J-naker
Jurnal Ketenagakerjaan

Jurnal Ketenagakerjaan
Volume 21 No. 1, 2026
Online ISSN: 2722-8770
Print ISSN: 1907-6096

Comparison of Indonesian and European Logistics Competency Frameworks in Supply Chain

Vina Dwiyanti[1], Ana A[2]*, Edi Supardi[3], Yusep Sukrawan[4]

[1,2,4]*Technical and Vocational Education Study Program, Universitas Pendidikan Indonesia, Bandung, Indonesia*
[1]*Logistics Engineering Study Program, Universitas Pendidikan Indonesia, Bandung, Indonesia*
[2]*Technical and Vocational Education and Training Research Center (TVET RC), Universitas Pendidikan Indonesia, Bandung, Indonesia*
[3]*Associate Degree Program in Logistics Administration, Universitas Logistik dan Bisnis Internasional*

*Email Correspondence: *ana@upi.edu*

Abstract

Rapid advancements in digital technologies, increasing sustainability pressures, and the growing complexity of global supply chains have reshaped the competency landscape for logistics professionals. This study conducts a comparative analysis of transversal skill requirements in the Indonesian logistics sector by benchmarking industry expectations against the existing national competency framework (SKKNI) and the European Logistics Association Qualifications Framework (ELAQF). Drawing on recent literature and industry reports (2022–2025), the findings reveal significant discrepancies across five critical domains: digital, managerial, technical, soft, and green skills. While industry practices increasingly demand integrated system proficiency, analytics-driven decision-making, agile management, and sustainability awareness, SKKNI remains largely procedural, emphasizing manual tasks and basic operational functions. To address these gaps, the study proposes an Integrated Transversal Skills Framework that conceptualizes how the five skill domains collectively enhance employability, workforce agility, and readiness for digital and green logistics transformation. This conceptual model highlights the strategic importance of embedding transversal skills into curriculum design, professional training, and national qualification updates. The study concludes that modernizing Indonesia's competency standards is essential for strengthening workforce competitiveness and aligning with global logistics trends. Future research should focus on empirical validation of the proposed model and sector-specific assessments across warehousing, transport, and supply chain services.

Keywords: digital and green logistics, logistics competency framework, skill gap analysis, transversal skills, workforce development.

DOI:10.47198/naker.v21i1.703 Received: 03-03-2026 Revised: 07-04-2026 Accepted: 30-04-2026

1. Introduction

Indonesia's logistics sector has experienced significant growth in recent years. According to Supply Chain Indonesia (2025), the transportation and warehousing industry is projected to contribute IDR 1,623.65 trillion to the national Gross Domestic Product (GDP), reflecting a 12.53% increase from the previous year. This upward trend is supported by activity in manufacturing, trade, agriculture, forestry, and fisheries. However, rapid growth in volume and economic contribution has not been accompanied by proportional improvements in logistics system readiness, particularly in terms of workforce competencies and global competitiveness. Despite this positive performance, Indonesia continues to face systemic challenges related to logistics efficiency and policy integration. The Logistics Performance Index (LPI) shows declines in key indicators such as customs process efficiency and infrastructure quality, suggesting the need for improvements in the national logistics ecosystem (Iskandar & Arifin, 2023).

Amid these developments, the logistics and supply chain sector increasingly requires not only technical expertise but also a broad range of transversal skills, including digital competencies, soft skills, and green skills. The World Economic Forum (2023) estimates that 40% of the global workforce will require reskilling due to rapid technological disruption. Similarly, the global shift toward digitalization and decarbonization in shipping highlights the importance of sustainable and technology-oriented competencies, with approximately 450,000 seafarers projected to need further training by 2030 to operate low-carbon fuels and emerging digital systems (Reuters, 2024). This transformation indicates that workforce competency standards are no longer locally bound but must be aligned with internationally recognized frameworks to ensure global workforce mobility and competitiveness. In Europe, efforts to address evolving skill needs are reflected in the ELA Qualification Framework (ELAQF), which aligns with the European Qualification Framework (EQF) and outlines competence expectations through an outcome-based structure (European Logistics Association, n.d.).

In Indonesia, competency development is outlined through the SKKNI for logistics, formalized through several Ministerial Decrees, including No. 94/2019 and No. 170/2020. These standards encompass a wide range of logistics occupations, from warehouse operators to supply chain managers (Coordinating Ministry for Economic Affairs of the Republic of Indonesia, n.d.). However, in the context of increasing globalization and cross-border labor competition, the adequacy of SKKNI in reflecting internationally benchmarked competencies becomes a critical issue. Initial observations reveal notable differences between SKKNI and internationally recognized frameworks such as the ELAQF, particularly in the integration of transversal skills, outcome-based descriptors, and alignment with emerging industry demands. This discrepancy raises concerns regarding the potential misalignment between Indonesia's national competency standards and global industry expectations, which may hinder workforce adaptability and international recognition like ELAQF. Moreover, industry feedback indicates persistent skills mismatch issues. Data from BPS and the World Bank show that approximately 44% of employers in Indonesia face challenges in finding workers with appropriate competencies, signaling a gap

between education outputs and labor market needs (JLIAIRA, 2023). Previous studies also highlight that vocational education related to logistics has not fully incorporated essential digital, managerial, and sustainability-oriented competencies (Nur Aini Alhamda, Hidayah, & Marezka, 2022).

