

Emerging Technologies and the Future of Warfare: A Strategic Analysis for Naval Power in the Indian Ocean Region

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Abstract

The character of warfare is being reshaped by artificial intelligence, unmanned systems, and quantum computing at a pace that outstrips the doctrinal and institutional habits of most navies. This paper argues that technological change, geopolitical multiplexity, and institutional inertia together constitute the central strategic problem facing maritime forces in the Indian Ocean Region (IOR), and Pakistan in particular. Drawing on historical analogy, market data, and defence-innovation scholarship, the paper examines three interlocking dimensions of this problem: the technological imperative driving cognitive superiority, the geopolitical shift from unipolarity to multiplexity, and the institutional shift from capability acquisition to indigenous innovation. The paper concludes that naval power in the twenty-first century will be determined less by tonnage than by the speed of adaptation, and recommends a triple-helix innovation model linking the navy, academia, and industry.

Keywords: Emerging Technologies, Future of Warfare, Multiplexity, Indian Ocean Region, Defence Innovation Ecosystem

1. Introduction

Every generation of naval officers inherits a fleet built for the last war and is asked to fight the next one. Rarely has that gap between inherited capability and emerging threat been as wide as it is today. Artificial intelligence (AI), autonomous vehicles, quantum sensing, and networked commercial technologies are compressing decision cycles, dissolving the distinction between combatant and non-combatant technology, and redistributing power away from states that merely possess large arsenals toward states that can adapt them fastest. The question that animates this paper is not new in form but urgent in substance: does technology shape warfare, or does warfare shape technology? Roland (2009) frames this as a false binary, arguing that technology is timeless in its logic even as war reshapes the tempo of its adoption. Yet the practical consequence for a mid-sized maritime power such as Pakistan is the same regardless of which side of the debate one favours: nations that fail to internalise technological change are punished by history, and the punishment does not wait for philosophical resolution.

This paper develops a structured argument organised around three drivers of change: a technological driver, rooted in the compression of time and space, the rise of non-contact warfare, and the weaponisation of commercial innovation; a geopolitical driver, rooted in the transition from a bipolar or unipolar order to what academic strategic discourse increasingly calls “multiplexity”; and an institutional driver, rooted in the need to shift from reactive capability acquisition toward a genuine defence-innovation ecosystem. The paper argues that these three drivers are not independent variables but a single interlocking system: technological change creates the geopolitical volatility of contested maritime spaces such as the Indian Ocean, and that volatility, in turn, can only be managed by institutions capable of generating indigenous technological responses rather than importing them after the fact.

The remainder of the paper proceeds in three major sections, followed by a section on policy implications and a conclusion. The first section examines why technology has become the primary shaping force of contemporary military power. The second situates that technological shift within the geopolitical structure of the IOR. The third turns to the institutional and industrial reforms required for a resource-constrained navy to remain relevant. A closing section distils these arguments into concrete recommendations for naval and national policy.

The argument advanced here is deliberately cumulative rather than sequential. It would be a mistake to read the technological, geopolitical, and institutional drivers as three separate problems that a navy might address one at a time, in whatever order its budget cycle permits. Each driver conditions the other two. The pace of technological diffusion determines how quickly a regional rival can convert a commercial innovation into a maritime threat, which in turn determines how volatile the geopolitical environment becomes, which in turn determines how urgently institutions must be reformed to generate an indigenous response rather than wait for one to be imported. A navy that treats these as independent work streams, assigning technology to a research directorate, geopolitics to a strategy cell, and institutional reform to a procurement office, will find that none of the three problems is actually solved, because the solution to each depends on progress in the other two. This paper therefore treats the three drivers as a single system and asks, at each stage, what a resource-constrained navy operating in a multiplex Indian Ocean must do differently if it is to remain a relevant actor rather than a historical footnote.

