Journal of Economics, Entrepreneurship, Management Business and Accounting, 2026, 4(5),1452-1463.
https://doi.org/10.61255/jeemba.v4i5.1114

Talent Development and Organizational Readiness for Maritime Technology Adoption: A Cross-Stakeholder Workforce Analysis

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ABSTRACT

Purpose – This study examines whether technology awareness among cadets, lecturers, and industry experts at an Indonesian maritime institution has converted into organizational readiness for smart port and Internet of Things-driven workforce transformation, identifying the talent development barriers between the two. **Design/methodology/approach** – A concurrent mixed-methods design administered a validated awareness and institutional readiness instrument to 90 participants across a three-programme, three-stakeholder-group factorial design, analysed using two-way analysis of variance, supplemented by a focus group of ten experienced practitioners, analysed through thematic coding mapped onto an Ability-Motivation-Opportunity framework.
Findings – Technology awareness reached 3.64 out of 5.00 while organizational readiness fell to 2.95, a gap present across every stakeholder-by-programme cell. Industry experts recorded simultaneously the highest awareness and lowest readiness confidence of any group, a Practitioner Pessimism Pattern reported here for the first time. Focus group analysis identified a compound four-barrier structure to workforce readiness, in which a trust deficit rooted in prior technology experience proved as consequential as documented competency gaps.
Originality/value – This study is the first to apply organizational readiness and Green Human Resource Management theory jointly to a maritime education setting, showing that talent development addressing ability, motivation, and opportunity jointly, not awareness or curriculum content alone, is the binding constraint on readiness for technology-driven transformation.

ARTICLE INFO

Keywords:
Maritime Human Resource Management, Organizational Readiness, Talent Development, Technology Adoption, Workforce Competency

Article Information:
Received: 23/06/2026
Revise: 25/07/2026
Accepted: 30/08/2026

ISSN:
2985-3168 (Online)
2985-3222 (Print)

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1. Introduction

An institution can be full of people who understand exactly what a technology does and still be unprepared to produce graduates capable of working with it, and this study's evidence shows that gap is not hypothetical. Across ninety participants at an Indonesian maritime higher education institution, awareness of smart port and Internet of Things technology scored a full 0.69 points higher, on a five-point scale, than confidence in the institution's own readiness to prepare graduates for that technology, a gap present in every one of the nine stakeholder-by-programme groups measured. This is a talent development problem before it is a technology problem: an organization does not become ready for workforce transformation simply because its members recognize the transformation is happening.

Organizational readiness for change theory holds that readiness is a distinct, multi-level construct, encompassing both the collective belief that a change is necessary and the collective confidence that the organization has the capacity to implement it, rather than a simple derivative of awareness or motivation alone (Weiner, 2009). This distinction matters directly for maritime workforce policy, because Indonesia's national port investment programme, committing significant capital to extend artificial intelligence berth scheduling, Internet of Things cargo monitoring, and renewable shore power infrastructure across seventeen terminals, implicitly assumes that awareness of these technologies among the maritime education community will translate into a workforce capable of operating them. Strategic talent management theory complicates this assumption further, arguing that organizational advantage depends not on general awareness but on the systematic identification and development of a specific talent pool aligned to pivotal roles the organization's strategy requires (Collings & Mellahi, 2009). If a maritime institution has not identified smart port and Internet of Things competency as a pivotal talent domain requiring deliberate development, general awareness of the technology among its cadets, lecturers, and industry partners will not, on its own, close the readiness gap.

