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Curriculum Relevance and Industry Alignment in Sea Transportation Cadet Education: A Management Perspective

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ABSTRACT

The accelerating pace of regulatory evolution, technological transformation, and decarbonization imperatives within the global maritime industry has placed unprecedented demands on the curriculum management systems of maritime higher education institutions. Ensuring that academic programs remain substantively aligned with current and emerging industry realities is a central institutional governance challenge that directly shapes the employability, competency readiness, and professional effectiveness of sea transportation graduates. This study investigates curriculum relevance and industry alignment in sea transportation cadet education at Sekolah Tinggi Ilmu Pelayaran (STIP) Jakarta, Indonesia, from a curriculum management perspective. Data were collected from thirty cadets—fifteen from the deck nautical program and fifteen from the engine technics program—alongside five practitioner-lecturers comprising three maritime captains and two master mariners, through semi-structured interviews analyzed using thematic analysis, cross-group comparison, and narrative synthesis. Findings reveal that curriculum-industry alignment is perceived as moderate to low across both cadet tracks, with engine technics cadets reporting more acute misalignment in relation to advanced propulsion technologies and digital systems. Practitioner-lecturers identify inadequate curriculum review cycles, weak industry stakeholder integration, and insufficient responsiveness to IMO regulatory updates as the principal structural barriers to alignment. The study contributes a management-focused curriculum alignment diagnostic framework and advances institutional recommendations grounded in the specific regulatory and technological challenges reshaping contemporary sea transportation.

Keywords : *curriculum relevance; industry alignment; maritime education management; sea transportation*

1. INTRODUCTION

The capacity of maritime higher education institutions to produce graduates whose knowledge, skills, and professional orientations are genuinely aligned with the operational demands of contemporary sea transportation is among the most strategically consequential dimensions of national maritime human capital development. In an industry defined by continuous regulatory evolution, rapid technological change, and growing environmental accountability, the question of curriculum relevance—whether academic programs substantively reflect the current and emerging realities of maritime professional practice—has moved from a peripheral quality assurance concern to a central institutional governance imperative. For Indonesia, whose archipelagic geography, vast shipping lanes, and expanding maritime economy make seafaring workforce quality a matter of

national strategic significance, the curriculum management practices of institutions like Sekolah Tinggi Ilmu Pelayaran Jakarta carry implications that extend far beyond individual institutional performance into the domain of national maritime capacity.

The challenge of maintaining curriculum-industry alignment in maritime higher education has been fundamentally intensified by three converging developments in the contemporary maritime regulatory and operational environment. First, the International Maritime Organization's accelerating decarbonization agenda—including progressive greenhouse gas emission reduction targets, alternative fuel regulations, and the emerging Carbon Intensity Indicator framework—has created an entirely new domain of regulatory knowledge that maritime officers are expected to understand, apply, and operationalize, yet which existing curriculum frameworks in many institutions have been slow to integrate. Liao and Lee (2023), in their analysis of regulatory impacts on international liner shipping companies, demonstrate that regulatory change in the maritime sector now occurs at a pace that substantially outstrips the capacity of conventional curriculum management systems to respond, creating a widening gap between regulatory reality and instructional content in maritime training programs. This regulatory lag represents a systemic curriculum management failure with direct consequences for graduate professional readiness.

Second, the progressive integration of intelligent vessel systems, digitally monitored machinery platforms, and autonomous navigation technologies into commercial fleet operations is redefining the technical competency profile of maritime officers across both deck and engineering tracks. Zhang et al. (2022), in their hierarchical risk scenario analysis for intelligent ships, demonstrate that the operational environments entering commercial service require deck officers and engineers whose competency profiles extend beyond conventional STCW standards to encompass digital system monitoring, autonomous process management, and human-machine interface navigation—competencies that existing maritime curricula were not designed to develop. The emergence of Maritime Autonomous Surface Ships (MASS) as a regulatory and operational reality has further accelerated this competency transformation, creating curriculum relevance pressures that are particularly acute for institutions whose training equipment and instructional content reflect the operational paradigms of an earlier technological era.