2. Technological Imperative in Modern Warfare

The debate over whether technology drives strategy or strategy drives technology is often treated as an academic curiosity, but it carries direct operational consequences. Walton (2019) observes that military historians have generally been reluctant to treat technological determinism as a serious category of analysis, preferring to emphasise leadership, doctrine, and the human factor in war. Yet Walton also concedes that a plain reading of both military history and contemporary policy shows that warfighters and political leaders routinely behave as though technology were transformative in its own right. History supplies blunt illustrations of what happens when that behaviour is absent. The Lodhi dynasty was not deficient in courage, yet it could not withstand the gunpowder weapons Babur brought to Panipat. France in 1940 was not short of soldiers or equipment, yet it was overwhelmed by the German army's revolutionary application of air power and armoured manoeuvre rather than by any simple deficit in numbers. In both cases the losing side treated technology as a supplement to an existing way of war rather than as a force capable of rewriting the rules of that war altogether.

Contemporary strategic writing increasingly frames this dynamic through the lens of technological determinism, the idea that the pace and direction of innovation set the boundaries within which strategy and tactics must operate (Walton, 2019). The North Atlantic Treaty Organization has

institutionalised this view by identifying a specific category of ‘emerging and disruptive technologies,’ including AI, autonomous systems, biotechnology, and quantum technologies, as forces that are actively redefining the character of military power across all domains (NATO, 2025). Three drivers, in particular, distinguish this transformation from earlier waves of military-technical change. The first is the compression of time and space, a phenomenon McCauley (2025) describes as the expansion of the decision space available to commanders even as the physical time available to make decisions contracts, because sensors, networks, and machine-assisted analysis now generate actionable information at a tempo that human staff processes were never designed to match. The second is the rise of non-contact warfare, which Verma (2022) defines as a mode of conflict in which information dominance, precision strike, and stand-off capability allow a state to project power and achieve strategic effect without the traditional requirement of close, kinetic engagement between opposing forces. The third is the weaponisation of commercial innovation, a trend Rickli and Vllasi (2025) trace to the dual-use nature of many emerging technologies, in which civilian innovations developed for commercial markets are repurposed, often by non-state or asymmetric actors, into instruments of military and security risk.

The scale of investment behind this shift is itself instructive. A widely cited market analysis projects that the global market for artificial intelligence in military applications will grow from roughly nine billion dollars in 2023 to nearly thirty-nine billion dollars by 2028, a more than fourfold expansion within half a decade (Markets and Markets, as cited in PR Newswire, 2023). That growth is not simply a story about defence budgets; it is a story about what militaries believe they are buying, namely what Kolobara (2023) calls ‘cognitive superiority,’ the ability to observe, orient, decide, and act faster and more accurately than an adversary across a contested information environment. Kolobara (2023) argues that information operations have become a primary means by which states pursue this cognitive edge, because the side that processes and acts on information fastest gains a structural advantage even when its physical platforms are inferior in number or firepower. The implication for a navy operating with finite resources is stark: a fleet that does not accelerate its own decision loop through these technologies does not merely fall behind, it becomes a stationary target in an environment where speed itself has become a form of protection.

This transformation also reframes the object of military competition. Where earlier eras of great-power rivalry were organised around the control of territory, and the industrial era around the

control of production, the current era is increasingly organised around the control of data and the algorithms that convert that data into decisions. A navy that continues to measure its strength primarily in tonnage and hull count, while its rivals measure strength in sensor fusion, autonomous coordination, and machine-speed targeting, risks winning arguments about the past while losing engagements in the present. The lesson of Panipat and of 1940 is therefore not a historical curiosity but a live warning: technological adaptation is not an optional modernisation programme that can be deferred to a future budget cycle; it is, in Walton's (2019) terms, the deterministic floor beneath which strategy cannot operate no matter how skilled its practitioners.