Despite growing attention to workforce competency development, three research gaps remain. First, existing studies have not adequately conducted comparative analyses between SKKNI and global competency frameworks such as ELAQF, with most research focusing on industry needs or general curriculum evaluation rather than structural and conceptual framework comparisons. This lack of comparative evidence limits the ability to justify whether Indonesia's competency standards are globally competitive or require fundamental reform. Second, limited emphasis has been placed on mapping transversal skills within these competency standards, even though such skills are crucial in the modern logistics landscape. Third, previous research has rarely applied a qualitative comparative approach to explore alignment gaps, structural differences, and implications for vocational curriculum development. Without such analysis, policy interventions risk being incremental rather than transformative, and may fail to address the root causes of skills mismatch. These gaps highlight the need for a systematic and in-depth comparison between ELAQF and SKKNI to strengthen Indonesia's logistics competency framework in line with global standards.

Therefore, this study aims to analyze the alignment between the ELAQF and SKKNI frameworks in the logistics and supply chain sector using a qualitative comparative approach. By explicitly examining the gap between national and international competency standards, this study responds to the urgent need for evidence-based policy and curriculum reform in Indonesia's logistics sector. This study offers a novel contribution by providing a structured comparative analysis between SKKNI and ELAQF, which has been largely absent in previous research, particularly in the Indonesian logistics context. Unlike prior studies that focus primarily on industry demand or curriculum evaluation, this research integrates a framework-based comparison with an in-depth mapping of transversal skills, including digital, managerial, and green competencies. Furthermore, this study introduces a qualitative comparative approach to systematically identify alignment gaps and structural differences, thereby offering a more comprehensive understanding of competency standard integration across national and international contexts.

The objectives of this research are to map and compare the structure, skill domains, and outcome-based descriptors of both frameworks; to identify differences and similarities in the integration of transversal skills such as digital, managerial, and green competencies; to examine the relevance of Indonesia's SKKNI to current and emerging industry needs; and to provide recommendations for enhancing competency standards, curriculum development, and workforce training programs. By doing so, this study not only contributes to the academic discourse on workforce competency frameworks but also provides actionable insights for policymakers, educators, and industry stakeholders in aligning Indonesia's logistics workforce development

with global standards.Through this analysis, the study seeks to contribute to the development of a more responsive and competitive logistics workforce in Indonesia.

2. Research method

This study adopts a qualitative comparative approach as the most appropriate method to examine the alignment between competency frameworks, which are inherently textual, structured, and context-dependent in nature. Unlike quantitative approaches that focus on measurable variables, this study aims to explore conceptual structures, underlying assumptions, and the meaning embedded within competency descriptors. Therefore, a qualitative approach enables an in-depth interpretation of how competencies are defined, categorized, and operationalized across different frameworks. Furthermore, the comparative design is essential because the primary objective of this research is not only to describe each framework independently, but to systematically identify similarities, differences, and alignment gaps between SKKNI and ELAQF. This approach allows for a structured cross-framework analysis that highlights inconsistencies in skill domains, qualification levels, and the integration of transversal competencies.

The use of qualitative comparative analysis is also justified by the need to capture contextual differences between national and international standards, particularly in relation to global labor market demands, digital transformation, and sustainability trends. Through this approach, the study is able to provide nuanced insights that go beyond surface-level comparison, offering a deeper understanding of how competency standards can be harmonized. In addition, this method supports the development of evidence-based recommendations, as it enables the identification of specific areas where SKKNI may require adaptation or enhancement to align with globally recognized frameworks such as ELAQF. Thus, the qualitative comparative approach is not only methodologically relevant but also strategically aligned with the study's objective to inform policy, curriculum development, and workforce training. The overall research process is presented in Figure 1.

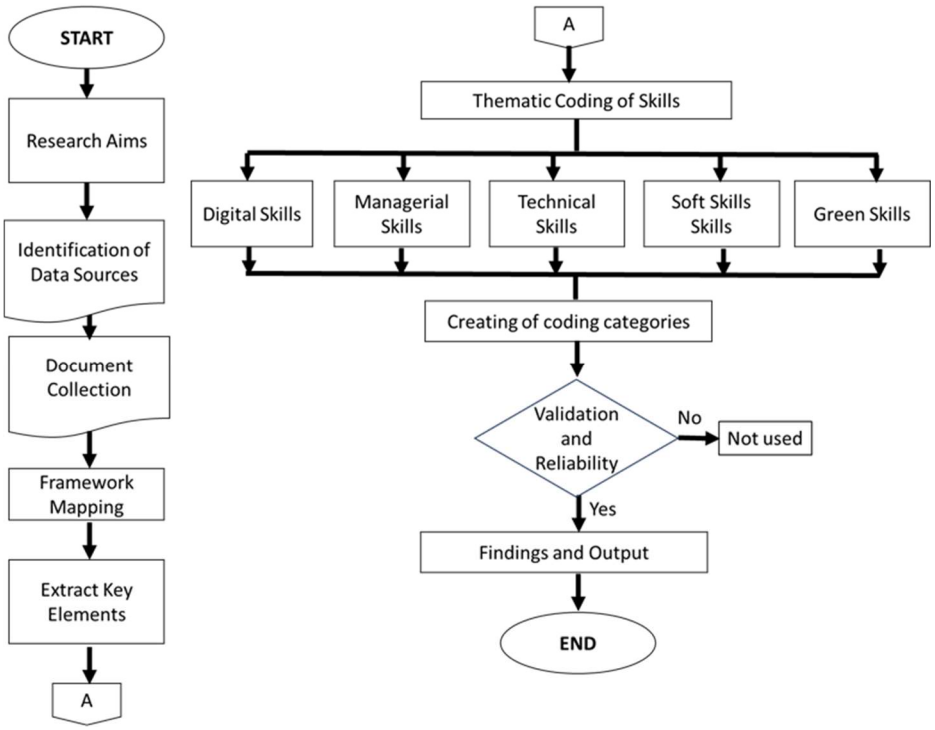

Figure 1. Flow of Research

Based on the stages shown in Figure 1, this study adopts a systematic qualitative research design to ensure methodological transparency and replicability. To address the research objectives, the study is organized into clearly defined sequential stages consisting of data identification, data collection, data analysis, and validation.

