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The Influence of Technological Developments and Human Resource Competence on the Reliability of the Logistics System of the Indonesian Navy Aviation Center

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Abstract *— This research investigates the impact of technological development and human resource competence on thereliability of the logistics system within the Indonesian Naval Aviation Center (Puspenerbal). Using aquantitative approach and SmartPLS analysis, the study surveyed 136 personnel directly involved in logisticsmanagement. The variables examined include technological influence (innovation, adaptability, communicationand collaboration), human resource competence (knowledge, skills, experience), combined effects of technologyand HR competence (operational efficiency, risk management, technological usability), and logistics systemreliability (timeliness, stock availability, service quality). Results show that both technological advancement andHR competence significantly influence logistics reliability, with operational efficiency and risk managementacting as key mediating factors. The study highlights the importance of integrating advanced digital logisticssystems with continuous HR development to enhance operational readiness. These findings provide strategicinsights for strengthening defense logistics management, ensuring timely and effective support for navalaviation operations.*

Keywords — *Technology, Human Resources, Logistics Reliability*

I. INTRODUCTION

In the context of modern defense, logistics constitutes one of the decisive factors for the success of militaryoperations. The reliability of a logistics system is not merely a matter of the availability of supplies or spareparts, but also encompasses the speed of distribution, cost efficiency, and the quality of services provided tooperational units. The Naval Aviation Center of the Indonesian Navy (Puspenerbal), as a key component insupporting naval operations, faces considerable challenges in ensuring that every operational requirement ofnaval aviation can be fulfilled accurately and in a timely manner.

Advancements in information technology, the digitalization of logistics, and the enhancement of human resourcecompetencies are critical variables that influence the degree of logistics system reliability. Global developmentsindicate that digital transformation in military logistics has become an urgent necessity. The experiences ofvarious navies around the world—such as the U.S. Navy with its Navy ERP (Enterprise Resource Planning) program and the Royal Navy with its Defence Logistic Transformation affirm that the utilization of advancedtechnologies not only improves efficiency but also strengthens logistics resilience in adapting to the dynamics ofoperational environments.

Nevertheless, technology alone cannot deliver optimal benefits without being supported by adequate personnelcompetencies. Therefore, the combination of technological advancement and human resource competence servesas two complementary elements in building a reliable logistics system. This study originates from the practicalnecessity of Puspenerbal to enhance the effectiveness of its logistics system, while simultaneously addressing anacademic gap concerning empirical studies on the interaction between technology, human resourcecompetencies, and the reliability of military logistics in Indonesia.

II. METHOD

The literature review underscores that modern logistics systems are profoundly influenced by technologicaldynamics and the quality of human resources. The Resource-Based View (RBV) theory (Barney, 1991) positsthat an organization's competitive advantage depends on its ability to leverage internal resources, both in theform of technological assets and personnel skills. In the context of military logistics, this theory is translated intothe mastery of logistics information systems, automation of distribution processes, and the enhancement ofpersonnel knowledge and skills in operating new technologies.

Christopher (2016), in his work on logistics and supply chain management, emphasized the importance of digitaltechnology integration in achieving operational efficiency. Similarly, Tseng et al. (2018) found that the use ofBig Data and predictive analytics can significantly improve the accuracy of logistics planning in the defensesector. From the perspective of human resource competence, Govaerts et al. (2011) highlighted that thecombination of experience, technical skills, and adaptability is a dominant factor in building a resilient logisticssystem. Several studies in Indonesia also support this argument. For instance, Andriani (2020), in her researchon the Indonesian Army (TNI AD) logistics system, demonstrated that the success of technologyimplementation in logistics largely depends on the readiness of human resources to adopt change. However, limited research has explicitly examined the direct relationship between technological development, humanresource competence, and logistics reliability within the Indonesian Navy, particularly at Puspenerbal.

Accordingly, this study addresses the existing literature gap by providing an empirical analysis using PartialLeast Squares Structural Equation Modeling (PLS-SEM) to test the relationships among these variables. Thestudy adopts a quantitative approach with a survey design. The research involved 136 respondents fromPuspenerbal personnel directly engaged in the logistics system, comprising officers, non-commissioned officers, and enlisted personnel within the Duklog, Matud, Wasmutu, and Bekmat units. The research instrumentconsisted of a questionnaire employing a five-point Likert scale, measuring four main variables:

1. Technological Influence (X1): innovation, adaptability, communication, and collaboration.
2. Human Resource Competence (X2): knowledge, skills, and experience. Combination of Technology & HR Competence (X3): operational efficiency, risk management, and technology usability.
3. Logistics System Reliability (Y): timeliness, stock availability, and service quality.

Data analysis was conducted using SmartPLS 4, consisting of the following stages: instrument validity and reliability testing, measurement model evaluation (outer model), structural model evaluation (inner model) and hypothesis testing.