It is worth pausing on why this floor is rising so quickly now rather than gradually, as earlier waves of military-technical change tended to do. The three drivers identified by Rickli and Vllasi (2025), McCauley (2025), and Verma (2022) share a common feature: each describes a mechanism by which civilian or commercial technology, rather than purpose-built military research, becomes the leading edge of military capability. Compression of time and space is driven as much by commercial satellite constellations and cloud computing as by dedicated military sensor networks. Non-contact warfare is enabled by precision-guidance components and commercial-grade drones that are often cheaper and more widely available than the platforms they threaten. The weaponisation of commercial innovation is, almost by definition, a story about technology developed for civilian markets being repurposed for military or asymmetric ends. This matters strategically because it changes who the relevant competitors are. A navy no longer needs to out-innovate only the defence-industrial base of a rival state; it must out-innovate a much larger, faster-moving global commercial technology sector that neither side fully controls. Under these conditions, the advantage accrues not to the actor with the largest defence budget in isolation, but to the actor whose institutions can most quickly absorb commercial innovation and adapt it to a military purpose, which is precisely the cognitive-superiority race that Kolobara (2023) describes.

3. Geopolitical Multiplexity and the Maritime Strategic Environment

Technological change does not occur in a geopolitical vacuum, and nowhere is that clearer than in the IOR, which has become one of the most volatile proving grounds for exactly the emerging technologies discussed above. Part of the explanation lies in the changing structure of the international system itself. The Cold War's bipolar order and the brief unipolar moment that

followed it have given way to what regional strategic literature terms ‘multiplexity,’ a global order composed of multiple, overlapping layers of power that cannot be adequately described by the older vocabulary of poles and blocs. Mills (2023) captures a closely related idea in describing the current period as an ‘era of persistent competition,’ in which state and non-state actors contest advantage continuously across military, economic, and technological domains rather than through discrete, bounded conflicts. In such an environment, no single power, however dominant, can unilaterally guarantee the security of a shared maritime space, and the IOR has become simultaneously an arena of great-power competition and a theatre crowded with assertive regional actors pursuing their own expansionist agendas.

For a middle power such as Pakistan, this shift has direct doctrinal consequences. The traditional posture of classical non-alignment, which assumed that a state could remain equidistant from competing blocs, is a poor fit for a multiplex order in which the blocs themselves are fluid and issue-specific. Friedman and Starr (1997) define agency as the capacity of an actor to bring about change in the world rather than merely to absorb the changes imposed by others, and it is precisely this exercise of agency that a strategy of multi-issue alignment and strategic minilateralism is designed to preserve. Rather than seeking a single, comprehensive alliance, a multiplex strategy builds flexible, interest-based partnerships that can be assembled and reconfigured issue by issue, whether the issue in question is maritime security, technology transfer, or counter-piracy cooperation. This is not, as critics sometimes suggest, evidence of strategic hedging or weakness; it is, on the contrary, the most realistic available expression of agency for a state that cannot dictate the structure of the system in which it operates.

The economic stakes attached to this maritime space are difficult to overstate. Global maritime transport carries more than eighty percent of world trade by volume, and nearly a third of the world's total maritime trade volume passes through the Indian Ocean (UNCTAD, 2024). Any significant disruption to the technological or security architecture of this space is therefore not a narrowly military concern but a matter of global economic consequence, since a single contested chokepoint or a sustained campaign against shipping can raise costs and reroute trade flows far beyond the region itself. This is why what might be called ‘algorithm diplomacy,’ the contest over data flows and the undersea cable networks that carry them, is beginning to rival control of physical sea lanes as a strategic priority. Digital infrastructure beneath the ocean's surface is now as vital to

national security as the surface fleets that patrol above it, yet it receives a fraction of the doctrinal attention.

The asymmetric character of contemporary maritime threats sharpens this concern further. The Indian Ocean and adjacent waters have seen a marked rise in what analysts describe as maritime grey-zone warfare, in which non-state or state-aligned actors employ inexpensive, commercially available systems to threaten platforms worth orders of magnitude more. Seligman and Berg (2023) document one especially stark illustration of this asymmetry from the Red Sea, reporting that Pentagon officials grew alarmed at the ‘cost-exchange ratio’ involved in defending against Houthi drone attacks, since warships valued in the billions of dollars were being defended using interceptor missiles costing well over two million dollars apiece against drones that could be procured for as little as two thousand dollars. That imbalance illustrates a broader strategic truth: a navy that invests only in expensive, exquisite platforms without a parallel investment in low-cost countermeasures is building an economically unsustainable form of defence, regardless of how technically capable that defence may be in any single engagement. The uncomfortable question this raises for planners is why so much investment continues to flow toward visible, symbolic shields when adversaries are quietly perfecting invisible, asymmetric swords. A strategy that is not grounded in an honest accounting of this cost asymmetry risks becoming what earlier remarks on this subject called a nightmare of technology without strategy, just as a strategy unsupported by technological investment remains merely a dream.