The maritime education literature has documented that curriculum content lags technological change in this sector for over a decade (Bogusławski et al., 2022), and safety management systems research confirms that this lag reflects institutional and governance factors more than individual competence (Wahid et al., 2023). Essential-competency research in maritime and port logistics vocational education similarly identifies digital and technical literacy as a distinct competency domain requiring deliberate curricular attention, one that does not develop incidentally through general exposure to technology in the surrounding industry (Lopes et al., 2025). Seafarer competency modelling using data-driven methods reinforces the same point from the operational side, finding that officer decision quality under constraint depends on an underlying technical knowledge base that formal certification alone does not guarantee (Shi et al., 2024). What this combined literature has not examined directly is whether the same institution's stakeholders diverge in how they experience this lag, whether awareness itself is evenly distributed across roles, and what specific organizational barriers, beyond a generic competency shortfall, prevent awareness from converting into workforce-ready talent. Technology adoption research offers a partial answer, distinguishing relative advantage, compatibility, and complexity as adoption determinants (Rogers, 2003) and locating adoption barriers in the interaction between technology, organizational capacity, and environment (Tornatzky & Fleischer, 1990), while the Technology Acceptance Model further distinguishes perceived usefulness from perceived ease of use as separate judgments an individual or institution can hold simultaneously without one predicting the other (Davis, 1989). This literature was developed primarily to explain organizational adoption decisions rather than the talent-development process that precedes and enables those decisions, and a maritime-specific instance of the trust dimension this gap can generate is documented in cybersecurity vulnerability research on shipboard navigation systems, where a single reliability failure in a safety-critical system has been shown to produce lasting operator caution well beyond the immediate technical fix (Svilicic et al., 2021).

This is the gap this study addresses. Three questions follow. First, does technology awareness and perceived organizational readiness vary systematically by stakeholder role and academic programme, and does any such variation reveal a specific talent development target rather than a generalized deficiency? Second, when practitioners with direct, sustained technology exposure are examined qualitatively, what specific barriers explain why documented awareness has not converted into workforce readiness? Third, does a green human resource management framework, which treats ability development, motivation, and opportunity as jointly necessary conditions for workforce transformation, better explain the resulting pattern than a technology-adoption framework focused on the technology itself?

Answering these questions matters practically as well as theoretically. For the institution studied here, the findings identify a specific, actionable talent development target rather than a generic call for more technology content. For Indonesia's broader port investment programme, the findings indicate that infrastructure deployment and workforce readiness are currently proceeding on different timelines, with direct consequences for whether the investment delivers its intended operational outcomes. For organizational behavior scholarship, the study extends readiness, talent management, and green human resource management theory (Collings & Mellahi, 2009; Renwick, Redman, & Maguire, 2013; Weiner, 2009), developed primarily in general organizational, healthcare implementation, and environmental management contexts, into a vocational education setting where the organization being assessed for readiness is not the eventual technology-adopting employer but the institution supplying that employer's future workforce, and where Freeman's (1984) stakeholder logic requires that no single constituency's account be treated as sufficient on its own. The remainder of this paper reviews the readiness, talent management, and green human resource management literature relevant to this distinction, describes the mixed-methods design used to test the three questions above, reports the quantitative and qualitative findings, and discusses their implications for how maritime institutions should sequence talent development investment relative to technology awareness-building.

2. Literature Review & Hypothesis Development

Organizational readiness for change theory distinguishes readiness from the antecedent conditions, awareness, motivation, and attitude, that are often mistaken for it, defining readiness instead as the shared belief among organizational members that they are both willing and collectively capable of implementing a specific change (Weiner, 2009). Parasuraman's (2000) Technology Readiness Index anticipates a compatible distinction from the individual-differences side of this literature, separating positive readiness drivers such as optimism from negative drivers such as discomfort and insecurity, and establishing empirically that these can coexist within the same person or institution rather than resolving into a single readiness score. Applied to a maritime education institution facing technology-driven curriculum transformation, this distinction predicts precisely the pattern this study investigates: an institution's members may score highly on recognizing that smart port technology matters while scoring considerably lower on believing the institution can actually prepare graduates for it, because the second judgment requires confidence in organizational capacity that the first does not. Smart city and smart port architecture research situates the technology itself within four integrated layers, sensing, analytics, renewable infrastructure, and documentation, that together define what a workforce-ready graduate must actually be able to operate (Albino, Berardi, & Dangelico, 2015), while digital twin research establishes that the analytics layer specifically depends on continuous, synchronized data exchange between physical asset and virtual model, a technical baseline that itself presupposes a workforce trained to maintain that synchronization reliably (Tao, Zhang, Liu, & Nee, 2019).