Third, the rapid diffusion of alternative marine fuels—most significantly liquefied natural gas, methanol, and ammonia—into commercial fleet propulsion systems has created urgent curriculum demands in the engine technics training domain that have not been systematically addressed in many Indonesian maritime polytechnics. Chae et al. (2021), in their analysis of LNG bunkering demand trajectories, demonstrate that LNG propulsion is now a commercially mainstream technology rather than an emerging novelty, yet training institutions in many maritime nations continue to deliver engineering curricula anchored in conventional marine diesel propulsion systems that are progressively becoming operationally secondary within the global fleet. For engine technics cadets at institutions like STIP Jakarta, this curriculum-technology gap represents a significant professional preparation failure with direct career implications.

Against this backdrop of accelerating industry transformation, the management of curriculum relevance and industry alignment at STIP Jakarta constitutes a research focus of both institutional urgency and scholarly significance. Existing studies have examined curriculum quality in maritime education primarily through the lens of regulatory compliance and instructional design, but have paid insufficient attention to the management systems and governance processes through which curriculum alignment is maintained, updated, and evaluated in response to industry change. Ciancarini et al. (2024), in their analysis of digital transformation in institutionally complex organizations, argue that curriculum governance systems that rely on periodic administrative review cycles rather than continuous industry-embedded feedback mechanisms are structurally incapable of maintaining alignment with rapidly evolving professional environments—a critique that applies with particular force to the maritime polytechnic context.

The perspectives of cadets and practitioner-lecturers are methodologically central to this study's investigative design. Cadets constitute the primary experiential evaluators of curriculum-industry alignment, their perceptions of whether instructional content prepares them for the professional realities they encounter during sea practice and anticipate in their careers providing a direct assessment of alignment quality that administrative curriculum review processes frequently fail to capture. Practitioner-lecturers, drawing on their seafaring professional experience and institutional

knowledge, provide a complementary expert evaluation of the structural and governance dimensions of alignment management that cadets are not positioned to assess. The integration of these two perspectives within a single analytical framework produces a curriculum management diagnostic that is both experientially grounded and institutionally actionable.

This study is guided by three research objectives: first, to document how deck nautical and engine technics cadets perceive the relevance and industry alignment of their respective curricula at STIP Jakarta; second, to examine how practitioner-lecturers evaluate the curriculum management processes and governance mechanisms through which alignment is maintained and updated; and third, to integrate these perspectives into a management diagnostic framework that identifies structural barriers to alignment and supports institutional policy reform. The study's significance lies in its contribution of a management-focused analytical framework for maritime curriculum governance that is responsive to the specific regulatory and technological transformation pressures shaping contemporary sea transportation. As automated port operations reshape logistics competency demands (Kim et al., 2022) and international liner shipping regulation intensifies environmental performance requirements (Liao & Lee, 2023), maritime institutions that cannot maintain curriculum-industry alignment will increasingly produce graduates whose professional preparation is structurally disconnected from the industry they are trained to serve.

2. LITERATURE REVIEW

2.1 Key Concepts: Curriculum Relevance, Industry Alignment, and Management Perspective

Curriculum relevance in the context of professional higher education refers to the degree to which the knowledge, skills, competencies, and values developed through academic programs correspond to the actual demands of the target professional practice environment. In maritime education, this correspondence is evaluated across multiple dimensions: regulatory knowledge alignment with current IMO and flag state requirements; technical competency alignment with contemporary vessel systems and operational technologies; professional judgment alignment with the decision-making demands of shipboard operations; and attitudinal alignment with the safety, environmental, and ethical standards governing maritime professional conduct. Industry alignment, as a related but distinct concept, refers specifically to the institutional responsiveness of curriculum management systems to changes in industry standards, operational practices, and workforce expectations—an ongoing governance function rather than a static curriculum quality attribute.

