EDUCATING NAVAL LEADERS FOR THE AGE OF ARTIFICIAL INTELLIGENCE: PEDAGOGICAL APPROACHES TO HUMAN-AI DECISION-MAKING IN MILITARY EDUCATION

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Abstract

Artificial Intelligence (AI) is transforming the operational environment of modern armed forces by accelerating information processing, expanding situational awareness, and supporting complex decision-making processes. However, while technological capabilities continue to evolve rapidly, the fundamental challenge lies in preparing future leaders to integrate algorithmic outputs with human judgment, ethical responsibility, and mission command principles. This paper explores the pedagogical implications of educating naval officers for leadership in AI-augmented operational environments. Drawing on contemporary literature in leadership, human-AI collaboration, and military decision-making, the study examines how traditional command philosophy, particularly Mission Command and the OODA (Observe-Orient-Decide-Act) cycle, must be reinterpreted within a socio-technical system where humans and intelligent systems interact continuously. The paper argues that the core challenge of leadership in the AI era is not technological adoption itself but the development of critical competencies that allow leaders to supervise, question, and appropriately integrate algorithmic recommendations into operational decision-making.

From an educational perspective, the article proposes a pedagogical framework aimed at developing what may be termed the "Human Dividend": the strategic advantage that emerges when advanced technologies are combined with superior ~~behavioral~~behavioural competencies such as ethical judgment, trust management, critical thinking, and psychological safety within teams. The framework emphasizes the importance of AI literacy, trust calibration between humans and intelligent systems, and the preservation of human accountability in high-stakes environments.

The paper further discusses how military higher education institutions can incorporate these competencies into leadership curricula through scenario-based learning, decision simulations, and reflective training focused on human-machine collaboration. By repositioning leadership education as a key enabler of responsible AI integration, the study highlights the role of pedagogical innovation in preparing officers capable of navigating complex operational environments shaped by artificial intelligence.

Keywords: Artificial Intelligence, Human-AI Collaboration, Leadership Development, Military Education, Experiential Learning, Decision-Making, Human Dividend Framework.

Comentado [S1]: Não deveria existir uma referência à metodologia, seja um capítulo independente ou um parágrafo na introdução

1 INTRODUCTION

The increasing incorporation of Artificial Intelligence (AI) into military operations represents more than a mere technological upgrade; it signifies a structural transformation in command and authority [1]. As algorithms begin to generate tactical recommendations, prioritise targets, and anticipate complex scenarios, a fundamental question emerges: who retains ultimate decision-making power when the machine suggests and the human executes? In a naval environment, characterised by high systemic complexity and extreme temporal pressure, this tension is not merely theoretical but profoundly operational [1].

AI has consolidated itself as the central engine of the Fourth Industrial Revolution, acting as a "meta-technology" with a unique capacity to drive innovation across multiple domains [2]. While these systems significantly enhance observation and orientation capabilities, informational acceleration does not necessarily translate into strategic clarification [1]. On the contrary, an excess of data may obscure original intent, induce overconfidence in automated systems—leading to automation bias—and weaken the critical scrutiny essential for high-stakes leadership [3].

Despite the promises of technological efficiency, approximately 70% of implementation challenges in AI-augmented organisations are related to people and processes rather than technical failures [4]. This gap highlights a strategic paradox: while AI permeates all levels of decision-making, there is often a lack of formal responsibility for its orchestration [2]. In this context, the strategic differential of leadership shifts toward "messy human" elements: building trust under uncertainty and creating psychological safety amidst chaos [5]. Traditional command and control doctrines are becoming obsolete, requiring leaders to transition from the role of a "Chess Master" to that of an "Orchestra Conductor", creating the conditions for human-machine harmony.

Comentado [S2]: substituir por:
non-technical human factors

This paper argues that operational superiority in the AI era results not from delegating judgment to algorithms, but from their critical integration through what is termed by Soares as the "Human Dividend" [1]. This dividend emerges when advanced technology is combined with superior behavioural competencies such as ethical judgment, trust management, and critical thinking [6]. Warfare remains a human phenomenon, marked by friction and a clash of wills; therefore, strategic decision-making continues to demand prudential judgment and moral responsibility – dimensions that no algorithm can fully replace in the exercise of command [1, 7].