Green human resource management theory supplies a complementary framework specifically suited to sustainability-linked technology transitions, categorizing the practices organizations need along three dimensions, developing employee ability through recruitment and training, motivating desired behavior through performance and reward systems, and providing opportunity for meaningful participation, the Ability-Motivation-Opportunity structure that has become the field's dominant analytical lens (Renwick, Redman, & Maguire, 2013). This framework predicts that a workforce readiness gap can originate in any of the three dimensions independently, meaning a diagnosis focused only on ability, curriculum content, without also examining motivation and opportunity would produce an incomplete remediation strategy. Organizational commitment theory reinforces why the motivation dimension in particular cannot be assumed away: Meyer and Allen (1991) demonstrate that behavior under unsupervised or high-uncertainty conditions depends on an internalized commitment that technical training alone does not reliably produce, a proposition this study's trust-deficit finding in Section 4.3 tests directly in a technology-adoption rather than organizational-tenure context. Competency theory situates the ability dimension specifically, with Boyatzis (1982) defining competency as an underlying, behaviorally observable characteristic that predicts effective performance, a definition that has since underpinned most competency-based human resource frameworks in technical and vocational settings.

Strategic talent management theory adds a fourth necessary layer, arguing that organizational advantage depends on the systematic identification of pivotal positions and the deliberate development of a talent pool aligned to those positions, rather than on general workforce capability building spread evenly across all roles (Collings & Mellahi, 2009), a claim consistent with human capital theory's broader argument that firms gain advantage from human capital investment that is specific and difficult to replicate rather than generic (Barney, 1991; Becker, 1964). This has a direct implication for the present study: if smart port and Internet of Things competency has not been formally identified as a pivotal talent category within Marine Engineering, Nautical Studies, and Port and Shipping Management curricula, the institution's talent development effort is, by this theory's logic, structurally unlikely to close the readiness gap regardless of how much general awareness-building occurs. Technology adoption theory contributes the final conceptual layer, with Rogers's (2003) diffusion framework identifying relative advantage and complexity as adoption determinants and the Technology-Organisation-Environment model locating adoption barriers in the interaction between technology characteristics and organizational capacity rather than in the technology alone (Tornatzky & Fleischer, 1990). The Technology Acceptance Model's distinction between perceived usefulness and perceived ease of use offers a further lens for interpreting the awareness-readiness divergence this study measures, since recognizing a technology's

usefulness and believing oneself, or one's institution, capable of using it easily are empirically distinct judgments that need not move together (Davis, 1989).
The maritime-specific literature confirms both the plausibility and the contemporary stakes of this gap. Autonomous shipping research argues that maritime education and training content has systematically lagged technological change because industry signals reach curriculum revision processes too late to shape content proactively (Bogusławski et al., 2022), while safety management research on Indonesian domestic shipping finds that institutional and governance factors, not individual competence, primarily determine whether formal standards translate into operational practice (Wahid et al., 2023). Seafarer competency modelling using data-driven methods confirms that officer decision quality under operational constraint depends on an underlying technical knowledge base that formal certification does not automatically guarantee (Shi et al., 2024), and cybersecurity vulnerability research on shipboard navigation systems illustrates a maritime-specific instance of the trust erosion this study's qualitative findings examine directly, since a system officers rely on for safety-critical decisions that later proves vulnerable or unreliable plausibly generates a lasting confidence deficit beyond the immediate technical fix (Svilicic et al., 2021). Essential-competency research in maritime and port logistics vocational education identifies technical and digital literacy as a distinct competency domain requiring deliberate curricular attention rather than incidental exposure (Lopes et al., 2025), directly reinforcing this study's talent-development framing over an awareness-only framing. Freeman's (1984) stakeholder theory justifies this study's decision to examine cadets, lecturers, and industry experts as three distinct constituencies whose readiness perceptions cannot be assumed to converge, a methodological choice the findings in Section 4 vindicate directly. Positioned against this combined literature, no prior study has tested whether organizational readiness and talent management theory, rather than technology-adoption theory alone, better explains a documented awareness-readiness divergence in a maritime education setting, nor identified which of the Ability-Motivation-Opportunity dimensions is most binding when that divergence is examined qualitatively through the kind of systematic thematic procedure Braun and Clarke (2006) established for extracting exactly this sort of cross-cutting pattern from practitioner accounts.