A management perspective on curriculum relevance and alignment directs analytical attention toward the institutional processes, governance structures, stakeholder relationships, and resource allocation decisions that determine whether curricula are developed, reviewed, and updated in ways that maintain meaningful connection to industry realities. Shi et al. (2023), in their comprehensive analysis of technology management institutions, identify adaptive governance—the capacity of institutional management systems to respond dynamically to external environmental change—as the primary organizational capability distinguishing institutions that maintain stakeholder relevance from those that suffer progressive disconnection from their professional service contexts.

2.2 Theoretical Frameworks

This study draws on two complementary theoretical frameworks. The first is Curriculum Alignment Theory, which holds that educational quality is fundamentally determined by the coherence among intended learning outcomes, instructional processes, assessment practices, and the professional demands of the target occupation. Misalignment at any point in this chain undermines the formation of genuine professional competency, regardless of the quality of individual instructional components. Applied to maritime cadet education, Curriculum Alignment Theory directs attention to the systemic coherence of the training management system—whether learning outcomes, instructional content, simulation-based practice, and assessment criteria collectively and consistently develop the competencies that contemporary maritime professional roles require. Adnan et al. (2023), in their review of technical experiential learning programs, demonstrate that curriculum alignment is most

effectively achieved through iterative co-design processes involving both academic and industry stakeholders—a governance practice that many maritime polytechnics, including those in Indonesia, have not systematically institutionalized.

The second framework is Adaptive Management Theory, drawn from organizational management literature and applied to curriculum governance. Adaptive management holds that complex institutional systems operating in rapidly changing environments require governance mechanisms characterized by continuous environmental scanning, rapid feedback integration, iterative adjustment, and distributed decision authority. Ciancarini et al. (2024) demonstrate that institutions undergoing significant digital transformation achieve superior governance outcomes when they adopt adaptive rather than periodic review management models—a principle directly applicable to maritime curriculum governance in an era of accelerating regulatory and technological change.

2.3 Critical Synthesis of Prior Studies

Research on curriculum-industry alignment in maritime higher education has documented a consistent pattern of alignment deficiencies across multiple national contexts, with the pace of curriculum revision consistently lagging behind the pace of industry transformation. Studies examining the integration of environmental regulatory content into maritime curricula have found that even after the adoption of major IMO instruments, the translation of new regulatory requirements into curriculum revisions and instructional materials takes years rather than months in most institutions—a lag that graduates entering the industry during the transition period are required to bridge through informal learning and on-the-job adaptation (Liao & Lee, 2023; Paridaens & Notteboom, 2021). This regulatory translation lag is not primarily a resource problem but a governance problem: institutions without continuous industry-embedded curriculum review mechanisms lack the feedback infrastructure to detect and respond to regulatory change promptly.

Technology-driven curriculum alignment challenges have been documented most acutely in engineering and technical training programs, where the rate of equipment and system evolution substantially exceeds the institutional capacity for curriculum and equipment updating. Chae et al. (2021) demonstrate that the diffusion of LNG propulsion technology into commercial fleets has outpaced the curriculum response of most maritime training institutions in the Asia-Pacific region, producing a generation of engineering graduates whose technical preparation is oriented toward propulsion systems that are progressively becoming secondary within the operational fleet. Zhang et al. (2022) extend this analysis to intelligent vessel systems, demonstrating that the competency demands of digitally integrated bridge and engine management platforms require curriculum frameworks that most STCW-aligned programs have not yet begun to develop.

Studies examining the role of industry stakeholder engagement in maritime curriculum management have found that institutions with formal, structured mechanisms for industry input into curriculum design and review achieve substantially higher alignment outcomes than those relying on informal or ad hoc industry consultation (Kim et al., 2022). Sabri et al. (2022), in their analysis of adult learning program relevance, identify stakeholder co-design as the governance practice most strongly associated with curriculum-practice alignment in professional training contexts—a finding that extends directly to the maritime polytechnic setting. Conversely, institutions that manage curriculum primarily through internal academic processes, without systematic industry feedback integration, tend to develop a progressive insularity that insulates curriculum content from the operational realities it is designed to reflect.

