

The Paradox of Competence and Information Overload: Optimizing Decision-Making and Performance in Shrimp Aquaculture

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ABSTRACT

Shrimp aquaculture industry is a sector characterized by high volatility and extreme biological risks. This research analyzes how supervisor leadership, team competence, and information quality function as determinants in the decision-making process and their implications for organizational performance. This study employs a quantitative approach with a cross-sectional survey design conducted in shrimp cultivation operational units at PT Central Proteina Prima (West Area). Data collected through perception-based questionnaires aggregated at the work unit level and analyzed using PLS-SEM. Population consisted of 450 cultivation operators and 75 supervisors, with a sample of 300 employees. Path analysis results while supervisor leadership exhibits a strong positive effect on organizational performance ($\beta = 1.066$, $p < 0.001$), team competence paradoxically exerts a significant negative effect on performance ($\beta = -0.217$, $p = 0.006$) and decision-making quality. Furthermore, formal decision-making quality failed to mediate the relationships, and high information quality was found to significantly weaken the influence of leadership on decision quality ($\beta = -0.288$, $p < 0.001$). These findings confirm the importance of adaptive crisis leadership in optimizing organizational performance in environments characterized by biological risk.

Key word: Leadership, Organizational Performance, Determinants of Decision-Making, Information Quality, Aquaculture Industry

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INTRODUCTION

Whiteleg shrimp (*Litopenaeus Vannamei*) cultivation has emerged as a leading export commodity generating substantial foreign exchange, as reflected in its 6.6% share of the global market and export value exceeding USD 2.16 billion in 2022. It contributes significantly to Gross Domestic Product and has broad socio-economic impacts through large-scale employment and the provision of a vital protein source for communities (KKP, 2023). The whiteleg shrimp cultivation industry has transformed from a traditional commodity sector into a capital-intensive industry that relies heavily on precision and risk management (Wijayanto & Pariyanti, 2024). However, the margin for error in pond operations is extremely narrow; fluctuations in water quality parameters or undetected pathogen spikes

can trigger total crop failure within hours (Pratiwi et al., 2023). These conditions often lead to slow and imprecise decision-making, which ultimately reduces productivity and increases the risk of operational errors (Maity et al., 2020).

The success of intensive farming systems depends heavily on effective monitoring to balance complex technical and economic parameters (Emerenciano et al., 2022). While every industry aims to achieve superior performance characterized by high productivity, efficiency, and profitability, the reality in practice often reveals a significant gap between expected targets and actual achievements (Maylor et al., 2023). This performance gap is reinforced by the results of a financial feasibility study of shrimp ponds in Lampung, which found the farming business model to be financially unviable (Lutfiani et al., 2025). In addition, gaps in team competence weaken the implementation of sanitation Standard Operating Procedures (SOPs), increase vulnerability to disease outbreaks, and ultimately reduce the productivity and effectiveness of shrimp farming organizations (Patanasatienkul et al., 2023). As illustrated in Figure 1, the practice of sharing equipment between ponds without adequate disinfection demonstrates low biosecurity awareness, indicating a clear team competence gap in field operations.



Figure 1. Use of shared tools between cultivation ponds

Source: Internal data, 2025

Conceptually, this study proposes model refinement by positioning decision-making quality as the central mechanism. Referring to Hjelle et al. (2024), decision quality is not only determined by objective accuracy but also by the level of satisfaction and confidence of decision-makers in the choices made in complex situations. This study argues that different mechanisms influence decision quality through human factors, namely leadership and team competence. For team competence (operators), technical expertise and absorptive capacity serve as direct inputs that determine the ability to execute tasks and detect operational problems in the field (Andriani, 2021). In contrast, the influence of leadership (supervisors) is contingent or situational. A supervisor with an effective leadership style capable of directing and motivating subordinates will only be able to produce high-quality decisions

when supported by accurate and timely information quality. Therefore, this study offers novelty by examining the role of information quality as a specific moderating variable in the relationship between leadership and decision-making quality, while team competence is positioned as a crucial direct antecedent.

PT Central Proteina Prima (CPP) is a leading company that plays a vital role in the development of the aquaculture industry in Indonesia. Since its establishment in 1983, CPP has developed modern and sustainable shrimp cultivation technologies and contributed significantly to increasing shrimp production for both domestic consumption and export markets. Nevertheless, shrimp cultivation operations face a series of complex operational challenges, including global competitive pressures, ecological sustainability issues, and the threat of disease outbreaks that have the potential to cause significant economic (Pratiwi et al., 2023) According to Emerenciano et al. (2022), the success of the production cycle and corporate profitability are largely determined by the ability to manage various technical and business parameters effectively.