The geopolitical and technological drivers examined so far converge most visibly at maritime chokepoints and along undersea infrastructure corridors, where the volume of trade described by UNCTAD (2024) intersects with the asymmetric threat environment described by Seligman and Berg (2023). A single successful attack on a high-value vessel transiting a strait, even one that inflicts limited physical damage, can generate insurance and routing effects that ripple through global supply chains far in excess of the direct military cost of the incident. This is the sense in which the earlier remarks framed the sea as simultaneously wide, deep, and dangerous: its danger is no longer confined to state-on-state naval engagement but extends to a diffuse set of low-cost, high-leverage threats that a purely platform-centric navy is poorly configured to deter. Mills's (2023) description of persistent competition captures this diffusion well, because grey-zone activity by its nature avoids the clear thresholds of declared conflict that traditional deterrence

theory assumes, forcing navies to defend continuously against actions that never quite cross the line into open war. Planning for this environment therefore requires navies to hold two capabilities simultaneously: the traditional capacity to deter and, if necessary, defeat conventional state adversaries, and a newer capacity to absorb, attribute, and respond to a constant low-intensity stream of grey-zone provocations without exhausting resources built for the former on the latter.

4. Institutional Innovation and the Indigenous Defence Ecosystem

If the technological and geopolitical drivers described above define the problem, the institutional response defines whether that problem can be managed. For a navy operating in a multiplex, technologically volatile environment, the central challenge is not simply acquiring new capability but changing the cognitive habits of the institutions responsible for generating that capability. This requires a deliberate shift from a posture of crisis management, in which new threats are answered reactively as they appear, toward one of strategic foresight, in which institutions anticipate and shape the technological landscape before a crisis forces their hand. The distinction matters because the innovation cycles that now define military-relevant technology, particularly software and autonomous systems, move far faster than the acquisition cycles built for an earlier, hardware-centric era of defence procurement.

This distinction between crisis management and strategic foresight is not merely rhetorical. A navy operating in crisis-management mode allocates its scarce research and development budget in response to the most recently observed threat, which guarantees that its innovation programme is always calibrated to yesterday's problem. A navy operating in strategic-foresight mode instead allocates a portion of that budget to technologies whose military relevance is not yet fully proven, accepting a higher rate of programme failure in exchange for a chance of identifying the next generation of capability before an adversary does. Given the pace of change documented throughout the technological and geopolitical drivers examined above, a purely reactive posture is no longer merely inefficient; it is a standing invitation to strategic surprise.

A central obstacle to this shift is the continued status of many resource-constrained navies as consumers rather than creators of technology. Kotila (2023) argues that overcoming this dependency requires the deliberate construction of a defence-innovation ecosystem, a networked set of institutional relationships that can translate emerging research into fielded capability far

more quickly than traditional, linear procurement pipelines allow. One widely referenced model for building such an ecosystem is the ‘triple helix,’ which describes the structured synergy between three previously siloed communities: military requirements generators, academic and scientific researchers, and industrial producers. When these three communities interact continuously, rather than sequentially, innovation cycles compress from years to months, because research questions are shaped by operational need from the outset rather than being translated into requirements only after a technology has already matured elsewhere.