The management of curriculum relevance in Indonesia's maritime higher education system is further complicated by the institutional structure of the national maritime polytechnic sector, in which curriculum frameworks are subject to both ministry-level governance and institutional-level management—a layered authority structure that can create governance ambiguity and slow the implementation of curriculum updates that industry urgency requires. Buddha et al. (2024), in their systematic review of technology-assisted learning, note that institutions operating within complex regulatory governance structures frequently experience curriculum innovation delays attributable to approval process complexity rather than intellectual resistance—a bureaucratic alignment barrier that is particularly relevant in the Indonesian public maritime education context.

2.4 Research Gap and Conceptual Position

The synthesis above reveals that while the general phenomenon of curriculum-industry misalignment in maritime education is well documented, the specific governance and management mechanisms through which this misalignment is produced and perpetuated at the institutional level—and how these mechanisms are experienced differently across cadet specialization tracks—remain insufficiently examined. No published study has applied a management-focused curriculum alignment diagnostic to STIP Jakarta specifically, or generated the integrated cadet-practitioner analytical perspective needed to identify the institutional governance levers most relevant to alignment improvement. This study occupies that gap, contributing both contextually specific evidence and a transferable management framework to the maritime curriculum governance literature.

3. METHOD

This study employs a qualitative descriptive research design to investigate curriculum relevance and industry alignment perceptions from a curriculum management perspective at STIP Jakarta. The design's emphasis on contextually embedded systematic description enables the generation of rich, analytically structured accounts of how curriculum alignment is experienced by cadets and evaluated by practitioner-educators within the same institutional governance environment, without imposing deductive theoretical categories on participants' meaning-making processes (Yuebo et al., 2024). This methodological orientation is particularly appropriate for investigating institutional management phenomena that are shaped by complex, context-specific governance factors that standardized quantitative instruments cannot adequately capture.

Participant selection employed purposive sampling to construct a sample of thirty cadets—fifteen from the deck nautical program and fifteen from the engine technics program—alongside five practitioner-lecturers comprising three maritime captains and two master mariners. Cadet participants were selected from the intermediate and advanced stages of their programs to ensure substantive curricular exposure enabling informed alignment assessments. Practitioner-lecturers were selected on the basis of fulltime institutional status, verified sea service history in their respective officer rank, and active involvement in curriculum delivery or review functions at STIP Jakarta. This sampling design ensures that curriculum alignment perceptions are collected from participants with both sufficient institutional experience and sufficient professional reference points to evaluate alignment meaningfully (Adnan et al., 2023).

Three semi-structured interview protocols were developed—one per respondent category—organized around thematic dimensions directly relevant to curriculum relevance and industry alignment management: content currency and regulatory responsiveness, technology and equipment alignment, sea practice integration, industry stakeholder engagement in curriculum design, and institutional curriculum review processes. Cadet items elicited experiential assessments of curriculum-practice correspondence from their program content and sea practice exposure. Practitioner-lecturer items examined institutional governance of curriculum review, stakeholder engagement mechanisms, and professional evaluations of the gap between current instructional content and contemporary maritime industry requirements. All instruments underwent content validity review by four maritime curriculum specialists and were refined through pilot testing.

Data collection proceeded through individual semi-structured interviews of forty-five to sixty minutes per participant, conducted in a private institutional setting over a three-week period. Interviews were audio-recorded with participant consent and transcribed verbatim. Data analysis employed thematic analysis to identify patterns in curriculum alignment perceptions across the dataset, cross-group comparison to map inter-track and inter-role divergences systematically, and narrative synthesis to integrate the thematic and comparative findings into a coherent curriculum management diagnostic account. Methodological rigor was maintained through triangulation of cadet and practitioner data sources, member checking with seven participants, and audit trail documentation of analytical decisions throughout the interpretive process (Ciancarini et al., 2024).