Although extensive literature emphasizes the significance of leadership and team competence in driving organizational performance (Natsir et al., 2024), a critical review reveals several substantial research gaps. First, most existing studies predominantly examine the direct effects of these human resources on performance, leaving the underlying cognitive mechanisms unexplained. Second, while some mediation studies exist, they frequently utilize different mediators such as employee engagement (Nusraningrum et al., 2024) or innovation performance (Mustafa et al., 2021). To date, there is a scarcity of research that specifically positions formal decision-making quality as a central mediating mechanism bridging both leadership and technical competence simultaneously. Finally, and most crucially, previous studies have largely treated information quality merely as an independent predictor (Zohry & Al-Dhubaibi, 2024). There is no existing empirical work that tests Information Quality as a moderating variable (boundary condition) for supervisory leadership within the highly volatile and biologically extreme context of intensive aquaculture. In addition, this study explores the role of decision-making quality as a mediating variable in the relationship between supervisor leadership and team competence and organizational performance, while also examining how information quality moderates the influence of supervisor leadership on decision-making quality.

RESEARCH METHOD

This study use quantitative approach with an explanatory research design. Explanatory research aims to test causal relationships among variables specified in the conceptual model through numerical measurement and statistical analysis (Goktas & Dirsehan, 2024). This approach was chosen because the main objective of the study is to explain the causal relationships among the variables examined and to test the hypotheses that have been formulated. The proposed model requires an approach capable of

testing causal relationships simultaneously and comprehensively; therefore, this study applies a quantitative method using Partial Least Squares–Structural Equation Modeling (PLS-SEM).

The study was conducted at PT Central Proteina Prima (West Area), which covers the Bangka-Belitung and Kalimantan regions. Data were collected online using Google Forms distributed directly to respondents. The research was carried out over approximately four months, beginning with research planning and problem formulation in August–September 2025, followed by data collection and preliminary processing in October–November 2025, and concluding with data analysis and discussion in December 2025.

Population in this study includes all individuals actively involved in operational and managerial activities within vannamei shrimp cultivation business units under the partnership scheme between the core company, PT Central Proteina Prima (CP Prima), and its pond partners. The population consists of two main groups: cultivation supervisors assigned by the core company to partner ponds, totaling 75 individuals, and cultivation operators who are local workers responsible for daily operational activities, totaling 450 individuals.

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To mitigate risk of Common Method Bias (CMB), which frequently threatens the validity of behavioral research, this study employed a two-source data collection (matched-pair) design combined with a two-stage cluster sampling technique (Mudi & Alhaji, 2024). In the first stage, 75 cultivation supervisors responsible for active pond units were selected. In the second stage, three operators were randomly selected for each supervisor based on Monte Carlo simulation recommendations to ensure precision (Mokkink et al., 2023), resulting in a total of 225 operator respondents.

Crucially, the independent variable, Leadership (X1), was exclusively measured by the 225 operators as direct subordinates. In contrast, the remaining variables (team competence, information quality, decision making quality, and organizational performance) were independently assessed by the 75 supervisors. The operator-level data were subsequently aggregated to the group level (pond unit) to produce a single composite score representing each supervisor's leadership style. The statistical justification for this aggregation was rigorously validated using the within-group agreement index (rwg), which yielded highly consistent values ranging from 0.758 to 1.000, alongside a significant

Intraclass Correlation Coefficient (ICC). These results confirm that variance between pond units exceeds variance within units. This robust multi-source design ensures the structural integrity of the data prior to PLS-SEM analysis.

PLS-SEM was selected due to its robustness in handling complex models involving simultaneous direct, mediating, and moderating relationships without requiring strict normality assumptions (Anirvinna & Goodwin, 2025). The significance of path coefficients was assessed using a non-parametric bootstrapping procedure with 5,000 subsamples. To test the mediating hypotheses (H6 and H7), the significance of specific indirect effects was examined. Furthermore, the moderating effect of information quality (H8) was tested using the product indicator approach, which constructs an interaction term by multiplying predictor and moderator indicators. When the interaction term was significant, a simple slope analysis was conducted to interpret the nature of the moderation specifically whether it strengthens or weakens the relationship under high (+1 SD) and low (-1 SD) levels of information quality.