2.1. Data Sources

First step is identification of data sources. Data sources consist of primary documents: SKKNI regulations and ELAQF framework, and supporting literature: journal articles, policy reports, and international publications related to logistics competencies. These included peer-reviewed journal articles on logistics competencies and qualification frameworks, International's reports (e.g., WEF Future of Jobs, OECD skills outlook), National studies related to workforce readiness, vocational education alignment, and skills gaps in Indonesia's logistics sector.

2.2. Data Collection

In the data collection stage, this study applies a systematic document review protocol following the flowchart stage document collection. Data were gathered through a systematic document review conducted during the first two months of the six-month research timeline. The process included: (1) identifying and retrieving all documents relevant to logistics competencies and qualification frameworks. Search Keywords used ("transversal skills" OR "soft skills" OR "core competences") AND ("circular economy" OR "circular job" OR "warehouse" OR "reverse logistics"

OR "green logistics"); (2) applying explicit inclusion and exclusion criteria for screening documents for alignment with research aims, particularly focusing on documents that contain description of skill domains, qualification levels, and competency descriptors. Inclusion criteria are peer-reviewed journal articles discussing skills, competencies, or job roles within the context of the circular economy/logistics/warehousing; Published in English; Published between 2021–2025; Exclusion criteria are Non-academic articles; Conference proceedings without peer review; Studies focusing solely on technology without addressing human skill aspects. From 556 sources, included criteria are 50 sources that used in this study; (3) cataloguing and organizing documents using a structured database to ensure tracerability and consistency. Each document was reviewed at least twice to minimize omission and ensure data completeness. The steps correspond to the subsequent analytical stages shown in the flowchart (Framework Mapping and Extract Key Elements).

2.3. Data Analysis

The data analysis process follows a structured and transparent sequence aligned with the flowchart, consisting of Framework Mapping, Extracting Key Elements, Thematic Coding, Development of Coding Categories, and Comparative Analysis. In the Framework Mapping and Extract Key Elements stages, both competency frameworks were systemically examined to extract: Qualification levels, Competency descriptors, Skill domains (technical, cognitive, transversal), Expected workplace performance indicators. All extracted data were organized into comparative matrices to facilitate systematic cross-framework analysis and ensure analytical consistency. Reflecting the flowchart's thematic branches (Digital, Managerial, Technical, Soft, and Green Skills), a coding framework was developed using a deductive approach based on predefined skill categories derived from the literature. Operational definitions were established for each category to guide the coding process and reduce subjectivity. Coding was conducted manually by identifying relevant keywords, phrases, and competency descriptors within the documents and analyzing key phrases, learning outcomes, and competency descriptors. To enhance reliability, the coding process followed clear coding rules and category definitions, and ambiguous cases were revisited iteratively to ensure consistency by comparing SKKNI and ELAQF in table 1. To improve reliability, the coding process followed consistent coding rules, and iterative refinement was applied when discrepancies or ambiguous classifications were encountered.

The final analytical stage parallels the decision step in the flowchart before arriving at Findings and Output. A qualitative comparative content analysis approach was employed: (1) structure of the framework (e.g., levels and hierarchy); (2) competency descriptors (e.g., outcome-based vs. task-based orientation); (3) coverage of skill domains (technical, cognitive, and transversal skills); and (4) integration of emerging competencies, particularly digitalization and sustainability. These criteria ensure that the comparison is systematic, transparent, and reproducible.

To further strengthen validity, multiple strategies were employed, including data triangulation across policy documents and supporting literature, peer debriefing with subject-

matter experts, and the use of an audit trail documenting all analytical decisions. These procedures enable the study to achieve analytical rigor while ensuring that the findings can be traced, verified, and replicated in future research. Because the study is based solely on documents and secondary literature, it involves no human subjects and does not require ethical clearance. All materials were used exclusively for academic purposes with strict adherence to citation and integrity standards.

3. Results and Discussion

3.1. Mapping and Alignment Between Frameworks (ELAQF vs SKKNI)

The comparison between ELAQF and SKKNI reveals a fundamental structural misalignment. ELAQF adopts a capability-based approach that emphasizes analytical reasoning, digital integration, and sustainability awareness. In contrast, SKKNI remains largely task-oriented, focusing on procedural and operational competencies. This difference reflects a deeper divergence in how workforce readiness is conceptualized.

From the perspective of Human Capital Theory, competencies represent strategic investments that enhance worker productivity, adaptability, and long-term economic value. However, the current SKKNI framework reflects a narrow interpretation of human capital development, focusing primarily on routine and task-specific skills rather than higher-order cognitive and analytical capabilities. This limitation reduces the potential return on human capital investment, particularly in sectors undergoing rapid technological transformation such as logistics. Modern logistics systems increasingly require workers who can operate within digitally integrated and data-driven environments. However, SKKNI continues to prioritize manual and routine tasks, limiting the development of higher-order competencies.