4. RESULTS and ANALYSIS

4.1 Analytical Structure Overview

Analysis of interview data generated findings organized around five thematic dimensions of curriculum relevance and industry alignment management: (1) regulatory content currency and IMO alignment, (2) technology and equipment curriculum alignment, (3) sea practice integration and experiential relevance, (4) industry stakeholder engagement in curriculum governance, and (5) institutional curriculum review mechanisms and responsiveness. Each dimension is presented with comparative data across respondent groups and followed by interpretive analysis.

4.2 Dimension 1: Regulatory Content Currency and IMO Alignment

Regulatory content currency—the degree to which curriculum content reflects current IMO conventions, amendments, and emerging regulatory instruments—was assessed as a primary dimension of curriculum-industry alignment. Among deck nautical cadets, ten of fifteen (66.7%) affirmed adequate coverage of core STCW-mandated regulatory content including SOLAS, MARPOL, and COLREGs, while five (33.3%) identified gaps in instruction relating to more recent regulatory developments, including the ISM Code implementation updates, the Maritime Labour Convention provisions, and early-stage MASS regulatory frameworks. The five cadets identifying gaps represented a regulatory currency concern rather than a fundamental alignment failure, suggesting that the deck nautical curriculum maintains reasonable baseline regulatory alignment while lagging on newer regulatory developments.

Engine technics cadets presented a more critical regulatory alignment assessment. Only seven of fifteen (46.7%) affirmed adequate regulatory content coverage, while eight (53.3%) identified significant gaps—most prominently relating to decarbonization regulatory instruments including the Carbon Intensity Indicator, the IMO GHG Strategy 2050 framework, and regulations governing alternative marine fuels. These gaps are directly consequential for engineering officer professional preparation, as decarbonization compliance is increasingly an engineering operational responsibility that requires substantive regulatory understanding alongside technical competency. Practitioner-lecturers corroborated these gap identifications, with all five confirming that decarbonization regulatory content was substantively underrepresented in current curriculum documentation.

Table 1: Regulatory Content Currency Assessment by Respondent Group

Regulatory Dimension	Deck Nautical (% Adequate)	Engine Technics (% Adequate)	Lecturers (% Adequate)
Core STCW Convention Content	80.0%	60.0%	60.0%
Environmental Regulations (MARPOL)	66.7%	46.7%	40.0%
Decarbonisation / GHG Frameworks	40.0%	26.7%	20.0%
Emerging Tech Regulations (MASS)	33.3%	26.7%	20.0%
Maritime Labour Convention	60.0%	53.3%	60.0%
Overall Regulatory Currency	56.0%	42.7%	40.0%

Table 1 reveals a consistent pattern of declining curriculum-regulatory alignment as regulatory content moves from established core conventions toward newer and emerging frameworks. The critical decarbonization and MASS regulatory scores—where even deck nautical cadets record only 33–40% adequacy and practitioner-lecturers assess only 20% adequacy—indicate systemic curriculum governance failure in the most rapidly evolving domains of contemporary maritime regulation. This finding directly corroborates Liao and Lee (2023), who identify regulatory translation lag as the dominant curriculum alignment challenge in maritime institutions across the Asia-Pacific region.

4.3 Dimension 2: Technology and Equipment Curriculum Alignment

Technology and equipment alignment—the correspondence between instructional content and training equipment on one hand, and the operational technologies cadets will encounter in professional service on the other—emerged as the most acute alignment deficiency across both tracks, though with significantly different profiles by specialization.

Deck nautical cadets identified moderate technology alignment concerns, with nine of fifteen (60%) rating navigation simulator content and equipment as adequately aligned with current integrated bridge systems, while six (40%) noted that Electronic Chart Display and Information System training did not fully reflect the interfaces and capabilities of contemporary ECDIS installations. The primary technology alignment concern among nautical cadets related to autonomous and remote-monitoring navigation systems—the operational frontier that Zhang et al. (2022) identify as defining the next generation of deck officer competency demands—which nine of fifteen (60%) described as absent or minimally present in their curriculum.