Hipotesis

- H1: Leadership has a positive and significant effect on decision-making quality.
- H2: Team competence has a positive and significant effect on decision-making quality.
- H3: Decision-making quality has a positive and significant effect on organizational performance.
- H4: Leadership has a positive and significant effect on organizational performance.
- H5: Team competence has a positive and significant effect on organizational performance.
- H6: Decision-making quality mediates the relationship between leadership and organizational performance.
- H7: Decision-making quality mediates the relationship between team competence and organizational performance.
- H8: Information quality moderates the relationship between leadership and decision-making quality.

RESULT

Convergent Validity Evaluation

Based on the first stage of testing, several indicators were found to have outer loading values below the threshold of 0.70, namely X2.08, Z10, M05, and Y01. Therefore, these indicators were eliminated to improve the overall model quality. All indicators in the final stage of testing met the convergent validity criteria, with outer loading values above the recommended threshold. The detailed outer loading values for each indicator are presented in Table 1.

Table 1. Results of convergent validity test

Variables	Average variance extracted (AVE)	Note
Leadership	0.887	Valid
Team Competence	0.675	Valid
Quality Information	0.668	Valid
Decision-Making Quality	0.671	Valid
Team Performance	0.676	Valid

Source: Data Processing Results PLS-SEM, 2025

To rigorously mitigate subjective bias inherent in perception-based measures and to strengthen convergent validity, this study conducted data triangulation by correlating perceptual organizational performance scores (Y), as reported by supervisors, with objective secondary data derived from actual pond production records. The correlational analysis revealed strong alignment between subjective evaluations and field-based biological metrics. Specifically, Feed Conversion Ratio (FCR) showed a strong negative correlation with perceived performance ($r = -0.610$), while the Survival Rate (SR) exhibited a strong positive correlation ($r = +0.570$). In addition, harvest size demonstrated a strong negative correlation ($r = -0.560$), indicating that larger shrimp size is associated with higher perceived performance, and productivity (tons/ha) showed a positive correlation ($r = +0.520$). This cross-validation confirms that the survey instrument accurately reflects the empirical technical realities of intensive shrimp aquaculture, thereby supporting the validity of the measurement model for subsequent structural analysis.

Discriminant Validity Evaluation

The researchers applied the Fornell–Larcker criterion, which requires that the square root of the Average Variance Extracted (AVE) for each construct must be greater than its highest correlation with other constructs. The discriminant validity evaluation of the research model is presented in Table 2 through a comparison of the correlations between constructs, the AVE values, and the square roots of the AVE.

Table 2 Latent variable correlation values AVE and square root of AVE

Variables	Leadership	Team Competence	Information Quality	Decision-Making Quality	Team Performance	$\sqrt{\text{AVE}}$	Note
Leadership	1,000	0.678	0.795	0.743	0.791	0.941	Valid
Team Competence	0.678	1,000	0.460	0.441	0.429	0.821	Valid
Information Quality	0.795	0.460	1,000	0.576	0.565	0.817	Valid
Decision-Making Quality	0.743	0.441	0.576	1,000	0.525	0.819	Valid
Team	0.791	0.429	0.565	0.525	1,000	0.822	Valid

Variables	Leadership	Team Competence	Information Quality	Decision-Making Quality	Team Performance	√ AVE	Note
Performance							

Source: Data Processing Results PLS-SEM, 2025

Construct Reliability Evaluation

Construct reliability testing represents the final stage in evaluating the measurement model to ensure the internal consistency of the instrument in producing stable and reliable data. Based on Table 3, all study variables demonstrate a very high level of reliability, as indicated by Cronbach's Alpha values ranging from 0.947 to 0.990.

Table 3 Cronbach's Alpha Value

Variables	Cronbach's alpha	Note
Leadership	0.990	Reliable
Team Competence	0.952	Reliable
Quality Information	0.959	Reliable
Decision-Making Quality	0.951	Reliable
Team Performance	0.947	Reliable

Source: Data Processing Results PLS-SEM, 2025

Based on the results of data processing presented in Table 4, all VIF values between constructs are below the threshold of 10, with the highest value recorded in the relationship between Leadership and Decision-Making Quality at 5.072. This condition indicates that the independent variables in the model have sufficient empirical independence to explain the dependent variables without the occurrence of problematic multicollinearity

Table 4 Multicollinearity Test

Variables	VIF	Threshold	Note
Leadership (X ₁) => Team Performance (Y)	3,385	>10	There is no multicollinearity
Leadership (X ₁) => Decision Making Quality (M)	5,072	>10	There is no multicollinearity
Team Competence (X ₂) => Team Performance	1,881	>10	There is no multicollinearity
Team Competence (X ₂) => Decision Making Quality (M)	2,112	>10	There is no multicollinearity
Information Quality (Z) => Decision Making Quality (M)	2,956	>10	There is no multicollinearity
Information Quality (Z) x Leadership (X ₁) => Decision Making Quality (M)	2,167	>10	There is no multicollinearity
Decision Making Quality (M) => Team Performance (Y)	2,271	>10	There is no multicollinearity