From an educational perspective, military higher education institutions must evolve their curricula to foster "AI-oriented leadership" [8]. This involves a pedagogical shift toward developing what we define as the strategic advantage of human agency: the capacity to maintain accountability and initiative within a socio-technical system where humans and intelligent systems interact continuously [1]. The following sections will explore a pedagogical framework aimed at developing these critical competencies, ensuring that naval officers are prepared to navigate the uncertainty of AI-augmented operational environments.

2 CONCEPTUAL FRAMEWORK: META-TECHNOLOGY AND THE LEADERSHIP PARADOX

Artificial Intelligence (AI) has established itself as the core engine of the Fourth Industrial Revolution, serving not merely as a tool but as a transformative meta-technology capable of driving innovation across unprecedented domains [2]. This technology expands the boundaries of digital delegation and automation, increasing human productivity and creativity on a global scale. However, its integration into military and naval organisations has generated a critical strategic paradox: while AI permeates all levels of operation and decision-making, there is frequently a lack of formal responsibility for its strategic orchestration. This leadership vacuum necessitates a new executive mindset where AI is managed as a strategic and ethical asset rather than a simple extension of information systems [2].

In a reality where AI increasingly absorbs routine expertise, pure technical skills are becoming commodities [1]. Consequently, the strategic differential of leadership shifts toward the "messy human" elements: the ability to build trust under uncertainty and foster psychological safety amidst chaos [5]. Modern leadership emerges from a synthesis between human agency – anchored in intuition, ethics, and empathy – and AI agency, which provides autonomous processing, execution, and optimisation capabilities. This hybridity requires a transition in command philosophy; the leader must move away from the "Chess Master" model of total control toward the role of an "Orchestra Conductor", orchestrating the collaboration between human and machine outputs [5].

The reality of organisational implementation remains challenging, with approximately 74% of enterprises struggling to obtain tangible value from their AI investments [4]. Research indicates that failures rarely stem from technical inadequacies but from a disconnect between technological capacity and organisational readiness, with 70% of challenges related to people and processes. To mitigate this, leaders should adopt the "10-20-70 Rule": allocating 10% of resources to algorithms, 20% to data infrastructure, and a decisive 70% to the development of people, human capital, and the redesign of workflows [1; 4].

Contrary to the myth of technical neutrality, emotions constitute fundamental strategic assets in this augmented era [6]. Neuroscience confirms that emotions are the scaffolding for reasoning, ethical judgment, and trust – the very elements that generate the "Human Dividend". This represents a new Return on AI Investment (ROI²), where long-term competitive advantage depends on maintaining human flows of empathy and creativity that machines cannot replicate [6].

For the Naval Officer, AI directly challenges the philosophy of “Mission Command”, which relies on decentralisation and initiative [9]. The omniscient surveillance potential of AI might tempt senior

commanders toward tactical micromanagement, potentially stifling the agility required in complex maritime operations [10]. This tension between centralised surveillance and decentralised autonomy requires officers to develop deep AI literacy to dynamically modulate their command styles, ensuring that the "human spirit" remains the decisive factor in the face of technical failure or extreme pressure [1; 10].

Comentado [S3]: considerer substituir por: *human judgment remains the decisional authority under uncertainty*

3 NAVIGATING BETWEEN AUTOMATION AND HUMAN JUDGMENT: THE AUGMENTED OODA LOOP

The integration of AI into the military sphere is not merely a technical improvement; it represents a fundamental reconfiguration of Command and Control (C2). The modern officer must evolve from a task manager into an organisational architect, redesigning processes to unlock the real value of technology for mission accomplishment. This architecture is most visible in the reinterpretation of the OODA Loop, where AI acts as a catalyst in each stage:

- **Observe:** Intelligence, Surveillance, and Reconnaissance (ISR) systems generate a density of information that exceeds human capacity, requiring AI to filter and prioritise data flows.
- **Orient:** AI assists in making sense of data by highlighting correlations and assessing risks, although the officer must ensure that algorithmic models do not promote narrow interpretations based solely on historical data.
- **Decide:** Decision support tools allow for the evaluation of multiple courses of action (COAs) in record time, but the leader must guard against *automation bias*, where subordinates accept algorithmic suggestions without critical scrutiny.
- **Act:** Execution is accelerated by autonomous systems, yet this speed requires human authority to retain "abort criteria" and ethical supervision.