3. Methodology

This study drew on data collected from 90 participants at an Indonesian maritime higher education institution, structured as a three-by-three factorial design crossing three academic programmes, Port and Shipping Management, Nautical Studies, and Marine Engineering, with three stakeholder groups, cadets, lecturers, and industry experts, at ten participants per cell. This population was selected specifically to test whether readiness perceptions vary by role and programme rather than being uniform across the institution, following Freeman's (1984) stakeholder logic that no single constituency's perception can substitute for a full organizational readiness assessment. Cadets represent the population whose eventual competency the readiness gap is meant to protect; lecturers represent the population responsible for the ability-development dimension of workforce transformation; and industry experts represent the population best positioned to judge whether current preparation matches actual operational demand, a triangulation structure consistent with strategic talent management's emphasis on aligning development effort with the pivotal roles an organization's environment actually requires (Collings & Mellahi, 2009). This quantitative sample was supplemented by a purposively selected focus group of ten Marine Engineering practitioners holding a minimum of ten years of operational experience and direct, sustained exposure to Internet of Things monitoring systems in commercial settings, selected to provide the depth of qualitative account the factorial survey design could not capture on its own.

The primary quantitative instrument comprised a validated twenty-item technology awareness index, covering six technology categories on a five-point scale, and an eight-item perceived institutional readiness scale, covering curriculum content, instructional methods, staff expertise, industry connections, and physical infrastructure, operationalizing Weiner's (2009) distinction between awareness and organizational capacity belief as two separate measured constructs rather than a single composite. Two-way analysis of variance with a programme-by-stakeholder-group factorial design tested main effects and their interaction, following standard procedure for factorial survey analysis (Field, 2018). This factorial structure was chosen specifically because it allows role and programme effects to be estimated and tested for interaction simultaneously, a design requirement that a simpler between-groups comparison would not satisfy and that this study's second research question, concerning whether the readiness gap concentrates in any single group or programme, required directly.

The qualitative protocol addressed current technology deployment experience, barrier identification across ability, motivation, and opportunity dimensions consistent with the green human resource management framework (Renwick et al., 2013), and assessment of curriculum adequacy for workforce preparation. Thematic analysis coded transcripts following Braun and Clarke's (2006) six-phase procedure, moving from initial familiarization through coding, theme development, and review to final theme definition, with quantitative and qualitative strands integrated at the interpretation stage rather than analyzed as two independent studies, consistent with concurrent mixed-methods design logic in which each strand is used to corroborate and extend the other (Creswell & Plano Clark, 2017).

4. Results and Discussion

4.1 Technology Awareness Against Perceived Organizational Readiness

Table 1. Technology Awareness and Perceived Organizational Readiness by Programme and Stakeholder Group (N = 90)

Stakeholder Group	PSM Awareness	PSM Readiness	DN Awareness	DN Readiness	ENG Awareness	ENG Readiness
Cadets	3.82	3.21	3.24	2.94	3.47	3.08
Lecturers	3.91	3.18	3.31	2.86	3.58	3.02
Industry Experts	4.24	2.86	3.48	2.64	3.76	2.74
Programme Mean	**3.99**	**3.08**	**3.34**	**2.81**	**3.60**	**2.95**

Note. Grand mean awareness = 3.64; grand mean readiness = 2.95; aggregate gap = 0.69.

Awareness exceeds readiness in every one of the nine cells in Table 1, confirming that the gap identified in Section 1 is a general institutional pattern rather than an artefact of any single group or programme. Port and Shipping Management recorded the highest awareness and readiness of any programme across all three stakeholder groups, a pattern consistent with smart port technology's most direct operational relevance sitting within port and shipping management practice specifically, closer to that programme's existing professional domain than to navigation or engineering content. Most consequentially, industry experts recorded both the highest awareness of any group, 3.83 averaged across programmes, and the lowest readiness confidence, 2.75, a pattern this study terms the Practitioner Pessimism Pattern. This is a direct empirical instance of the theoretical distinction Weiner (2009) draws between recognizing a change is needed and believing the organization capable of delivering it: the practitioners closest to the technology's actual operational demands are precisely the group least confident that talent development processes are producing graduates equipped for those demands. Cadets and lecturers, by contrast, showed a smaller awareness-readiness gap and did not differ significantly from each other on either measure, suggesting the pessimism specifically concentrates among those with direct commercial exposure to the technology's operational reality rather than reflecting a generalized institutional mood.