The urgency of building such an ecosystem is visible in the trajectory of specific technology sectors relevant to naval operations. The global fleet of unmanned surface vessels is projected to grow at a compound annual growth rate of nearly fourteen percent through 2030 (Mordor Intelligence, 2025), a rate of expansion that reflects growing confidence, across multiple navies, that autonomous surface platforms can deliver persistent presence and sensing capability at a fraction of the acquisition and operating cost of crewed vessels. For a navy operating under real fiscal constraints, this ‘force multiplier’ effect is not a marginal efficiency gain but a structural opportunity to extend maritime coverage without a proportional increase in personnel or platform cost. Realising that opportunity, however, depends on the institutional capacity to design, test, and integrate autonomous systems domestically rather than purchasing them, at a premium and with attached dependencies, from external suppliers.

This points to a second, closely related institutional shift: the move beyond what might be called ‘tyre and tube’ indigenisation, in which local industry is limited to assembling or maintaining components designed elsewhere, toward what Soare, Singh, and Nouwens (2023) describe as software-defined defence, in which the operational value of a modern platform increasingly resides in its code and algorithms rather than in its steel hull or hardware alone. Under a software-defined model, a warship's capability can be upgraded, reconfigured, and extended through iterative software releases long after its hull has been built, in much the same way that commercial technology firms continuously update products already in the hands of users. Achieving this requires deliberately incentivising local technology firms, many of which have no prior defence experience, to pivot toward maritime and defence applications, and it requires procurement institutions willing to accept the shorter, more iterative development cycles, often measured in months rather than years, that characterise the wider technology sector. An acquisition system built

for decade-long hardware programmes cannot absorb software-defined capability at the pace its adversaries are fielding it, and the resulting mismatch between institutional tempo and technological tempo is, in itself, a strategic vulnerability.

The triple-helix model advocated by Kotila (2023) offers a practical template for closing this tempo gap, but only if each of its three participants is given a genuine stake in the outcome rather than a purely advisory role. Naval requirements-generation offices must be willing to share early, unclassified problem statements with universities and firms rather than waiting until a requirement has already hardened into a fixed specification, since much of the value of academic and industrial input lies precisely in shaping the problem before it is locked in. Universities, for their part, must be incentivised to treat maritime and defence-adjacent research as a legitimate and fundable line of inquiry rather than a peripheral activity subordinate to purely civilian research agendas. Domestic firms, particularly smaller technology companies without prior defence experience, need predictable, transparent pathways into naval procurement, since the uncertainty and long timelines associated with conventional defence contracting deter exactly the kind of agile firms best positioned to deliver software-defined capability. None of this requires abandoning larger, traditional acquisition programmes for major platforms; it requires running a second, faster institutional track alongside them, one calibrated to the innovation tempo that Mordor Intelligence's (2025) projected growth in unmanned surface vessels and Soare et al.'s (2023) account of software-defined defence both imply is now the pace of the field.

5. Policy Implications and Strategic Recommendations

Taken together, the technological, geopolitical, and institutional dimensions examined above point toward a coherent set of policy priorities for a navy such as Pakistan's operating in the IOR. First, doctrine and training should be explicitly organised around the pursuit of cognitive superiority rather than platform superiority alone, given Kolobara's (2023) argument that the speed and accuracy of decision-making, not merely the quality of individual platforms, increasingly determines outcomes in contested environments. This implies sustained investment in the sensor fusion, data architecture, and artificial-intelligence-enabled decision support tools that allow commanders to compress their own observe-orient-decide-act cycle relative to an adversary's.

Second, strategic partnerships should be pursued on the flexible, issue-specific basis implied by multi-issue alignment rather than through attempts to revive a comprehensive non-alignment posture that no longer matches the multiplex structure of regional competition (Mills, 2023). This means building minilateral arrangements around discrete shared interests, such as undersea cable security, counter-piracy cooperation, or technology-sharing agreements, that can be adjusted as the underlying geopolitical configuration shifts, without requiring a single overarching alliance commitment.