Engine technics cadets reported substantially more severe technology alignment deficiencies. Only five of fifteen (33.3%) rated engine room simulator technology as adequately aligned with current fleet propulsion systems, while ten (66.7%) described training on conventional diesel propulsion systems that do not reflect the dual-fuel, LNG, or digitally integrated engine management platforms entering widespread commercial service. This finding directly corroborates Chae et al. (2021), whose analysis of LNG bunkering trajectories demonstrates the commercial mainstreaming of alternative propulsion technologies that engine technics curricula in many Asia-Pacific institutions have not yet incorporated.

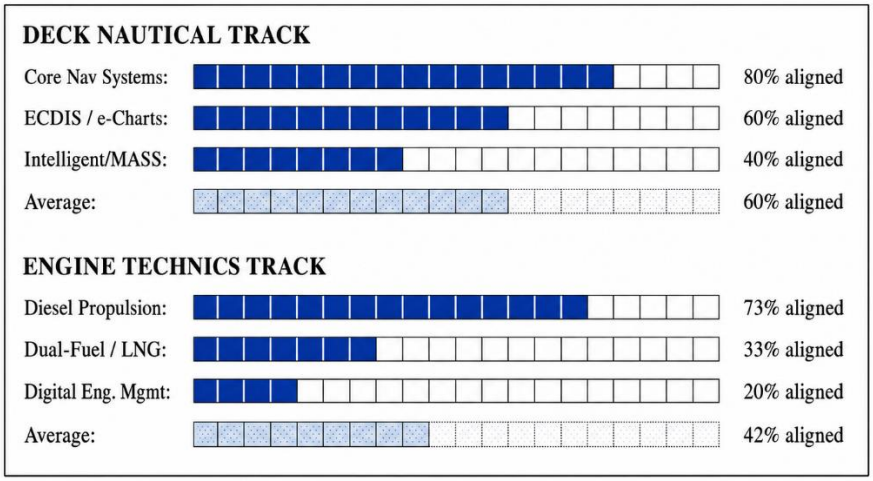

Figure 1: Technology Alignment Gap — Curriculum vs. Current Fleet Technology

The technology alignment profiles in Figure 1 reveal a structural divergence between the two tracks: deck nautical curriculum maintains reasonable alignment with established navigational systems while lagging on frontier technologies, whereas engine technics curriculum faces acute misalignment even on technologies that are now commercially mainstream. This difference reflects the faster rate of propulsion technology change relative to navigational system change, producing a more severe alignment crisis in the engineering curriculum domain.

4.4 Dimension 3: Sea Practice Integration and Experiential Relevance

Sea practice integration—the degree to which shore-based curriculum content is reinforced, applied, and tested through structured experiential learning during sea practice placements—was assessed as a critical mediating dimension of curriculum-industry alignment. Effective sea practice integration transforms curriculum alignment from an abstract governance concern into a lived learning experience, enabling cadets to validate, extend, and critically evaluate their classroom preparation against operational realities.

Twelve of fifteen deck nautical cadets (80%) reported that sea practice placements were sufficiently structured to enable meaningful curriculum application, with watchkeeping duties, passage planning responsibilities, and navigational equipment operation providing direct experiential

validation of classroom learning. Engine technics cadets reported substantially lower sea practice integration quality, with only eight of fifteen (53.3%) affirming that sea practice responsibilities were structured to enable systematic curriculum application, while seven (46.7%) described placements characterized by task assignment that reflected vessel operational needs rather than cadet curriculum development objectives.