As a result, the current framework risks preparing workers for roles that are vulnerable to automation rather than for adaptive and analytical positions. This condition can be further explained through Skill Mismatch Theory, which highlights the misalignment between the skills supplied by education and training systems and those demanded by the labor market. The persistence of task-oriented competencies within SKKNI indicates a structural mismatch, where workers are trained for declining job profiles while industry demand shifts toward digital, analytical, and sustainability-oriented roles. This misalignment may contribute to persistent skills mismatch and reduced workforce competitiveness. Based on the comparative dataset between ELAQF Level 4 and SKKNI Level 4, the competencies were reorganized into five transversal skill categories: Digital, Managerial, Technical, Soft, and Green Skills. This reclassification aligns with widely used logistics competency frameworks, including ELAQF/EQF standards and the Indonesian SKKNI structure for logistics and supply chain occupations. The adjusted classification is presented in table 1.

Table 1. Comparative TS Betwen ELAQF and SKKNI

Skill Category	ELAQF Level 4	SKKNI Level 4
Digital Skills	1) Integrated use of ICT across logistics functions, including WMS (4.4.06.12) 2) TMS (4.4.07.08) 3) CRM systems and data analytics (4.4.09.04).	1) Operating logistics information systems (stock management, warehouse systems). 2) IT system protection and data security (H.52LOG00.050.1 3) Digital usage is limited to operational-level system handling.
Managerial Skills	1) Decision-making in logistics operations (4.1.02.05). 2) Chairing and leading meetings (4.1.02.06). 3) Participation in change management processes (4.1.02.02). 4) Project documentation and coordination (4.2.04.01).	1) Leading and managing team effectiveness (BSBWOR502). 2) Managing coordination in procurement and warehousing. 3) Adaptive planning in routine operational contexts. 4) Managerial skills focus mainly on daily operations, not strategic leadership.
Technical Skills	1) Execution of logistics operations: warehousing, transport coordination, inventory flow, and documentation (4.4.xx.xx modules). 2) Technical handling of hazardous goods (4.4.06.09). 3) Use of logistics performance indicators (KPIs).	1) Technical operations in warehouse activities (picking, storing, inventory control). 2) Procurement and supply chain technical procedures. 3) Hazardous goods handling according to national standards (H.52LOG00.023.1).
Soft Skills	1) Communication across organizational functions (4.1.02.04) 2) Cross-functional teamwork (4.1.02.03). 3) Team management (4.1.02.07). 4) Behavioral decision-making as soft managerial competence.	1) Communication and coordination skills. 2) Discipline, teamwork, and SOP compliance. 3) Team leadership within routine operations (BSBWOR502) 4) Soft skills emphasized more behaviorally than strategically.
Green Skills (Sustainability & Safety)	1) Lean logistics principles for resource efficiency (4.2.03.04). 2) Safe storage of hazardous goods (4.4.06.09). 3) Warehouse safety procedures and risk prevention (4.4.06.11).	1) Implementation of OHS/K3 procedures (H.52LOG00.023.1). 2) Awareness of hazardous goods handling. 3) Focused primarily on health and safety compliance, with limited integration of sustainability principles.

Based on table 1, the two frameworks reflect distinct epistemological orientations: ELAQF adopts a capability-based approach that emphasizes integrative reasoning, digital-enabled decision-making, and sustainability-oriented judgment, whereas SKKNI embodies a task-based, compliance-driven conception of vocational competence (Thai et al., 2024; Jin et al., 2024). This divergence can be analytically interpreted as a contrast between "dynamic human capital formation" and "static skill reproduction." ELAQF promotes dynamic capabilities that enable workers to adapt to technological and organizational changes, while SKKNI reinforces static competencies tied to predefined tasks. According to Human Capital Theory, such static orientation limits skill accumulation over time and reduces workforce mobility across roles and industries. In high-performing logistics systems, competencies are increasingly defined by cognitive adaptability, systems thinking, and analytical responsiveness—capabilities that are largely absent in SKKNI (Mhaske, 2025; Mishrif, 2023).

More critically, the SKKNI framework appears to reinforce an outdated industrial paradigm in which logistics work is conceptualized as linear, manual, and operational. From a Skill Mismatch perspective, this paradigm contributes to what is often described as a "structural lag," where institutional frameworks fail to keep pace with technological and industrial transformation. As a result, education and training systems continue to produce graduates whose competencies are misaligned with real-world job requirements. Such a paradigm stands in stark contrast to empirical evidence showing that modern supply chains operate as digitally synchronized, data-intensive socio-technical systems, requiring workers who can interface with AI-driven analytics, integrated logistics platforms, and green performance metrics (Jin et al., 2024; Trevisan, 2025). The persistence of a narrow operational orientation in the SKKNI indicates that national standards are not keeping pace with emergent capability demands. This gap raises concerns about the potential institutional reproduction of low-skill labor markets, where workers are systematically prepared for roles vulnerable to automation rather than for supervisory, analytical, or innovation-oriented functions.

A further critical issue concerns the absence of sustainability competencies in the SKKNI. Within the Human Capital framework, sustainability competencies can be viewed as "future-oriented capital," which enhances long-term employability and supports green economic transitions. The absence of such competencies in SKKNI indicates a short-term orientation in competency development, limiting the ability of the workforce to respond to global environmental and regulatory pressures.

Although green skills are globally recognized as central to the future of logistics and supply chain resilience, SKKNI limits sustainability to procedural adherence under occupational safety regulations. This framing neglects broader imperatives of energy optimization, circular resource flows, and carbon-reduction strategies that are now central to green logistics performance (Trevisan, 2025). Consequently, the framework may inadvertently hinder the development of a workforce capable of supporting Indonesia's transition toward sustainable logistics ecosystems.