III. Results and Discussion

The findings of this study, obtained through data processing using Structural Equation Modeling (SEM) with theSmartPLS software, indicate significant relationships between technological development, human resourcecompetence, and the integration of both variables with the reliability of the Puspenerbal logistics system. Theanalysis involved 136 respondents comprising Puspenerbal personnel, including structural officials, planningstaff, and operational personnel directly engaged in logistics activities. Initial results demonstrate that thevariable of technological development measured through indicators of innovation, adaptability, and digital-basedcommunication and collaboration exerts a positive influence on logistics system reliability. This is evidenced bysignificant path coefficients and t-statistics exceeding the minimum threshold, signifying that higher levels oftechnology utilization and mastery correlate with greater logistics system reliability in supporting IndonesianNaval Aviation operations. For example, the implementation of digital applications in supply chain monitoringand aircraft spare parts inventory systems has enhanced stock data accuracy and accelerated decision-makingprocesses related to operational requirements distribution.

Furthermore, human resource competence including knowledge, skills, and experience was also found tocontribute significantly to logistics system reliability. The analysis reveals that personnel with in-depthunderstanding of military logistics procedures, proficiency in operating supporting technologies, and hands-onexperience in logistics missions play a critical role in minimizing distribution errors, improving deliverytimeliness, and maintaining service quality. Within the Puspenerbal context, personnel with technicalcertifications and prior operational experience are better equipped to anticipate potential distribution challengessuch as transport delays or communication barriers and to provide more effective solutions. Subsequent findingsshow that the combination of technological development and human resource competence produces a synergisticeffect on logistics system reliability. This integration manifests in improved operational efficiency, enhancedrisk management, and optimized technology usability. For instance, the implementation of real-time logistics information systems can only deliver maximum benefits when supported by personnel skilled in data analysisand experienced in interpreting operational demand patterns. Thus, the success of the

Puspenerbal logisticssystem is determined not only by the availability of modern technologies but also by personnel readiness toemploy them effectively.

Further discussion highlights that the reliability of the Puspenerbal logistics system can be assessed throughthree main indicators: timeliness, stock availability, and service quality. In terms of timeliness, the application ofinternal Navy-based distribution tracking technology has reduced the risk of delays in the delivery of spare partsand aviation support equipment. Regarding stock availability, the integration of digital inventory systems withmanual evaluations conducted by experienced personnel has resulted in more accurate record-keeping, therebyminimizing the risk of shortages during operations. From the perspective of service quality, the synergy betweenintranet-based military communication technologies and the interpersonal skills of logistics personnel hasfostered faster and more effective coordination across units, ensuring that operational requirements are metaccording to established standards.

The analysis results confirm that all indicators achieved loading factor values above 0.7, with AVE valuesexceeding 0.5 and Composite Reliability greater than 0.8, establishing the validity and reliability of the researchinstrument. The R-square value for logistics system reliability (Y) is 0.672, indicating that 67.2% of the variancein logistics system reliability can be explained by technological development, human resource competence, andtheir integration. Specifically, the direct effect of technological development on logistics system reliabilityyielded a path coefficient of 0.312 ($p < 0.01$), indicating a significant influence. Human resource competencealso showed a significant effect, with a path coefficient of 0.287 ($p < 0.01$). Meanwhile, the combination oftechnology and human resource competence demonstrated the strongest influence, with a path coefficient of0.421 ($p < 0.001$).

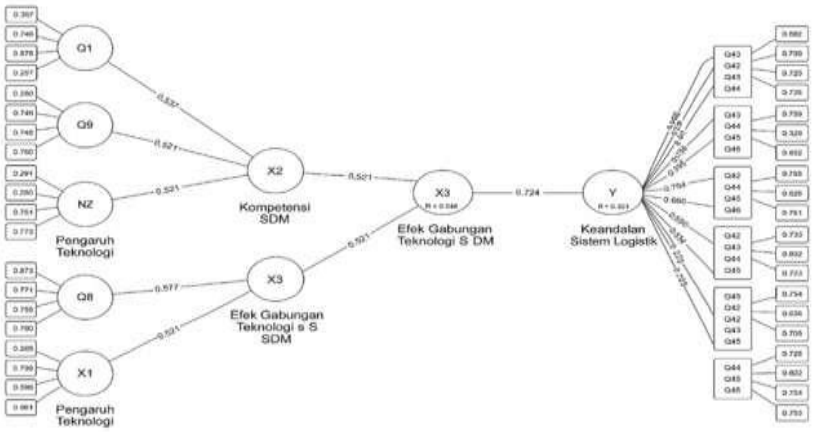

Figure 1. SEM Visual Model

These findings reinforce the theory that the reliability of modern logistics systems is determined not only by thequality of technology but also by the readiness of human resources to operate it. When compared withinternational research, such as Gattorna's (2019) study on dynamic supply chains, the results of this study alignwith the argument that integration with digitalization is a key determinant of logistics resilience. From a globalperspective, the navies of the United States, the United Kingdom, and Australia have already implementeddigital defense logistics systems. Their systems are based on real-time data integration, predictive maintenance, and the use of cloud-based logistics. The strength of such systems lies in the speed of decision-making and theiradaptability to operational disruptions. However, the greatest challenge which is also highly relevant to theIndonesian context concerns the limited competence of personnel in operating complex digital systems. Thisstudy shows that while technology plays a critical role, the success of logistics systems ultimately depends onthe preparedness of personnel.

