Big Data Utilization in Port and Shipping Management Education: An Expert Validation Study

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Abstract
Indonesian port and shipping management has entered a rapid data-driven transformation: the Inaportnet electronic port clearance system, container terminal operating systems, and logistics analytics platforms now constitute the operational data infrastructure within which port and shipping management graduates must work competently from their first professional appointments. Yet the degree to which STIP Jakarta's Port and Shipping Management curriculum equips cadets with the big data literacy and analytical competency these environments require has not been empirically validated against the assessments of practitioners who have directly experienced both historical curriculum outputs and current industry data demands. This study examines big data utilization competency gaps in PSM maritime education through an expert validation design involving 10 retired and active Port and Shipping Management practitioners from the STIP Jakarta expert community, using focus group discussion combined with systematic document triangulation of PSM curriculum materials. Four competency gap clusters were identified: Data Literacy Foundation (moderate curriculum coverage, expert-assessed as insufficient for industry demands), Logistics Analytics Application (low curriculum coverage, highest industry urgency), Platform and System Proficiency (minimal curriculum coverage, high and growing demand), and Data-Driven Decision Making (absent from curriculum, identified as the meta-competency gap most consequential for graduate employability). Document triangulation confirms that 0 of 12 PSM core module syllabi contain assessed big data competency learning outcomes. The study contributes the first expert-validated big data competency gap diagnostic for PSM maritime education in Indonesia and provides specific curriculum integration recommendations derived directly from practitioner demand evidence.

1. Introduction

The container terminal of Tanjung Priok Port that PSM graduates of Sekolah Tinggi Ilmu Pelayaran Jakarta enter upon graduation is not the documentation-and-regulation-oriented workplace that the PSM curriculum was designed to prepare them for. It is a data-intensive operational environment in which the Inaportnet port clearance platform generates and processes thousands of data transactions daily, Terminal Operating

Systems track container movements, vessel positioning, and equipment utilization in real time, and logistics analytics platforms aggregate supply chain data across shipper, carrier, freight forwarder, and customs interfaces whose effective management requires data literacy that the PSM curriculum has not systematically developed [1]. The gap between what PSM graduates are prepared to do upon STIP Jakarta's graduation and what Indonesian port and shipping industry data environments increasingly require them to do represents a specific and measurable curriculum-industry misalignment whose resolution is urgent and whose evidence base, in the form of practitioner-validated competency gap assessment, is currently absent from the Indonesian maritime education literature.

Big data — characterized by the volume, velocity, variety, and veracity dimensions that Laney [2] proposed as the definitional architecture of the big data phenomenon — is not an abstract technology trend but an operational reality for port and shipping management professionals in major Indonesian ports. Container terminals generate millions of sensor and transaction data points per vessel call; shipping companies process continuous AIS position streams, fuel consumption telemetry, and weather routing data across their fleets; freight forwarders manage API-connected logistics platform data across multimodal supply chains. The PSM professional's data literacy requirements span from the foundational — being able to read, interpret, and act on operational data dashboards — to the applied — using logistics analytics tools to optimize container dwell times, identify port throughput bottlenecks, and evaluate carrier performance against key metrics. Neither of these capability levels is adequately addressed by regulatory and operational knowledge instruction that constitutes the current dominant orientation of Indonesian maritime PSM curricula [3].

The expert validation research design — in which practitioners with direct industry experience assess the adequacy of institutional curriculum against the competency demands they have personally encountered — is a methodologically established approach for generating the practitioner-grounded curriculum gap evidence that purely academic curriculum analysis cannot supply [4]. For PSM maritime education specifically, expert validation offers a particularly productive methodology because the practitioner community includes both individuals who completed PSM formation at STIP Jakarta and subsequently encountered big data competency demands in their professional careers — providing a direct curriculum-outcome-demand comparison — and individuals who have recruited and supervised PSM graduates across multiple cohorts — providing a longitudinal assessment of how curriculum output quality has or has not kept pace with industry data environment evolution. This expert community's validation of specific big data competency gap clusters provides the practitioner-demand evidence base that data-driven PSM curriculum reform requires and that literature review of the general big data education field cannot supply.