The findings indicate that achieving meaningful alignment requires more than incremental adjustments. From a theoretical standpoint, addressing the identified gaps requires a shift from a supply-driven competency model toward a demand-driven and adaptive human capital development approach. This involves aligning national standards not only with current industry needs but also with anticipated future skill demands, as emphasized in both Human Capital and Skill Mismatch theories. Rather, it calls for a fundamental redesign in which policymakers and curriculum developers shift vocational standards toward a capability-oriented, technologically integrated, and sustainability-driven learning model. Without such transformation, the gap between the competencies of Indonesian vocational graduates and the evolving demands of digital and green supply chains is likely to widen, potentially affecting employability, productivity, and overall national competitiveness (Mhaske, 2025; Thai et al., 2024). Accordingly, this study not only maps existing competency gaps but also emphasizes the need to reconsider how national qualification systems conceptualize logistics work in response to ongoing technological and environmental transitions. Furthermore, the differences between ELAQF and SKKNI in five domains skills are illustrated in Figure 2.

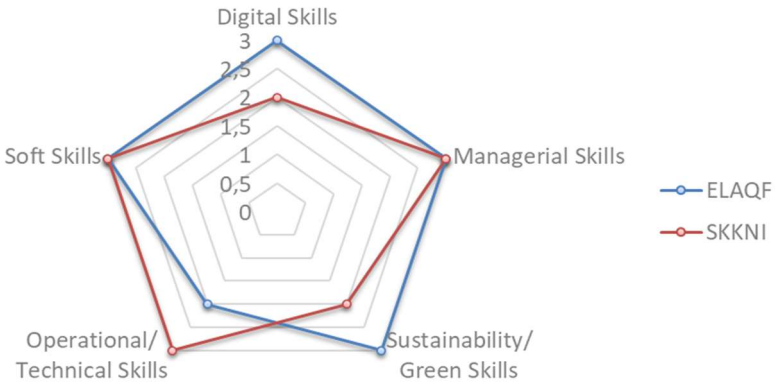

Figure 2. Comparison ELAQF and SKKNI

Figure 2 presents a radar chart comparing ELAQF Level 4 and SKKNI Level 4, revealing a clear contrast in competency emphasis. This pattern empirically supports the existence of a skills mismatch, particularly in high-value competency domains such as digital, managerial, and green skills. According to Skill Mismatch Theory, such gaps are associated with lower productivity, inefficient labor allocation, and reduced innovation capacity at the sectoral level. A key gap in SKKNI lies in the limited scope of digital competencies. From a Human Capital perspective, digital competencies represent high-value skills that significantly enhance worker productivity and adaptability. The limited inclusion of these competencies in SKKNI suggests an underinvestment in critical forms of human capital required in Industry 4.0 environments. ELAQF explicitly incorporates ICT applications such as WMS, TMS, and CRM, along with data analytics and cross-functional digital integration as expected workplace outcomes. In contrast, SKKNI primarily focuses on system operation and IT security, with less attention to analytics,

ERP integration, and data-driven decision-making capabilities. This pattern aligns with existing studies on logistics digitalization and workforce readiness, which consistently highlight a persistent digital skills gap, particularly in the Global South and ASEAN region (Aravindaraj et al., 2022; Gayatri, 2022). Prior research indicates that the adoption of Industry 4.0 technologies necessitates a shift from procedural skills toward analytical and system-level competencies, while national assessments in Indonesia point to a mismatch between workforce capabilities and industry demands in digital domains (Aravindaraj et al., 2022; Gayatri, 2022).

Second, managerial competencies reveal a qualitative mismatch: although both frameworks nominate leadership and coordination, ELAQF specifies higher-order managerial behaviours (formal decision-making, chairing meetings, change management, and project documentation), whereas SKKNI frames leadership primarily as operational team supervision. This distinction matters because contemporary supply chains require managers who can enact rapid reconfiguration, cross-functional coordination, and strategic decision-making under uncertainty — capabilities associated with dynamic managerial competencies in the literature (Müller, 2023). Empirical work on supply chain agility and ad-hoc responses to disruption shows that managerial decision quality and formal governance routines are key determinants of adaptive performance (Müller, 2023; Patrucco et al., 2023).

Third, a significant gap is observed in the domain of green and sustainability competencies. ELAQF integrates elements such as lean logistics, resource efficiency, and environmental safety into its expected learning outcomes. In contrast, SKKNI primarily emphasizes Occupational Health and Safety (OHS) and hazardous materials handling, without explicitly linking these aspects to broader sustainability indicators, circular practices, or efficient resource management. This limitation is critical, as recent studies demonstrate that green logistics competencies and green human resource management are closely associated with improved environmental performance and organizational resilience (Setyadi et al., 2023). The lack of sustainability-oriented framing within national competency standards may therefore constrain graduates' readiness to engage in decarbonization efforts and circular logistics systems, which are becoming increasingly integral to industry development.

Fourth, although technical/operational skills are well covered in SKKNI (warehouse operations, inventory control, procurement workflows), the comparative analysis shows a divergence in orientation: SKKNI foregrounds task-level proficiency whereas ELAQF situates technical skills within an outcomes-based, performance-oriented framework that includes KPI usage and cross-functional integration. The literature suggests that coupling technical proficiency with performance evaluation and digital enablers improves operational effectiveness and supports the transition to hybrid roles (technical + analytical) required by modern logistics operations (Aravindaraj et al., 2022).

Finally, soft skills (communication, teamwork, discipline) are the area of closest convergence between the two frameworks; both frameworks acknowledge their centrality for employability. Nevertheless, ELAQF frames soft skills in more structured and strategic terms (e.g., meeting

facilitation, cross-functional negotiation), whereas SKKNI emphasizes procedural cooperation and SOP compliance. This nuanced difference aligns with broader calls for TVET reform which argue that soft skills must be taught as strategic, situational competencies rather than as generic behavioural traits (ILO, 2023).

