts to broaden the strategic offer of A2/AD with functions such as demonstrating presence, the gathering of intelligence and direct contestation in the grey zone will periodically draw on assets that are not likely to be deployed to the Indo-Pacific on a long-term basis. This in turn creates a capacity challenge, given that any long-range deployment will rupture maritime readiness. Episodic deployments comparable to CSG21 or the presence of SSNs in the Indo-Pacific will need to be balanced with pre-existing commitments.

Conclusion

IN THIS PAPER, the authors have noted and analysed the significance of the tilt in the UK defence posture towards the Indo-Pacific region as posited in the 2021 Integrated Review. The paper went on to match this signalling to the elements of the policy framework outlined in the Integrated Review's sister paper, the DSIS, and extrapolated the importance of an effective and targeted commercial–industrial strategy to the objective of a UK defence posture centred on the Indo-Pacific theatre. Moreover, there is the suggestion that this posture has to be anchored not just on British maritime capability, important though this is, but on a wider relationship of influence through UK-based defence exports, technology insertion and competency transfers. Such a stance also supports the UK policy imperative for prosperity at home, driving influence abroad. Indeed, this framework force of public–private components of capability, exchange and influence seems critical to the UK's tilt to the Indo-Pacific, but to the authors' knowledge it has not been explored previously.

In this manner, the Royal Navy can operate within its means, with partner forces in theatre, to maintain a regional security equilibrium by reinforcing and enhancing the capabilities and capacities of regional nations. Importantly, in this role it can offer regional powers a much-sought-after alternative to either subordination to Beijing or enlistment in a Sino-American competition. As a consequence of such an approach, combined and overlapping A2/AD bubbles of control can be generated to thwart, and thereby help to deter, the ambitions of the leaders of the PRC and PLAN.

Three significant factors emerge from the paper's analysis:

1. There is a continual and unrelenting need to focus on A2/AD capabilities in the region. The UK should be in the vanguard of nations committing to the development of enabling technologies and systems, integrated with extant and emerging capabilities across the region, in order to both defensively generate and (in limited localised contexts) offensively penetrate A2/AD bubbles.
2. Selecting the correct current and future technologies, processes and practices to sponsor, invest in and systematise across defence is a major challenge for all governments, and the UK is no exception. But it would be naïve to downplay the significance of technological maturation and exploitation to the notion of a framework force in the Indo-Pacific.
3. An effective and bespoke industrial and commercial strategy focused on the region and concept of operations is critical to the execution of this vision and, perhaps, the UK's post-Brexit role in the world and self-regard. Early 'buy-in' from onshore industries seems important, as does a commitment from government for significant investment in early-years TRL development.

There is much to ponder as the UK embarks on what is, in many ways, a new force posture and concept of operations in far-away seas, based on reach, endurance, sustainment and multi-partner and multi-sector cooperation. What is clear, though, is that the tilt to the Indo-Pacific resides in so much more than the *Queen Elizabeth*-class carriers, new fleet support vessels and CSG operations. If UK military leaders and analysts debate only high-profile operations, strategic failure is a probability. However, should the focus be on the multiple components of the enterprise and framework force proposition, with smart execution and political consistency, there is a chance of success.

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