This study pursues three objectives: first, to map the specific big data competency domains that expert practitioners identify as most urgently underserved by current STIP Jakarta PSM curriculum through systematic focus group discussion analysis; second, to triangulate these practitioner-identified gaps against a systematic review of current PSM curriculum documents, establishing the documentary evidence that the expert-identified gaps reflect curriculum design choices rather than incidental instructional omission; and third, to propose specific, expert-validated big data competency integration priorities for PSM curriculum reform that STIP Jakarta's curriculum development process can immediately engage.

1.1 Theoretical Framework

This study is grounded in two theoretical frameworks that jointly provide the analytical architecture for expert-validated big data competency gap research in maritime vocational education.

Competency-based education theory, as articulated in its maritime vocational application by the STCW Convention's Table A frameworks and elaborated in Boyatzis's [5] foundational competency model, establishes that professional competency is an integrated performance capacity — not merely declarative knowledge or isolated skill — whose specification requires both cognitive, affective, and psychomotor dimensions and whose adequacy can only be fully evaluated against the professional performance demands of the specific occupational contexts within which it must operate. Applied to PSM big data competency, this

framework requires that gap assessment engage not merely whether cadets know what big data is but whether they can perform the specific data literacy tasks — reading container terminal dashboards, interpreting port throughput analytics, using logistics platform reporting functions — that port and shipping management professional contexts require.

Human capital theory, as applied to vocational education curriculum alignment, establishes that the productivity-enhancing purpose of vocational education is fulfilled only when the competencies it develops are matched to the specific capability demands of the labor market its graduates enter [6]. Indonesian port and shipping management's documented digitalization trajectory — with Inaportnet processing growing volumes of digital port clearance transactions annually and Terminal Operating Systems becoming standard across major Indonesian container terminals — establishes a specific human capital alignment imperative that PSM curriculum's current regulatory and operational orientation does not address [1]. Expert validation provides the most direct evidence for the magnitude of this human capital alignment gap, because practitioners who deploy PSM graduates in data-intensive environments directly observe and can articulate the specific competency mismatches between curriculum output and labor market requirement [7].

2. Method

This study employed an expert validation qualitative design combining semi-structured focus group discussion with systematic curriculum document triangulation, conducted at STIP Jakarta from August 2025 to March 2026. Expert validation was selected as the primary design because the study's objective — establishing practitioner-grounded curriculum gap evidence for PSM big data competency — requires the specific form of professional judgment that expert practitioners with both industry experience and curriculum product knowledge can supply, and that literature review or cadet self-assessment cannot substitute for [4].

The participant population comprised 10 Port and Shipping Management experts selected from STIP Jakarta's practitioner network through purposive criterion sampling requiring: minimum 10 years of professional experience in port operations, shipping company management, freight forwarding, or maritime logistics; direct experience with data system deployment in Indonesian port and shipping contexts, including Inaportnet or container Terminal Operating System use; and either direct recruitment or supervision of STIP Jakarta PSM graduates, or personal PSM educational background at STIP Jakarta, providing direct curriculum-output-demand comparison capacity. The n=10 expert sample is consistent with established expert validation design norms for qualitative competency gap research, where depth of practitioner knowledge rather than statistical representativeness is the appropriate sampling criterion [8].

A single extended focus group discussion was conducted with all 10 participants over two three-hour sessions, using a semi-structured protocol organized around four domains: practitioner assessment of current PSM graduate big data literacy levels; identification of specific big data competency gaps most consequential for early-career PSM professional performance; evaluation of current STIP Jakarta PSM curriculum coverage of big data literacy; and prioritized recommendations for competency integration. Participants were provided with relevant PSM curriculum document excerpts for reference during discussion, enabling direct and immediate document-grounded competency gap assessment rather than relying solely on retrospective practitioner judgment.

Document triangulation involved systematic review of all 12 PSM core module syllabi current at STIP Jakarta, coded for the presence, depth, and integration quality of big data literacy learning outcomes using a structured coding rubric covering five dimensions: data tool familiarity objectives, analytics application learning outcomes, platform and system proficiency indicators, data-driven decision making competency statements, and assessed big data performance tasks. Thematic analysis [9] was applied to FGD transcripts with cross-referential integration with document coding findings. Member checking was conducted with two expert participants via email follow-up [10].