The mapped gaps most pronounced in digital, green, and strategic managerial domains have direct implications for TVET curriculum design and national standards revision. Three priority reforms are suggested: (1) explicitly integrate strategic digital literacy (ERP/TMS/analytics) and assessment of digital problem-solving into SKKNI units; (2) embed sustainability and lean logistics principles into green-skills units and align OHS with environmental performance indicators; and (3) introduce competency units on decision-making, meeting leadership, change management and project documentation to elevate managerial capacity. These recommendations resonate with international policy guidance calling for stronger industry–education calibration, modular upskilling pathways, and performance-oriented competency descriptors to support digital and green transitions (ILO, 2023; Setyadi et al., 2023; Aravindaraj et al., 2022).

3.2. Industry Skill Requirements in the Indonesian Logistics Sector

Recent transformations in global logistics characterized by rapid digitalization, heightened sustainability pressures, and increasingly agile supply chain configurations have fundamentally reshaped the competency expectations for logistics professionals in Indonesia. These developments have accelerated the integration of advanced digital systems, expanded sustainability-driven logistics practices, and promoted cross-functional collaboration within supply chain networks (World Economic Forum, 2024; ADB, 2023). These transformations reinforce the central argument of Human Capital Theory, where continuous skill upgrading and reskilling are essential to maintain workforce relevance in rapidly evolving industries. At the same time, persistent gaps between SKKNI and industry requirements reflect systemic skill mismatch conditions, particularly in emerging domains such as digital logistics and sustainability. Contemporary literature emphasizes that logistics professionals must now possess not only technical abilities but also transversal skills supporting adaptability, analytical reasoning, and problem-solving in dynamic operational environments (Hohenstein & Feisel, 2022; Ivanov, 2023). Within this context, a comparative analysis between industry-driven skill requirements and Indonesia's national competency framework (SKKNI) becomes essential to evaluate alignment and identify structural gaps.

A review of recent international and domestic publications reveals three core clusters of competencies increasingly emphasized by logistics employers. First, digital logistics competencies—such as operating WMS, TMS, ERP, and analytics-based dashboards—are now central to daily performance. Industry reports consistently highlight that digital literacy and basic data analytics for real-time decision-making have become foundational requirements rather than advanced specializations (DHL, 2023; McKinsey & Company, 2024). Second, green logistics and sustainability skills have grown in prominence due to regulatory pressures and global ESG

commitments. Competencies such as emissions monitoring, eco-efficient routing, waste minimization, and circular logistics practices are recognized as emerging global standards (UNCTAD, 2023; Korchi & Bentaleb, 2024). Third, transversal soft and managerial skills—such as cross-functional communication, team coordination, and agile decision-making—have become indispensable in technology-enabled and customer-responsive logistics systems (Schenk & Weber, 2022; PwC, 2024). These clusters closely align with the holistic competency structure of the ELAQF, which integrates technical, cognitive, and interpersonal skills.

However, the comparative analysis reveals a clear divergence between industry-aligned competencies and those articulated in the national SKKNI, as presented in Table 2. Industry practices and the ELAQF framework consistently emphasize the integration of digital systems, data-driven decision-making, sustainability, and managerial adaptability. In contrast, SKKNI remains largely oriented toward procedural, manual, and task-specific logistics functions (Kemnaker RI, 2022). For example, contemporary warehouse operations increasingly require personnel to interpret performance indicators, interact with automated systems, and operate within digital workflows. The SKKNI continues to prioritize conventional tasks such as documentation, manual inventory handling, and basic operational routines. Moreover, limited attention is given to analytical capabilities, system integration, and decision-making competencies, indicating that the framework has not been fully aligned with the demands of digital transformation (Sari et al., 2023).

This structural gap becomes more apparent when examined through the lens of transversal competencies across five domains. First, the digital skills gap reflects the limited inclusion of integrated systems, analytics, and strategic ICT applications within SKKNI compared to industry requirements and ELAQF standards (Heriot-Watt University, 2024). Second, the managerial skills gap is evident in the minimal emphasis on decision-making, agile leadership, and change management, despite their growing importance in modern logistics contexts (Leon et al., 2024). Third, the technical skills gap highlights the discrepancy between industry needs—such as KPI-driven operations, automation literacy, and multi-system integration and SKKNI's continued focus on manual processes (Bylund & Martínez, 2024). Fourth, the soft skills gap underscores the limited representation of communication, negotiation, and problem-solving competencies, which are consistently identified as critical by employers (WEF, 2024). Finally, the green skills gap is particularly pronounced, as sustainability-related competencies are not explicitly embedded within SKKNI, despite the global transition toward low-carbon and circular logistics systems (UN ESCAP, 2023; OECD, 2024).

However, without a systematic and evidence-based revision mechanism, the competency framework risks becoming increasingly misaligned with the rapid technological and structural transformation of the logistics sector. This lag reflects deeper institutional challenges, including slow regulatory update cycles, limited industry engagement, and insufficient benchmarking against international frameworks. If these constraints persist, Indonesia may face widening mismatches between workforce capabilities and industry demands, reduced productivity, and

declining competitiveness within regional supply chain networks, where digital and sustainability competencies are becoming baseline requirements. Therefore, the modernization of SKKNI should be positioned not merely as a technical revision, but as part of a broader strategic reform. Such reform must strengthen governance mechanisms, enhance collaboration between industry and policymakers, and establish continuous updating systems to ensure that competency standards remain responsive to ongoing changes in the logistics landscape.