Comentado [S4]: COA

While AI accelerates the cycle, a doctrinal boundary must be maintained: AI agents should ideally be limited to the first two phases – Observe and Orient – while Deciding and Acting remain human prerogatives. This delimitation is not technological but ethical, as the responsibility of command is non-transferable. Each phase introduces specific tactical risks that the leader must manage, as detailed in Table 1:

Table 1 - Tactical risk of the OODA loop with AI. Adapted from Raska [11].

OODA PHASE	AI IMPACT	OFFICER RESPONSIBILITY	TACTICAL RISK
OBSERVE	Real-time multispectral data fusion.	Define relevance and information priority.	Data saturation and cognitive fatigue.
ORIENT	Predictive analysis and anomaly detection.	Contextualise data with strategic/moral intent.	Algorithmic bias and "black box" opacity.
DECIDE	Recommendation of multiple COAs.	Final selection based on ethics and prudence.	Automation bias (blind trust).
ACT	Accelerated execution by autonomous systems.	Continuous supervision and abort authority.	Diffusion of responsibility for system errors.

Comentado [S5]: COA

Modern command architecture evolves towards the orchestration of multiple autonomous systems, where the officer manages not only people but "fleets" of technological agents. In this context, command becomes the orchestration of human-machine teams, demanding profound AI literacy to know when to trust, when to challenge, and when to ignore system outputs. Failure to maintain transparency in this process risks creating a diffusion of responsibility where no one assumes the error, compromising the inalienable nature of military command.

4 THE "HUMAN DIVIDEND" AND THE ORCHESTRATION OF THE AUGMENTED SHIP

As technical skills and data processing capabilities become increasingly accessible commodities, the strategic differential of the naval officer shifts toward exclusively human elements. In an environment where AI can automate diagnostics and information analysis, leadership must focus on creating psychological safety within a context of technological chaos. If AI is considered the engine, behavioural leadership serves as the driver that determines the direction and the reason why the journey matters.

4.1 The "Two-Leader Situation" and Trust Management

The introduction of autonomous systems creates what is known as a "two-leader situation," where subordinates find themselves caught between the directives of a human leader and the recommendations of an agentic element. This dynamic generates three critical areas of friction:

- **Blurring of Responsibilities:** Ambiguity regarding who holds the decision when an error occurs during human-machine interaction. Legal and moral responsibility cannot be delegated to an agentic element; the Officer of the Watch remains accountable even when following AI recommendations.
- **Decision Conflicts:** In high-risk situations, humans may show an increasing inclination to follow algorithms over human orders, putting extreme pressure on the officer's credibility.
- **The "Unheard Voice":** The risk of the officer and the AI converging on a decision while ignoring the specific context sensed by the sailor on the ground, which can be perceived as a disrespect for human experience and undermine team cohesion.

4.2 Performance vs. Trust

In an AI-augmented Navy, there is a strong temptation to evaluate personnel solely through automated technical performance metrics. However, lessons from elite units like the Navy SEALs demonstrate that trust is the "cement" that holds a unit together under operational pressure:

- **Performance:** Technical competence in task fulfilment.
- **Trust:** The certainty that an individual "has one's back" and acts with integrity.

Operational readiness must prioritise character and integrity; a highly skilled specialist empowered by AI who does not inspire trust becomes a toxic element to the ship's morale. Behavioural integrity constitutes the normative foundation of command authority, ensuring coherence between intention and action in technologically mediated environments.

4.3 Defining the Human Dividend

The Human Dividend is the incremental strategic return emerging from the deliberate integration of advanced technology with superior behavioural competencies. It translates into sustained trust, cohesion, and quality of judgment under pressure. This construct rests on four operational pillars:

1. **Critical AI Literacy:** The ability to interpret and challenge algorithmic outputs.
2. **Inalienable Ethical Responsibility:** Maintaining moral accountability in the exercise of command.
3. **Psychological Safety:** Creating a climate that allows for upward scrutiny and questioning of systems.
4. **Advanced Emotional Skills:** Cultivating "Behavioural Superpowers" such as radical empathy, critical curiosity, and constructive discomfort.