Practitioner-lecturers identified the coordination between shore-based curriculum content and sea practice placement structure as the weakest institutional link in curriculum-industry alignment management, with three of the five identifying the absence of a formal sea practice curriculum integration protocol as a governance gap requiring immediate institutional attention. This finding resonates with Kim et al. (2022), who demonstrate that institutional performance in complex operational environments depends critically on the structural integration of training and operational experience—an integration that cannot be achieved through informal or ad hoc coordination.

4.5 Dimension 4: Industry Stakeholder Engagement in Curriculum Governance

Industry stakeholder engagement in curriculum governance—the systematic inclusion of shipping company representatives, maritime authority officials, and maritime industry professionals in curriculum review and design processes—was identified by practitioner-lecturers as the most consequential structural gap in STIP Jakarta's curriculum alignment management system. All five practitioner-lecturers described curriculum review processes that were predominantly internal and academically driven, with industry input limited to informal consultation rather than structured co-design. Three lecturers explicitly noted that curriculum review cycles were determined by administrative schedules rather than industry change events, meaning that significant regulatory or technological developments in the maritime sector did not automatically trigger curriculum review processes.

This governance pattern directly contradicts the evidence base for alignment-effective curriculum management. Sabri et al. (2022) identify systematic stakeholder co-design as the practice most strongly associated with curriculum-practice alignment in professional training contexts, while Adnan et al. (2023) demonstrate that technical professional programs achieve the highest alignment outcomes when curriculum design integrates both academic and industry expertise through formal collaborative structures rather than informal advisory relationships. The absence of such structures at STIP Jakarta represents a governance design gap rather than an operational failure—it reflects a curriculum management architecture that was not designed for the adaptive responsiveness that contemporary maritime industry transformation demands.

Table 2: Industry Engagement and Curriculum Review Management Assessment

Governance Dimension	Deck Nautical (% Adequate)	Engine Technics (% Adequate)	Lecturers (% Adequate)
Industry Input in Curriculum Design	46.7%	33.3%	20.0%
Frequency of Curriculum Review	53.3%	40.0%	20.0%
Regulatory Change Response Speed	40.0%	33.3%	20.0%
Sea Practice Curriculum Integration	80.0%	53.3%	40.0%
Equipment Currency Management	53.3%	33.3%	20.0%
Overall Governance Adequacy	54.7%	38.6%	24.0%

Table 2 presents a strikingly critical picture of curriculum governance adequacy at STIP Jakarta, particularly from the practitioner-lecturer perspective where overall governance adequacy is assessed at just 24%. The particularly low ratings for industry input, regulatory response speed, and equipment currency management across all respondent groups indicate that the alignment management architecture of the institution requires fundamental governance redesign rather than incremental improvement.

4.6 Dimension 5: Overall Curriculum Alignment — Integrated Summary

Table 3: Integrated Curriculum Alignment Summary by Dimension and Respondent Group

Alignment Dimension	Deck Nautical (% Adequate)	Engine Technics (% Adequate)	Lecturers (% Adequate)
Regulatory Content Currency	56.0%	42.7%	40.0%
Technology & Equipment Alignment	60.0%	42.0%	35.0%
Sea Practice Integration	80.0%	53.3%	40.0%
Industry Governance Engagement	54.7%	38.6%	24.0%
Overall Curriculum Relevance	62.7%	44.2%	34.8%
Grand Mean	62.7%	44.2%	34.8%

The integrated summary in Table 3 confirms that curriculum-industry alignment at STIP Jakarta is inadequate across both tracks and from all respondent perspectives, with engine technics cadets and practitioner-lecturers providing the most critical assessments. The 18.5-percentage-point gap between deck nautical and engine technics overall alignment scores reflects the structural vulnerability of the engineering curriculum to technology change, while the 27.9-percentage-point gap between deck nautical cadet perceptions and practitioner-lecturer assessments suggests that cadets may not yet have sufficient industry exposure to fully perceive the depth of the alignment gaps that their educators, drawing on professional seafaring experience, are able to identify.