Table 2. Comparative Summary of Transversal Skill Gaps between Industry Requirements and SKKNI and Their Implications

Competency Domain	Current Industry Requirements (Industry Practice)	SKKNI Condition (National Standard)	Type of Gap (Comparative Gap)	Implications (Curriculum & Training Development)
Digital Skills	Mastery of WMS/TMS/ERP; multi-system integration; basic data analytics; digital troubleshooting	Focus on basic ICT; does not include digital integration and analytics	Major gap in strategic digital literacy and analytics	Integration of digital logistics modules; system-based practice; KPI-driven analytical tasks
Managerial Skills	Decision-making; agile leadership; change management; project coordination	Procedural supervision and routine operational control	Does not include agility and change readiness	Case-based learning; decision-making simulations; project-based leadership training
Technical Logistics Skills	KPI-driven operations; warehouse automation; IoT-based tracking; multi-system workflows	Manual operations; basic documentation; lacks modern technical integration	Insufficient modern technical competencies aligned with warehouse digitalization	IoT and automation curriculum; hands-on exposure to integrated systems
Soft Skills	Negotiation; cross-functional communication; problem-solving; teamwork agility	Minimally explicit; not measurable; focused on basic discipline	Interpersonal skills inadequate for cross-functional operations	PBL; communication assessment; cross-program/industry teamwork
Green Logistics Skills	Emission tracking; eco-routing; green warehousing; circular logistics	Not explicitly included; focuses only on OHS	Significant lack of environmental and green logistics literacy	Sustainability modules; environmental audit practices; circular economy case studies

3.3. Conceptual Model for Transversal Skills Development

The proposed conceptual model integrates five domains of transversal skills, digital, managerial, technical, soft, and green into a unified framework aimed at addressing the

competency gaps between industry requirements and national standards. This model is grounded in emerging evidence that logistics workforce capability increasingly depends on a multidimensional skill set encompassing technological, cognitive, and sustainability-oriented competencies (World Bank, 2024; Hohenstein & Feisel, 2023). As supply chains continue to evolve through digitalization and environmental transformation, transversal skills have become key determinants of employability and workforce adaptability (Tan et al., 2023; Wüstemann et al., 2022). This model is theoretically grounded in Human Capital Theory, which emphasizes the importance of multidimensional skill development in enhancing productivity and employability. By integrating digital, managerial, technical, soft, and green skills, the model reflects a holistic approach to human capital formation that aligns with the demands of modern logistics systems.

At the center of this framework is the Integrated Transversal Skills Model, illustrated in Figure 2, which conceptualizes digital, managerial, and technical skills as core enabling competencies for operating within technology-intensive logistics systems. These domains form the foundation upon which other competencies are developed and applied. Digital skills—particularly in WMS/TMS platforms, data analytics, and system troubleshooting—are no longer specialized capabilities but essential operational requirements (Krittayakieran et al., 2024; Deloitte, 2023). Managerial competencies, including agile decision-making, leadership, and change management, function as cognitive enablers that support adaptation to uncertainty and technological disruption (Fernando & Long, 2022). Meanwhile, technical logistics skills remain critical in linking automation processes, KPI-based performance systems, and multi-platform operations (Rayi et al., 2023).

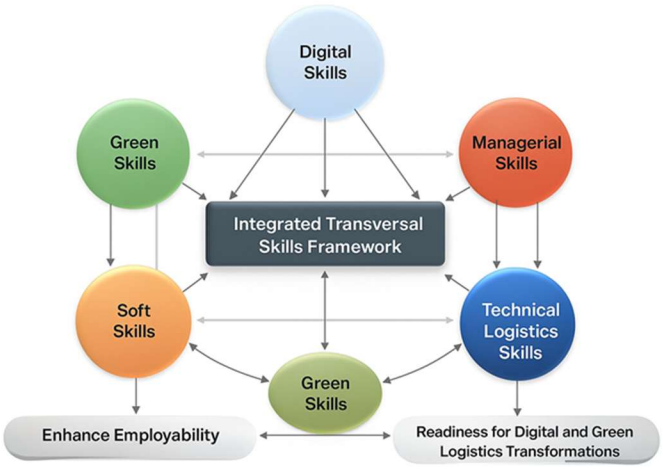

Figure 3. Conseptual Model of Transversal Skills Development for the Indonesia Logistics Workforce

Figure 2 visually represents the integration of five transversal skill domains digital, managerial, technical, soft, and green skills within a single developmental framework. The model illustrates how these competencies interact to reduce identified skill gaps and strengthen workforce readiness in the logistics sector. Within the model, digital, managerial, and technical

skills are positioned at the core, reflecting their role as foundational competencies that underpin modern logistics operations. Their central placement signifies their importance in enabling effective performance in environments characterized by digital systems, automation, and data-driven workflows. Surrounding these core domains, soft skills and green skills function as complementary competencies that enhance collaboration, problem-solving, and sustainability integration, thereby supporting more adaptive and future-ready workforce capabilities. At the same time, the model also addresses the structural issues highlighted in Skill Mismatch Theory by proposing a framework that bridges the gap between education outputs and industry requirements. The integration of transversal skills is expected to reduce mismatch by aligning competency development with real-world job demands and future skill trajectories.