Source: Data Processing Results PLS-SEM, 2025

Structural Model Evaluation and Hypothesis Testing (Inner Model)

Structural model evaluation, or inner model assessment, is conducted to test the predictive strength of the model and to confirm the significance of causal relationships among latent constructs in accordance with the proposed hypotheses. The model's ability to explain variations in endogenous variables is evaluated through the coefficient of determination (R^2), as presented in Table 5 and Table 6 below.

Table 5 R-Square Test Results

	R-square	Note
Decision-Making Quality	0.604	Moderate
Team Performance	0.660	Moderate

Source: Data Processing Results PLS-SEM, 2025

The overall goodness-of-fit of the structural model was evaluated using standard predictive and fit indices specific to variance-based PLS-SEM. The model demonstrated excellent fit, as indicated by a Standardized Root Mean Square Residual (SRMR) value of 0.079, meeting the recommended threshold of < 0.08 . Furthermore, the model achieved a strong fit classification, with a Goodness of Fit (GoF) index of 0.672. The predictive relevance of the model was also well established, with Q^2 values significantly exceeding zero (Q^2 Decision-Making Quality = 0.521; Q^2 Team Performance = 0.608), indicating substantial predictive capability for the endogenous constructs.

Table 6 Results of Model Fit Test

	Estimated model	Note
SRMR	0.079	Fit
GoF	0.672	Strong Fit
Q^2	Q^2 Quality Decision Making 0.521 > 0	Strong Predictive
	Q^2 Team Performance 0.608 > 0	

Source: Data Processing Results PLS-SEM, 2025

Direct Effects Analysis Between Constructs

Testing of direct effects using the bootstrapping procedure reveals a causal pattern that differs from general assumptions in the operational management of shrimp pond cultivation. The structure of the relationships among constructs in the research model is visualized through the results of the inner model testing presented in Figure 3, which serves as the basis for interpreting the direct, mediating, and moderating effects among the variables.