3. Results and Analysis

3.1 Curriculum Document Audit: Big Data Coverage in PSM Syllabi

Table 1 presents the results of the 12-syllabus PSM curriculum document review, coded across the five big data literacy dimensions.

Table 1. Big Data Literacy Content Coverage in STIP Jakarta PSM Core Module Syllabi (n = 12)

Big Data Dimension	Syllabi with Any Coverage	Syllabi with Specific Learning Objectives	Syllabi with Assessed Performance Tasks
Data Tool Familiarity	3/12 (25.0%)	0/12 (0.0%)	0/12 (0.0%)
Analytics Application	1/12 (8.3%)	0/12 (0.0%)	0/12 (0.0%)
Platform and System Proficiency	2/12 (16.7%)	0/12 (0.0%)	0/12 (0.0%)
Data-Driven Decision Making	0/12 (0.0%)	0/12 (0.0%)	0/12 (0.0%)
Any Big Data Content	**4/12 (33.3%)**	**0/12 (0.0%)**	**0/12 (0.0%)**

The curriculum document audit reveals a structural pattern of radical incompleteness: while one-third of PSM syllabi contain some form of big data-relevant content, not a single syllabus contains specific big data learning objectives or assessed big data performance tasks. The content that does appear in the 4 syllabi with any coverage is uniformly incidental — references to digital documentation platforms, electronic port clearance within regulatory compliance content, and generic digital business environment discussions that do not constitute big data literacy instruction. Data-driven decision making — the meta-competency that expert participants universally identified as most consequential for PSM graduate professional performance — is entirely absent from all 12 syllabi, confirming that the highest-priority competency identified by practitioners is not merely inadequately covered but completely absent from the formal curriculum architecture.

3.2 Expert FGD Findings: Four Competency Gap Clusters

Thematic analysis of the two-session expert FGD generated four competency gap clusters, organized around practitioners' descriptions of specific professional performance deficits they had observed in PSM graduates or experienced in their own post-graduation professional contexts.

Cluster 1: Data Literacy Foundation. This cluster captures competency in reading, interpreting, and acting on structured data outputs from port and shipping operational systems — the most foundational big data literacy layer. Expert participants described PSM graduates as generally able to recognize the existence of digital data systems but frequently unable to locate specific information within system interfaces, interpret performance metric displays without supervisor assistance, or extract relevant data subsets for specific operational inquiries. "The graduate knows that the terminal operating system exists, but they can't read the equipment utilization dashboard and tell me whether we have a crane availability problem or a vessel positioning problem. That reading skill — we're teaching it on the job from scratch." This gap was assessed as moderate in curriculum severity (some foundational digital literacy instruction exists) but high in industry urgency, given that reading operational data displays is an entry-level professional competency in data-intensive port environments.

Cluster 2: Logistics Analytics Application. This cluster captures the applied analytics competency required to use logistics platform reporting and analysis functions for port throughput assessment, container dwell time analysis, carrier performance benchmarking, and supply chain bottleneck identification. Expert participants described this as the competency domain showing the largest mismatch between curriculum output and current industry demand: "Inaportnet generates data that tells you exactly what's happening

across every vessel call at every Indonesian port. The PSM graduate who can analyze that data — identify patterns, build a simple performance report, propose an improvement — is extremely valuable. We almost never hire that person from STIP; we develop them internally over two years." Document triangulation confirms that analytics application has the lowest curriculum coverage of any competency cluster (1/12 syllabi), consistent with expert assessment.

Cluster 3: Platform and System Proficiency. This cluster captures operational competency with the specific digital platforms constituting Indonesian port and shipping management's data infrastructure, including Inaportnet, container Terminal Operating Systems, freight management systems, and maritime logistics APIs. Experts drew a precise distinction between knowledge of these platforms (knowing they exist and what they do, which they assessed as adequately addressed by curriculum) and proficiency in operating them for practical data tasks (which they assessed as entirely absent from curriculum and frequently absent from graduates). "We don't need graduates who can describe what Inaportnet is in an exam answer. We need graduates who can log in, find a specific vessel's documentation status, identify a clearance delay cause, and escalate appropriately. That's a practical proficiency, not a knowledge item."