4.2 Statistical Structure of the Awareness-Readiness Gap

Two-way analysis of variance confirmed significant main effects for both programme and stakeholder group on awareness (Major: $F = 12.47$, $p < .001$, eta-squared = .229; Group: $F = 8.63$, $p < .001$, eta-squared = .171) and, at a smaller effect size, on readiness (Major: $F = 3.82$, $p = .026$, eta-squared = .083; Group: $F = 4.16$, $p = .019$, eta-squared = .090). Post-hoc Tukey comparisons for the programme effect on awareness showed Port and Shipping Management scoring significantly higher than Nautical Studies (mean difference = 0.65, $p < .001$) and Marine Engineering (mean difference = 0.39, $p = .006$), with Marine Engineering in turn scoring higher than Nautical Studies (mean difference = 0.26, $p = .042$). For the stakeholder group effect, industry experts scored significantly higher than cadets (mean difference = 0.32, $p < .001$) and lecturers (mean difference = 0.23, $p = .014$), while cadets and lecturers did not differ significantly from each other ($p = .358$).

Critically, the programme-by-group interaction was non-significant for both awareness ($p = .300$) and readiness ($p = .487$), confirming that the two main effects are additive rather than synergistic: the specific combination of a given programme and a given stakeholder role does not produce any effect beyond what the two main effects predict independently. This has a direct talent development implication. Because the Practitioner Pessimism Pattern is a stakeholder-group effect rather than a programme-specific effect, it holds with statistically indistinguishable strength across Port and Shipping Management, Nautical Studies, and Marine Engineering alike. A talent development intervention targeted at Marine Engineering alone, the programme from which this study's qualitative sample was drawn, would therefore leave the same pattern intact among Port and Shipping Management and Nautical Studies experts, who registered comparably elevated awareness alongside comparably depressed readiness confidence. The additive statistical structure thus argues for an institution-wide talent development response rather than a single-programme pilot, a point developed further in Section 5.

4.3 Qualitative Barrier Structure

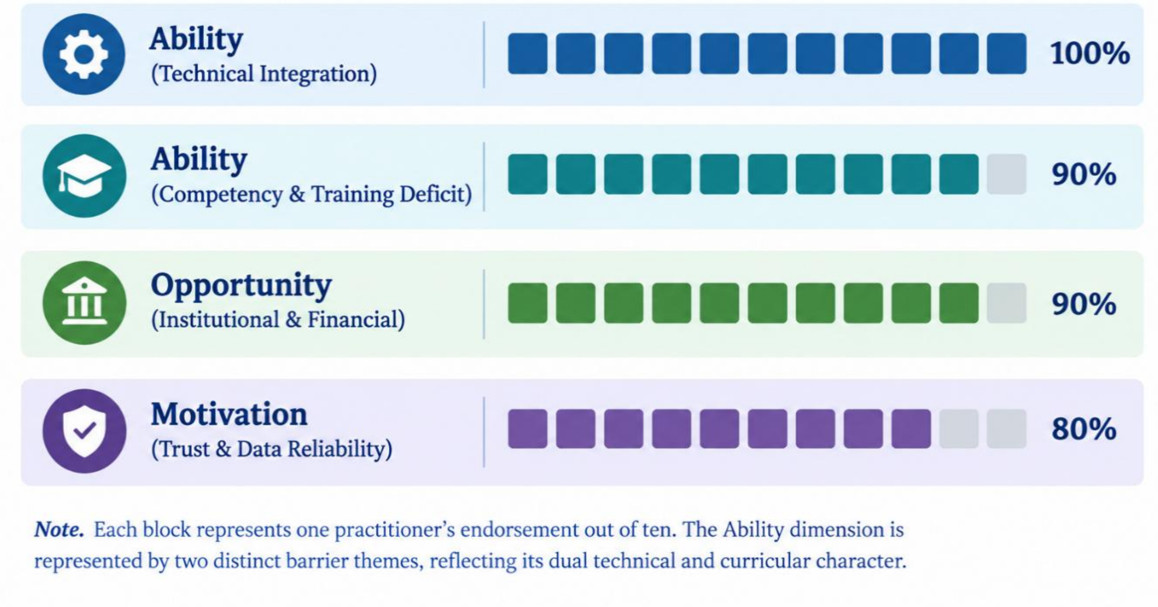
Focus group thematic analysis with ten experienced practitioners identified four compounding barriers to workforce readiness, summarized in Table 2 and mapped here onto the Ability-Motivation-Opportunity structure that organizes green human resource management practice (Renwick et al., 2013).