By investing in these human-centric capabilities, the naval force mitigates *automation bias* and preserves initiative in data-saturated environments, converting technological superiority into a sustainable operational advantage.

Comentado [S6]: será uma designação que decorre da literature?
Caso não seja, poderá adotar-se:
behavioural advanced competencies
OU
advanced socio-cognitive competencies

5 PEDAGOGICAL FRAMEWORK: EDUCATING NAVAL LEADERS FOR AI INTEGRATION

The transition to an AI-augmented operational environment requires military higher education institutions to move beyond traditional digital literacy. Instead, the focus must shift toward developing Dynamic Managerial Capabilities (DMC), which allow officers to align human and technological resources with evolving mission objectives. This pedagogical shift is anchored in three critical processes: Sensing (identifying emerging threats), Seizing (mobilising systems for tactical advantage), and Reconfiguring (redesigning workflows to prevent organizational friction).

To address the challenge of preparing officers for hybrid operational contexts, this paper proposes a pedagogical model conceptualised as the Human Dividend Framework. This model emphasizes that AI systems amplify – rather than replace – leaders who possess specific cognitive and behavioural skills. The framework identifies five interrelated competencies that leadership education programmes should cultivate, as illustrated in Figure 1.

Figure 1 - The Human Dividend Framework: Core cognitive and behavioural competencies for effective leadership in AI-augmented environments

5.1 Implementing the 10-20-70 Instructional Rule

To mirror the organizational requirements of AI success, the pedagogical approach adopts the 10-20-70 Rule. While students must understand the 10% (algorithmic logic) and the 20% (data infrastructure), 70% of the educational effort must be dedicated to the development of human capital and cultural readiness. This ensures that technology amplifies human judgment rather than replacing it.

5.2 Scenario-Based Learning and Decision Simulations

To cultivate the "Human Dividend", naval education must incorporate Scenario-Based Learning (SBL) and high-fidelity simulations. These exercises should specifically target:

- Trust Calibration: Training officers to adjust their dependence on automated systems dynamically, avoiding both blind trust and systemic rejection.
- The "Two-Leader" Conflict: Simulating environments where AI recommendations contradict human tactical sensing, forcing students to adjudicate and assume accountability.

- Speed Bumps in Planning: Introducing "speed bumps" in creative processes to prevent the "labour leads to love" erosion, ensuring teams remain committed to critical analysis rather than instantly accepting AI-generated plans.

5.3 Combatting Deskilling through "Degraded Mode" Training

A primary pedagogical concern is the risk of deskilling—the loss of fundamental professional skills due to automation. Military education must implement regular "degraded mode" drills where students are forced to operate manually (e.g., celestial navigation practice or manual propulsion control exercises) when digital systems are simulated as compromised or offline. This reinforces the principle that the human officer is the decisive factor when technical systems fail.

5.4 Fostering "Voice Behaviour" and Psychological Safety

Pedagogy must empower junior officers to exercise "Voice Behaviour", as the ability to question AI outputs or report system anomalies without fear of hierarchical censure. Simulations should include scenarios where an algorithm provides an unethical or flawed course of action (COA), rewarding students who demonstrate "Critical Curiosity" and "Constructive Discomfort" by challenging the system.

By repositioning leadership education as an orchestrator of hybrid teams, institutions can ensure that the next generation of officers possesses the maturity to manage the opacity of algorithms while preserving the moral and strategic integrity of the naval mission.

6 DISCUSSION: ETHICS, GOVERNANCE, AND CHANGE MANAGEMENT

The implementation of AI in a naval context is not a fragmented responsibility; it is an executive function that must permeate all levels of command. To ensure that technology aligns with the mission without compromising moral integrity, the discussion must focus on governance and the human-centric management of change.

6.1 The Role of the Commander as an AI Orchestrator

Given that AI is a meta-technology, its management cannot be relegated to technical departments. Commanders must assume roles analogous to a "Chief AI Officer" (CAIO) at sea, orchestrating five strategic dimensions:

- **Operational Value Creation:** Identifying specific areas where AI generates excellence versus where human control is essential.
- **Strategy and Vision:** Aligning AI capabilities with the long-term objectives of the mission.
- **Transversal Integration:** Breaking down departmental silos to ensure a seamless flow of data.
- **Leadership in Change:** Preparing the crew for a culture of collaborative intelligence.
- **Governance and Risk:** Managing the opacity of algorithms to guarantee ethical decisions.