Cluster 4: Data-Driven Decision Making. This cluster captures the meta-competency of using data analysis outputs as inputs to professional management decisions — integrating data interpretation with contextual operational judgment to produce reasoned recommendations or actions. Expert participants unanimously identified this as the most consequential gap and the most structurally absent from curriculum: no participants recalled encountering a PSM graduate who had received formal instruction in data-driven decision making, and document triangulation confirms its complete absence from all 12 PSM syllabi. "Data is everywhere in modern port operations. The question is whether our graduates treat it as a tool for thinking or as noise on a screen. Most treat it as noise — not because they're not capable, but because nobody taught them that data is what you think with, not what you report about."

Table 2 presents these four competency gap clusters alongside their expert-assessed industry urgency ratings and document-triangulated curriculum coverage levels.

Table 2. Big Data Competency Gap Cluster Summary: Expert Assessment and Document Triangulation

Gap Cluster	Expert Industry Urgency (1–5)	Curriculum Coverage Level	Priority for Integration
Data Literacy Foundation	4.2/5	Low-moderate (incidental)	High — strengthen existing foundation
Logistics Analytics Application	4.7/5	Minimal (8.3% syllabi)	Highest — new content development needed
Platform and System Proficiency	4.4/5	Minimal (16.7% syllabi)	High — practical proficiency units needed
Data-Driven Decision Making	4.9/5	Absent (0% syllabi)	Critical — meta-competency integration needed

Figure 1 presents the relationship between expert-assessed industry urgency and document-triangulated curriculum coverage across the four gap clusters, visualizing the inverse pattern in which the highest-urgency competencies receive the least curriculum coverage.

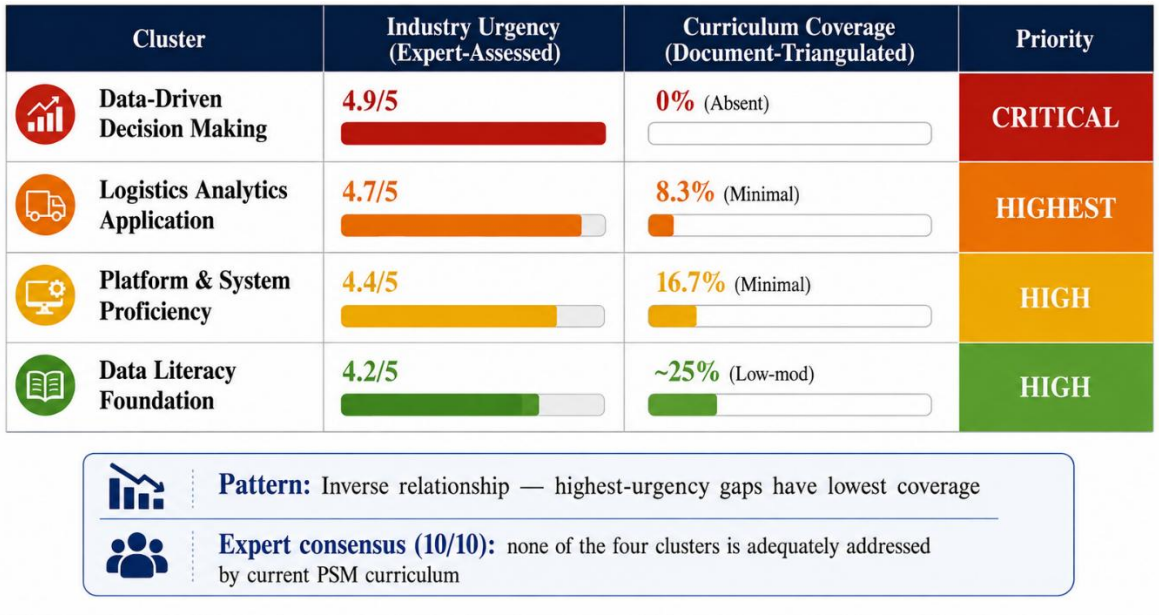

Figure 1. Big Data Competency Gap Cluster Matrix: Industry Urgency vs. Curriculum Coverage