Table 2. Workforce Readiness Barriers by AMO Dimension (n = 10 practitioners)

AMO Dimension	Barrier Theme	Endorsement	Illustrative Sub-Barriers
Ability	Competency and Training Deficit	9/10	No formal IoT commissioning knowledge; no data interpretation training in curriculum

Ability	Technical Integration	10/10	Legacy equipment incompatibility; limited network bandwidth
Motivation	Trust and Data Reliability	8/10	Sensor false-positive history; algorithmic override resistance
Opportunity	Institutional and Financial Readiness	9/10	No shore-side fleet management centre; absent ROI guidance

Figure 1. Proportional Endorsement of Workforce Readiness Barriers by AMO Dimension



Document analysis corroborated the Ability-dimension finding directly: zero of ten Marine Engineering core module syllabi contained learning objectives related to Internet of Things technology, connecting the Competency and Training Deficit theme to a specific, auditable curriculum gap rather than a general impression of inadequate preparation. All ten practitioners endorsed the Technical Integration theme, describing legacy vessel electrical systems, insufficient network bandwidth for continuous sensor data, and slow classification-society approval processes for new sensor equipment as compounding, rather than independent, obstacles: a graduate with strong data-interpretation training still cannot commission a system on a vessel whose electrical architecture cannot support it, and an institution cannot teach commissioning practice realistically without access to equipment reflecting current commercial specifications.

The Trust and Data Reliability theme, mapped here to the Motivation dimension, is this study's most analytically significant finding, because it identifies a barrier neither the Ability nor Opportunity dimensions alone would predict or resolve. Eight of ten practitioners described direct experience of sensor false-positive alerts, maintenance flags generated by fouling, calibration drift, or installation vibration rather than genuine equipment failure, that produced operational disruption without corresponding benefit. This experience generated a durable motivational resistance to relying on automated systems that persisted even after the underlying technical cause was identified and corrected, a pattern consistent with cybersecurity research showing that a single trust-eroding incident with a safety-relevant system can produce lasting behavioral caution disproportionate to the incident's technical severity (Svilicic et al., 2021). Several practitioners specifically described colleagues who, after one or two false alerts, reverted to manual verification of every automated recommendation, effectively negating the efficiency benefit the technology was installed to provide, an outcome standard technology-adoption frameworks emphasizing relative advantage and organizational capacity (Rogers, 2003; Tornatzky & Fleischer, 1990) do not explicitly account for, whereas the green human resource management framework's explicit separation of ability, motivation, and opportunity as independently necessary conditions correctly predicts that closing the Ability-dimension curriculum gap alone would leave the Motivation-dimension trust deficit unresolved. The Institutional and Financial Readiness theme, mapped to the Opportunity dimension, reinforces this compounding structure from a third angle: nine of ten practitioners cited the absence of a shore-side fleet management centre and clear return-on-investment guidance as reasons their companies had not yet created structured opportunities for graduates to apply whatever competency they did possess, meaning even a fully resourced, trust-building curriculum could still fail to produce workforce readiness if employing companies provide no organizational opportunity to exercise the resulting skill.

Taken together, the four barriers in Table 2 do not simply co-occur; participants described them as actively reinforcing one another in practice. Technical integration complexity is harder to overcome without engineers whose training has already built the ability to reason about Internet of Things architecture generally, so the Ability-dimension deficit compounds the Technical Integration barrier rather than sitting alongside it independently. The trust deficit is, in turn, harder to resolve without data-interpretation training that would let an engineer distinguish a genuine fault signal from sensor noise with confidence, meaning the Ability and Motivation dimensions interact directly rather than operating as separable levers a company could pull one at a time. And the institutional investment case for expanding Internet of Things deployment is harder to make to company leadership without confidence in the available engineering workforce's competency, linking the Opportunity dimension back to the Ability dimension in a closed loop. This compounding structure is the practical reason Section 5 argues against addressing any single AMO dimension in isolation: the qualitative evidence indicates that a talent development intervention targeting only curriculum content, the most common institutional response to a documented competency gap, would likely leave the trust and opportunity barriers fully intact, producing a smaller readiness improvement than the size of the curriculum gap alone would suggest.