Third, given the stark cost asymmetries documented by Seligman and Berg (2023) in the Red Sea theatre, investment should be rebalanced toward low-cost, layered countermeasures against inexpensive threats such as drones and unmanned surface systems, rather than relying solely on high-value interceptor systems whose per-unit cost makes sustained defence economically unsustainable. Fourth, and most fundamentally, the navy should accelerate its institutionalisation of the triple-helix model advocated by Kotila (2023), formally linking naval research requirements with university research programmes and domestic technology firms, so that innovations such as unmanned surface vessels and software-defined systems can be developed indigenously rather than imported after adversaries have already fielded comparable capability. Procurement regulations should be revised specifically to permit the shorter, iterative acquisition cycles that software-defined defence, as described by Soare et al. (2023), requires, even where this means departing from acquisition norms designed for traditional hardware programmes.

Fifth, given the projected expansion of the unmanned surface vessel sector documented by Mordor Intelligence (2025), naval planners should treat autonomous platforms not as a supplementary experiment running alongside conventional fleet modernisation but as a core pillar of force structure planning for the next decade, with acquisition, training, and doctrine developed in parallel rather than sequentially. Sixth, because the weaponisation of commercial innovation identified by Rickli and Vllasi (2025) means that many future threats will originate outside traditional defence-industrial channels altogether, naval intelligence and requirements staff should maintain standing engagement with the domestic commercial technology sector, monitoring dual-use innovations for both offensive potentials in the hands of adversaries and defensive potential in the hands of the navy itself. None of these six recommendations is individually sufficient. Their value lies in being pursued together, since a navy that adopts a triple-helix innovation model without also rebalancing

its investment toward low-cost countermeasures, or one that pursues cognitive superiority without a corresponding minilateral partnership strategy, will address only one face of a problem that, as this paper has argued throughout, is fundamentally interconnected.

6. Conclusion

This paper has argued that the future of warfare in the IOR will be shaped less by any single weapons system than by the interaction of three forces: a technological imperative that rewards speed of adaptation over size of arsenal, a geopolitical shift toward multiplexity that rewards flexible, issue-based agency over rigid alignment, and an institutional imperative that rewards indigenous innovation over dependent consumption. History offers a consistent warning about what happens when any one of these forces is ignored. The Lodhi dynasty's defeat and France's collapse in 1940 were not failures of courage but failures of technological adaptation (Roland, 2009; Walton, 2019), and the same underlying dynamic now operates at machine speed rather than at the pace of muskets or tanks. The Indian Ocean's centrality to global trade (UNCTAD, 2024) and the documented cost asymmetries already visible in contemporary grey-zone conflict (Seligman & Berg, 2023) suggest that the region will continue to serve as a proving ground for exactly the technologies discussed throughout this paper.

The path forward is neither purely technological nor purely doctrinal; it is institutional. A navy that builds a genuine defence-innovation ecosystem, in the sense described by Kotila (2023), linking military requirements, academic research, and industrial production through a triple-helix model, converts external technological volatility into a source of domestic strategic advantage rather than a source of permanent vulnerability. As Singer (2009) observed in his study of military robotics, technology may change the rules of the game, but it is the capacity of institutions to adapt their thinking, not the technology itself, that ultimately determines the victor. For Pakistan's navy, and for comparable middle powers navigating a multiplex Indian Ocean, that adaptive capacity, more than any single platform or partnership, will determine whether the coming decades are shaped by strategic foresight or absorbed by strategic surprise.

None of the drivers examined in this paper will resolve themselves on a convenient timetable. The market for military artificial intelligence will continue to expand regardless of whether any particular navy chooses to participate in shaping its direction (Markets and Markets, as cited in PR

Newsire, 2023), the Indian Ocean will remain the conduit for the majority of global seaborne trade regardless of whether its security architecture keeps pace with that responsibility (UNCTAD, 2024), and commercial innovation will continue to be weaponised by actors who feel no obligation to wait for defence institutions to modernise their procurement rules (Rickli & Vllasi, 2025). What remains within the control of naval and national leadership is the speed and coherence of the institutional response? A navy that treats indigenous innovation, flexible geopolitical alignment, and machine-speed decision-making as three components of a single strategic project, rather than as three separate agenda items competing for the same limited budget, gives itself the best available chance of shaping the future of warfare rather than merely surviving it.

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