3.3 Discussion

The inverse relationship between expert-assessed industry urgency and document-triangulated curriculum coverage — most starkly expressed in Data-Driven Decision Making's 4.9/5 urgency rating alongside its 0% curriculum coverage — constitutes the study's most institutionally consequential finding and its most direct evidence for the urgency of PSM curriculum reform. This inverse pattern is not the result of benign neglect or resource constraint but reflects a deeper curriculum design assumption: that PSM graduates' primary professional competency requirements are regulatory, operational, and procedural rather than analytical. This assumption was accurate when the current PSM curriculum structure was designed, and it may continue to describe the competency demands of smaller Indonesian ports and domestic shipping companies whose digital maturity is lower than the major hub port environments that expert participants primarily referenced. But for PSM graduates entering the major Indonesian port and international shipping company contexts that STIP Jakarta's institutional positioning most directly prepares them for, the assumption is empirically incorrect, as expert consensus confirms with high consistency [11].

The expert community's distinction between platform knowledge (which curriculum addresses) and platform proficiency (which curriculum does not address) directly parallels the awareness-to-practice gap documented across this research program's other studies of green maritime competency and IMO regulatory readiness — a pattern suggesting that the fundamental curriculum design limitation is not subject matter selection but pedagogical mode: STIP Jakarta's curriculum consistently develops declarative knowledge of professional domains while underserving the applied performance competency that professional practice actually demands [3]. For big data competency specifically, the shift from declarative to applied pedagogy requires not merely additional content but fundamentally different instructional approaches: actual Inaportnet interface navigation exercises, container terminal data analysis case studies using real or realistic operational datasets, and logistics analytics platform sessions producing usable data products rather than textbook readings about data systems.

The Data-Driven Decision Making meta-competency gap — unanimously identified by all 10 expert participants as the highest-urgency gap and documented as completely absent from all 12 PSM syllabi — points to a curriculum philosophy question whose resolution cannot be accomplished through content addition alone: should PSM education form graduates to be proficient executors of established operational procedures (the current curriculum's implicit model) or adaptive professional problem-solvers who use data

as their primary analytical medium (the industry demand model expert participants describe)? The expert community's consensus is unambiguous, and Inaportnet's progressive extension as Indonesia's national port data infrastructure confirms that the industry demand model is not an optional future state but a present operational reality [1].

Study limitations include the n=10 expert sample, which, while appropriate for the expert validation qualitative design and consistent with established norms [8], does not statistically represent the full population of Indonesian port and shipping management practitioners. The PSM-major-exclusive focus of this study does not address the cross-major big data literacy picture available through the broader STIP Jakarta Digital Transformation dataset, which will be addressed in the companion study on Cloud-Based Learning Infrastructure Readiness (DIGITS Paper 4). Future research should validate the four-cluster competency gap framework against a larger expert sample spanning multiple Indonesian maritime institutions and port authority contexts, and investigate whether practitioner-developed curriculum supplementation — through industry-partnership practical exercises and platform-access arrangements with Inaportnet and Terminal Operating System providers — produces measurable improvement in PSM cadet logistics analytics and data-driven decision making competency relative to the current curriculum baseline.

4. Conclusion

This study has established through expert validation and document triangulation that STIP Jakarta's Port and Shipping Management curriculum exhibits a systematic, structurally embedded big data competency gap across all four identified clusters — Data Literacy Foundation, Logistics Analytics Application, Platform and System Proficiency, and Data-Driven Decision Making — with the inverse relationship between expert-assessed industry urgency and curriculum coverage confirming that the highest-priority competencies are precisely those most absent from the formal curriculum. Data-Driven Decision Making's 4.9/5 urgency rating alongside its 0% curriculum coverage represents the most critical single gap finding and the most urgent curriculum reform priority. These findings provide STIP Jakarta's PSM curriculum development with the practitioner-demand evidence base necessary for specific, prioritized curriculum reform — moving from regulatory and procedural instruction as the primary competency development mode toward applied analytics pedagogy that develops the data-literate, decision-capable port and shipping management graduates that Indonesia's accelerating port digitalization requires.

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