4.4 Discussion

These findings answer the three research questions posed in Section 1 directly. The factorial results in Section 4.1 and 4.2 confirm that awareness and readiness diverge systematically across every stakeholder group and programme, with the Practitioner Pessimism Pattern identifying industry experts as the group whose diagnosis carries the greatest evidential weight, since they combine the highest technology familiarity with the lowest confidence in institutional talent development capacity. The qualitative findings in Section 4.3 answer the second question by locating the specific barrier structure beneath this pattern: a genuine Ability-dimension curriculum gap, consistent with prior findings that maritime education content lags technological change (Bogusławski et al., 2022) and that digital literacy requires deliberate curricular attention rather than incidental exposure (Lopes et al., 2025), coexists with an independent Motivation-dimension trust deficit that curriculum reform alone would not resolve. The third question is answered by the pattern's overall shape: a green human resource management framework explicitly separating ability, motivation, and opportunity (Renwick et al., 2013) accounts for this study's findings more completely than a technology-adoption framework built primarily around the technology's own characteristics (Rogers, 2003; Tornatzky & Fleischer, 1990), since the latter offers no natural place for a barrier generated by practitioners' accumulated experience rather than by the technology's design, and since the Technology Acceptance Model's usefulness-ease distinction (Davis, 1989), while correctly predicting that awareness and readiness could diverge, does not on its own specify which organizational dimension, ability, motivation, or opportunity, is responsible for that divergence in a given setting.

This finding extends organizational readiness theory (Weiner, 2009) into a setting the theory's originating literature, largely healthcare implementation science, did not anticipate: an educational institution whose "organization" being assessed for readiness is structurally distinct from the eventual technology-adopting employer, meaning readiness here must be built for a workforce transition the institution itself will never directly experience. It also refines strategic talent management theory's (Collings & Mellahi, 2009) pivotal-position logic by showing that a technology domain can be widely recognized as important, high awareness, while remaining institutionally unclaimed as a pivotal talent category, evidenced directly by the zero-hour curriculum finding in Section 4.3, a distinction the theory's original organizational settings, where pivotal positions are typically formally designated by management, did not need to draw as sharply. Freeman's (1984) stakeholder framework is likewise vindicated methodologically rather than only theoretically: had this study surveyed only lecturers, the standard population for curriculum needs assessment, it would have missed both the sharper pessimism industry experts expressed and the specific trust mechanism only sustained practitioner exposure could surface, reinforcing that a single-stakeholder talent development diagnosis in this sector risks systematic under-detection of the barriers that matter most.

This study's principal strength is its combination of a factorial design capable of isolating role and programme effects with qualitative depth sufficient to identify the AMO-dimension structure beneath the aggregate gap; a survey alone would have documented the Practitioner Pessimism Pattern without explaining it, and a seafarer-competency lens alone (Shi et al., 2024) would have located the deficit in technical knowledge without surfacing the independent motivational barrier. Its main limitation is the single-institution design, which cannot establish whether the specific magnitude of the awareness-readiness gap generalizes to institutions with different industry partnership density or different regional technology exposure. A further limitation is that the qualitative sample was drawn exclusively from Marine Engineering practitioners, so while the non-significant statistical interaction in Section 4.2 supports generalizing the awareness-readiness pattern across programmes, this study cannot confirm that the specific AMO barrier structure identified in Section 4.3, particularly the trust deficit, takes an identical form among Port and Shipping Management or Nautical Studies practitioners rather than a related but distinct one rooted in their own domain's technology exposure. Future research should test whether a talent development intervention explicitly designed around all three AMO dimensions, rather than curriculum content alone, closes the Practitioner Pessimism Pattern more effectively than content-only reform, and should examine whether the trust deficit identified here generalizes beyond Marine Engineering to the other two programmes this study's factorial design shows share the same aggregate readiness gap.

5. Conclusion

This study examined whether an Indonesian maritime institution's technology awareness has converted into genuine organizational readiness for workforce transformation, finding a persistent 0.69-point gap between the two constructs across every stakeholder group and programme measured. Industry experts recorded the sharpest divergence, the highest awareness paired with the lowest readiness confidence, a Practitioner Pessimism Pattern this study documents for the first time. Qualitative analysis located this gap in a compound barrier structure spanning ability, motivation, and opportunity, with a previously undocumented trust deficit proving as consequential as the curriculum shortfall a purely content-focused diagnosis would have emphasized. These findings indicate that closing this institution's readiness gap requires a deliberate talent development strategy addressing all three dimensions jointly, not an awareness-building or curriculum-content intervention alone.

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