6.2 Ethical Supervision and the "Speed Bump" Strategy

A significant risk in AI-augmented environments is the erosion of human commitment to the planning process. The ease of generating instant plans can lead to a lack of ownership and critical scrutiny. Leaders must intentionally introduce "speed bumps" in creative and planning cycles to prevent the "labour leads to love" phenomenon from fading, ensuring that the team values the effort of critical analysis over algorithmic convenience. In routine planning, teams should be encouraged to debate alternatives before approving an AI-suggested solution, reserving instant execution for genuine emergencies.

6.3 Managing the "Two-Leader" Ethical Friction

The "two-leader situation" creates a high-risk ethical vacuum regarding accountability. If an Officer of the Watch follows an AI recommendation that leads to an incident, the moral and legal responsibility remains inalienable and cannot be transferred to the machine. Change management must therefore focus on Trust Calibration: ensuring that the crew neither defaults to blind trust (automation bias) nor systemic rejection of the technology.

6.4 Emotional Intelligence as a Strategic Asset

Contrary to the belief that technology demands a more "robotic" approach, the age of AI requires more robust emotional intelligence. Emotions serve as the scaffolding for ethical judgment and the "Human Dividend". For change to be sustainable, the leader must cultivate:

- **Radical Empathy:** To validate crew concerns regarding automation and preserve mutual trust.
- **Constructive Discomfort:** Serving as an ethical alert when a proposed algorithmic action contradicts moral or humanitarian norms.
- **Transparency:** Sharing the reasoning process behind why an AI output was accepted or ignored, thereby preventing the diffusion of responsibility.

Ultimately, the successful integration of AI depends on a disciplined implementation that emphasizes human relevance. By redesigning roles to show that human competencies are amplified—not replaced—leadership ensures that the "spirit of the force" remains the decisive factor in maritime operations.

7 CONCLUDING REMARKS

The incorporation of Artificial Intelligence into the naval context is not merely an incremental technological innovation; it represents a structural transformation of how information is processed, situational awareness is constructed, and decisions are prepared. Algorithmic systems drastically expand observation capabilities, refine orientation processes, and reduce the time required to formulate courses of action. However, this acceleration does not alter the doctrinal foundation of command: the decision remains a human act—situated, contextual, and ethically non-transferable.

Considering the principle of “Mission Command”, delegated authority rests on the commander's clear intent, mutual trust, and individual responsibility for execution. The introduction of intelligent systems does not replace these pillars; on the contrary, it makes them more demanding. The abundance of data and automated recommendations can obscure strategic intent if not framed by critical judgment. Thus, the officer must continue to interpret superior intent, assess risks under uncertainty, and assume final responsibility for the decision, even when informed by highly sophisticated systems.

Operational effectiveness in this new era depends on the ability to calibrate trust continuously and informedly, avoiding the traps of both over-reliance and defensive distrust. Leadership becomes a permanent exercise in active supervision: integrating technological contributions without relinquishing cognitive autonomy. It is within this framework that the "Human Dividend" emerges as the primary differentiator. Sustainable operational superiority stems from the articulation of technical capabilities with superior behavioural competencies, such as critical AI literacy and the organisational courage to maintain constructive discomfort when faced with ethical or strategic misalignment.

In a complex socio-technical system, the commander does not merely manage material means but the interdependencies between humans and machines. Effective leadership implies creating organisational conditions that favour continuous learning, transparent communication, and clearly defined accountability. As advocated by “Mission Command”, initiative must be encouraged but anchored in a shared understanding of intent and the limits of action. Limits that technology cannot autonomously redefine.

Ultimately, Artificial Intelligence changes the rhythm, scale, and informational density of the theatre of operations, but it does not redefine the nature of military authority. The legitimacy of command continues to rest on the ability to decide under uncertainty, to protect force cohesion, and to preserve the moral dimension of the mission. Technology amplifies means and possibilities; conscious, responsible, and human leadership continues to determine the strategic outcome.

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