Encircling the core are two complementary domains Soft Skills and Green Logistics Skills. Their placement on the outer layer suggests that while not always directly operational, they are essential in shaping worker adaptability, communication effectiveness, and environmental responsibility. These outer competencies serve as cross-cutting enablers that strengthen interactions within and across supply chain networks. Arrows or linking lines in the diagram (if included) visually emphasize the interconnectedness and bidirectional influence among all skill domains. This shows that transversal skills do not function in isolation; instead, they reinforce one another. For example:

1) Digital skills enhance the effectiveness of managerial decision-making and technical operations.
2) Managerial and soft skills jointly support agile leadership and collaboration.
3) Green skills introduce sustainability awareness into both technical and digital workflows.

The structure of the proposed model reflects a synergistic system in which the integration of transversal skill domains plays a central role in addressing the misalignment between industry expectations and the current SKKNI framework. As illustrated in Figure 2, the model emphasizes that embedding these competencies in a holistic and interconnected manner—particularly within curriculum design and workforce training—can significantly enhance graduate readiness for both digital transformation and sustainable logistics practices. Taken together, the model conveys a clear strategic implication: strengthening multidimensional transversal skills is essential to developing a logistics workforce that is not only technically competent, but also adaptive, competitive, and responsive to ongoing technological and environmental changes.

Surrounding these foundational competencies is the soft skills domain, which functions as a relational layer essential for cross-functional coordination, communication, and collaborative problem-solving. Recent studies emphasize that interpersonal and communication capabilities significantly influence logistics performance, especially within digitally interconnected supply networks (Leung et al., 2022; Suharto et al., 2024). Complementing this is the green skills domain, which anchors the model in sustainability literacy—covering emission tracking, eco-routing, waste minimization, and circular logistics. These competencies are widely acknowledged as

emerging requirements due to the global shift toward carbon-sensitive supply chains and ESG compliance frameworks (UNCTAD, 2024; Govindan & Hasanagic, 2022).

The interaction among these five domains creates a synergistic skill ecosystem. Digital and technical capabilities enhance operational accuracy and data-driven decision-making; managerial and soft skills facilitate agility and coordination; and green skills embed long-term environmental responsibility into logistics practices. This integrated system directly addresses the skill gaps previously identified in the comparison between industry requirements, ELAQF, and SKKNI—particularly gaps in analytics, multi-system integration, agile leadership, and sustainability awareness (Akbar et al., 2023; Nurlaila & Wibowo, 2024). By embedding these underrepresented competencies into curriculum and training designs, the model supports a more holistic, industry-aligned approach to workforce development.

Ultimately, this conceptual model reinforces graduate competitiveness by equipping workers with the transversal competencies demanded by technologically advanced and sustainability-driven logistics ecosystems. It strengthens employability through a balanced skill portfolio that aligns with global logistics transformations and anticipates future occupational demands (OECD, 2025). In doing so, the model positions Indonesia's logistics workforce to support national competitiveness, digital readiness, and green logistics transitions within regional and global supply chains.

4. Conclusion and Recommendations

This study provides clear evidence that Indonesia's national logistics competency standards are no longer adequately aligned with the realities of contemporary logistics and supply chain systems. The comparative analysis reveals a structural and multidimensional gap between the procedural, task-oriented orientation of SKKNI and the digitally integrated, analytics-driven, agile, and sustainability-centered competencies demanded by industry. This misalignment is not marginal; it is systemic. As logistics operations increasingly depend on digital platforms, cross-functional coordination, adaptive decision-making, and environmentally responsible strategies, the continued reliance on predominantly manual and operational definitions of competence risks constraining workforce competitiveness and slowing national integration into global logistics networks.

The proposed Integrated Transversal Skills Framework advances a decisive shift from fragmented technical skill definitions toward a holistic competency ecosystem that integrates digital, managerial, technical, soft, and green as core competencies. To operationalize this transformation, several targeted policy actions are recommended. First, the government (e.g., Kemnaker) should initiate a structured revision of SKKNI by incorporating outcome-based competencies, particularly digital skills (ERP, WMS, analytics), sustainability practices, and higher-order managerial capabilities. Second, a modular upskilling system (e.g., micro-credentials) should be developed to support continuous workforce training through TVET

institutions and training centers. Third, alignment between SKKNI and education curricula must be strengthened through mandatory industry-based learning (apprenticeships, project-based learning) and periodic curriculum audits. Fourth, a regular benchmarking mechanism (every 3–5 years) referencing international frameworks such as ELAQF/EQF should be institutionalized. Finally, implementation should be supported by clear performance indicators (e.g., employability rates, digital skill integration) and capacity building for instructors and training infrastructure. Without concrete and coordinated policy measures, the competency gap will persist; with systematic and actionable reforms, Indonesia can strengthen workforce quality, enhance global competitiveness, and position its logistics sector at the forefront of digital and sustainable transformation.

Acknowledgement

The authors gratefully acknowledge the financial support provided under the Doctoral Dissertation Research Grant Program (Program Penelitian Disertasi Doktoran) funded by BIMA, Kementerian Riset, Teknologi, dan Pendidikan Tinggi (KEMRISTEKDIKTI), under Master Contract Number 101/C3/DT.05.00/PL/2025 (2025). This funding support significantly contributed to the completion of this research. The authors also extend sincere appreciation to the Technical and Vocational Education and Training Research Center (TVET RC), the Technical and Vocational Education Study Program, and the Logistics Engineering Study Program at Universitas Pendidikan Indonesia (UPI), as well as the Associate Degree Program in Logistics Administration at Universitas Logistik dan Bisnis Internasional (ULBI), for their institutional support, academic collaboration, and scholarly input throughout the research process. Constructive feedback from colleagues and industry practitioners is also gratefully acknowledged, as it strengthened the analytical rigor and conceptual development of this study.

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