5. DISCUSSION

5.1 The Governance Architecture of Misalignment

The most institutionally significant contribution of this study's findings is the demonstration that curriculum-industry misalignment at STIP Jakarta is not primarily a content quality problem but a governance architecture problem. The patterns documented across regulatory currency, technology alignment, sea practice integration, and industry engagement dimensions collectively indicate that the institution lacks the adaptive curriculum management infrastructure needed to maintain alignment with an industry undergoing continuous and accelerating transformation. This governance diagnosis extends and contextualizes the predictions of Adaptive Management Theory, confirming that institutions without embedded environmental scanning, stakeholder co-design, and responsive review mechanisms are structurally unable to maintain curriculum relevance regardless of the dedication of their academic staff or the quality of their formal curriculum documentation.

This finding resonates with Ciancarini et al. (2024), who demonstrate that institutionally complex organizations—including public maritime polytechnics operating within multi-layered regulatory governance structures—consistently underperform in curriculum innovation relative to more agile institutional governance models. The solution, as these authors argue, is not the removal of regulatory governance but the redesign of curriculum management processes within that governance context to enable faster, more systematically industry-responsive adaptation.

5.2 The Engine Technics Alignment Crisis

The severity of curriculum-industry misalignment in the engine technics track—where overall alignment adequacy is assessed at 44.2% by cadets and 34.8% by practitioner-lecturers—constitutes an institutional emergency rather than a manageable quality concern. The specific misalignments documented in alternative fuel technology, digital engine management systems, and decarbonization regulatory content are not peripheral curriculum gaps but failures in the core professional preparation domain of engineering officers who will spend their careers managing the very technologies absent from their training. Chae et al. (2021) demonstrate that LNG propulsion is now operationally mainstream across multiple fleet segments, making its curriculum absence at a national maritime

polytechnic a preparation failure with direct consequences for graduate employability and operational safety.

5.3 Sea Practice as an Alignment Bridge

The relatively stronger sea practice integration ratings among deck nautical cadets (80%) compared to engine technics cadets (53.3%) suggest that structured experiential learning can function as a partial curriculum-industry alignment bridge—enabling cadets to develop professional competencies that classroom instruction has not adequately developed—but only where sea practice placements are sufficiently structured to serve this bridging function. The unstructured nature of many engine technics sea practice placements, as described by cadet participants, indicates that this alignment bridging function is not consistently realized in the engineering track, leaving cadets without the experiential compensation for curriculum content gaps that more structured nautical sea practice provides.

5.4 Implications and Future Research

The study's findings support three principal institutional recommendations: the establishment of a continuous curriculum intelligence function that systematically monitors IMO regulatory developments, fleet technology trends, and industry competency requirement changes; the creation of a formal industry curriculum advisory panel with structured co-design authority over curriculum review cycles; and the development of a sea practice curriculum integration protocol that aligns placement responsibilities with curriculum content objectives across both tracks. Future research should develop and validate a Maritime Curriculum Alignment Index enabling cross-institutional comparison and longitudinal monitoring of alignment trajectories at Indonesian maritime polytechnics.

6. CONCLUSION

This study has generated a comprehensive management-perspective diagnosis of curriculum relevance and industry alignment in sea transportation cadet education at STIP Jakarta, revealing systemic misalignment across regulatory content, technology currency, sea practice integration, and industry governance engagement dimensions. Engine technics cadets report substantially more acute misalignment than their deck nautical counterparts, while practitioner-lecturers provide the most critical institutional assessments across all alignment dimensions. The central finding—that misalignment is fundamentally a governance architecture problem rather than a content quality problem—positions adaptive curriculum management redesign as the primary institutional reform imperative. By contributing a management-focused curriculum alignment diagnostic framework grounded in the specific regulatory and technological transformation pressures reshaping contemporary sea transportation, this study provides STIP Jakarta and comparable maritime higher education institutions with an evidence-based foundation for institutional governance reform that is both contextually grounded and analytically transferable.

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