This finding provides an important note for Puspenerbal: modernization strategies in logistics should not solely prioritize technological investments but must also emphasize capacity-building for personnel through education, training, and operational experience. Nevertheless, this study has certain limitations. First, the research samplewas restricted to the Puspenerbal environment; hence, the results cannot yet be generalized to the entireIndonesian Navy logistics system. Second, the study employed a purely quantitative approach, which

did notexplore qualitative aspects such as organizational culture or resistance to change. For future research, it isrecommended to conduct comparative studies across different branches of the Indonesian Armed Forces, or evenbetween Indonesia's military logistics system and those of other Southeast Asian countries. Furthermore, adopting a mixed-methods approach that combines quantitative and qualitative analysis could provide a morecomprehensive understanding of the factors influencing the reliability of defense logistics systems.

IV. CONCLUSION

Based on the results of this study on the influence of technological development and human resourcecompetence on the reliability of the logistics system at the Naval Aviation Center of the Indonesian Navy(Puspenerbal), several comprehensive, systematic and scientific conclusions can be drawn, as follows:

1. Technological development has been proven to have a significant influence on improving the reliabilityof the logistics system. Indicators covering innovation, adaptability, and technology-basedcommunication and collaboration demonstrate that the utilization of modern technology acceleratеslogistics distribution flows, enhances data transparency, and reduces the risk of human error. Theanalysis shows that the integration of digital-based logistics information systems, the use of real-timemonitoring devices, and the application of standardized communication technologies make tangiblecontributions to timeliness, stock availability, and service quality. Thus, technological advancementserves as a key factor in strengthening the efficiency and effectiveness of logistics management withinPuspenerbal.
2. Human resource competence also plays a crucial role in ensuring logistics system reliability. Thevariables of knowledge, skills, and experience among logistics personnel contribute to the optimizationof technology utilization and distribution process management. Personnel with sufficient technicalcapacity are capable of operating digital logistics systems effectively, analyzing data accurately andmaking timely and appropriate decisions in response to dynamic operational demands. Moreover, operational experience provides added value in terms of risk anticipation, improvisation underemergency conditions, and the application of practical solutions to maintain logistics continuity. Therefore, human resource competence is a vital pillar supporting logistics reliability, particularly inmilitary operations that demand precision, speed, and accuracy.
3. The synergy between technological development and human resource competence has been shown toenhance operational efficiency, strengthen risk management, and optimize the usability of availabletechnologies. The positive interaction between these two variables produces a logistics system that isadaptive, reliable, and responsive to situational changes. Technology without competent personnelcannot be fully optimized, while skilled personnel require advanced technologies to enhanceproductivity and effectiveness. In other words, the success of logistics management at Puspenerbal isthe result of a harmonious combination of technological factors and personnel competence.
4. Logistics system reliability, as measured by timeliness, stock availability, and service quality, hassignificantly improved through the implementation of technology and the enhancement of humanresource competence. Timeliness in distribution is better guaranteed through digital-based monitoringsystems that enable real-time process control. Stock availability is more accurately managed throughdata-driven inventory systems, reducing the risks of shortages or oversupply. Service quality has alsoimproved, as reflected in higher internal user satisfaction, smoother operations, and fewer incidents ofdelays or distribution failures.

Accordingly, strengthening Puspenerbal's logistics system must be pursued through a dual strategy: acceleratingthe adoption of modern logistics technologies and enhancing the capacity of the personnel who manage thesystem. This study emphasizes that the success of logistics management in supporting the operational readinessof the Indonesian Navy is not only determined by technological infrastructure but also by the quality, expertiseand experience of the personnel who operate it. These findings carry strategic implications for policydevelopment within Puspenerbal. First, continuous investment is required in the modernization of informationtechnology based logistics systems. Second, enhancing human resource competence through education, training, and career development programs must be prioritized to ensure that personnel can master new technologies andrespond effectively to dynamic military logistics needs. Third, stronger integration between technological andhuman factors is needed through a unified logistics management system based on the principles of efficiency, precision and adaptability. In sum, this study reaffirms that the reliability of Puspenerbal's logistics system can be achieved through astrong synergy between technological development and human resource competence. The findings are expectedto serve as a foundation for strategic policy-making in the development of a modern, adaptive and highlycompetitive military logistics system in support of the Indonesian Navy's primary mission.

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