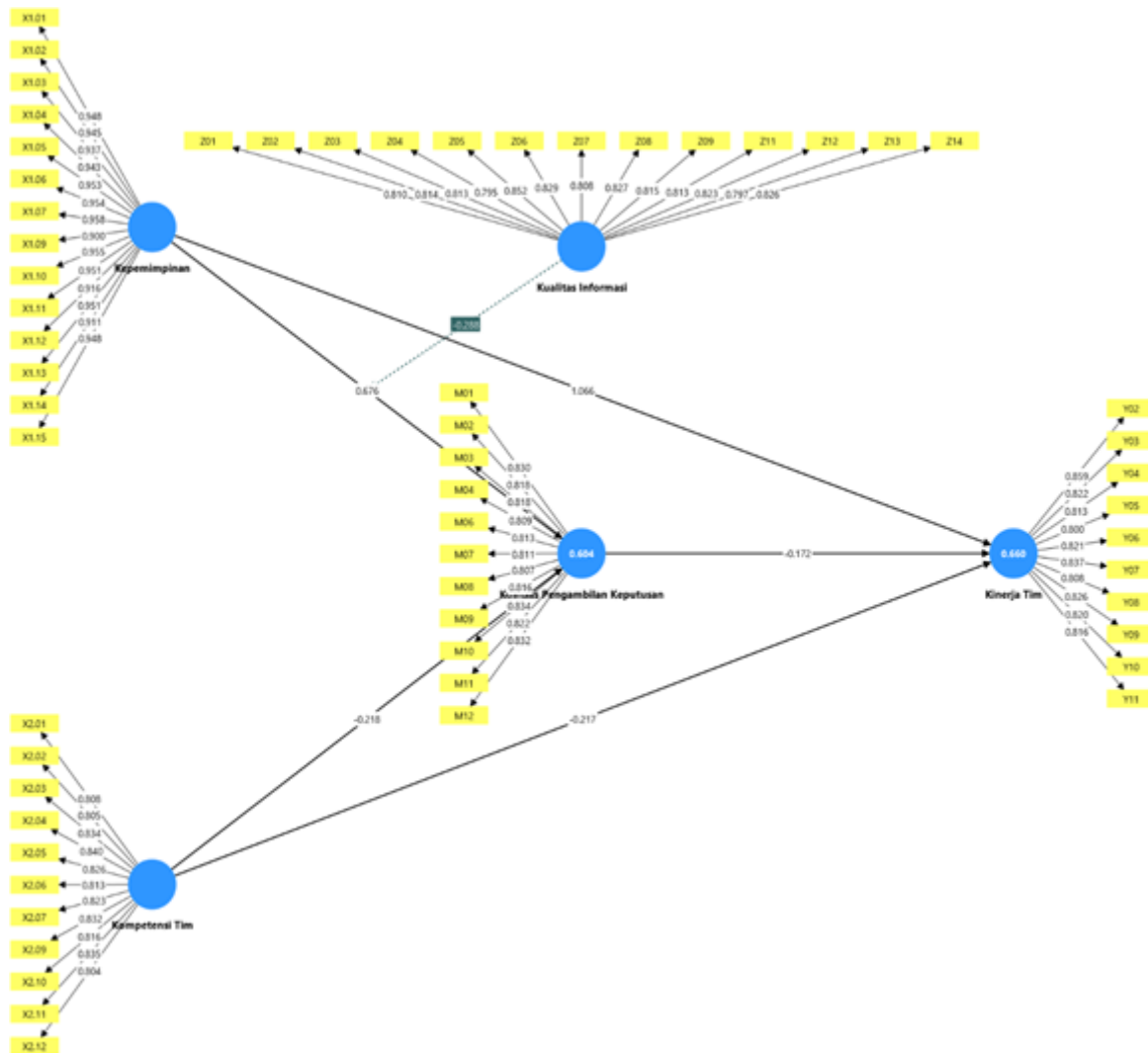


Figure 3 Results of inner model testing

Source: Data Processing Results PLS-SEM, 2025

This phenomenon indicates the presence of complex relationships in the field, where high levels of operator technical competence or overly cautious decision-making may actually be associated with a decline in team performance. The direct effects between variables in the research model are presented in Table 7 below as the basis for interpreting the structural relationships tested.

Table 7 Results of Direct Effect Testing

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics	P values
Leadership => Quality Decision Making (H ₁)	0.676	0.663	0.128	5,262	0.000
Competence => Quality Decision Making (H ₂)	-0.218	-0.208	0.090	2,437	0.007
Quality Decision Making => Team Performance (H ₃)	-0.172	-0.155	0.095	1,812	0.035

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics	P values
Leadership => Team Performance (H ₄)	1,066	1,053	0.087	12,251	0.000
Competence => Team Performance (H ₅)	-0.217	-0.213	0.087	2,491	0.006
Information Quality => Decision-Making Quality	0.016	0.034	0.106	0.149	0.441
Information Quality x Leadership => Decision-Making Quality (H ₈)	-0.288	-0.281	0.079	3,648	0.000

Source: Data Processing Results PLS-SEM, 2025

These findings indicate that although decision-making itself presents challenges in improving performance, the synergy between leadership and information still plays a strategic role in the organizational value creation process. This emphasizes that cognitive processes in shrimp pond operations are highly sensitive to the availability of supporting operational data in the field. A summary of the results of the specific indirect effects testing in the research model is presented in Table 8.

Table 8 Results of indirect effect testing

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics	P values
Information Quality x Leadership => Quality Decision Making => Team Performance	0.049	0.043	0.027	1,829	0.034
Leadership => Quality Decision Making => Team Performance (H ₆)	-0.116	-0.098	0.061	1,897	0.029
Competence => Quality Decision Making => Team Performance (H ₇)	0.037	0.033	0.025	1,527	0.063
Information Quality => Quality Decision Making => Team Performance	-0.003	-0.007	0.022	0.125	0.450

Source: Data Processing Results PLS-SEM, 2025

Results of the ANOVA test in Table 6 show that the interaction between the two variables has a highly significant effect ($F = 12.779$; $p < .001$), providing statistical confirmation that the influence of leadership on decision-making depends on the level of information quality available in the field. These findings provide consistent validation through cross-checking with the path estimation results obtained from the previous PLS-SEM model. The interaction pattern between leadership and information quality on decision-making quality is visualized in Table 9 below to clarify the direction and form of the tested moderating effect.

Table 9 Results of the ANOVA test of the interaction between
ANOVA

ANOVA - Dec_Qual					
Cases	Sum of Squares	df	Mean Square	F	p
Leadership_17	21.712	1	21.712	40.937	< .001
Inf_Qual_47	0.645	1	0.645	1.216	.274
Leadership_17 * Inf_Qual_47	6.778	1	6.778	12.779	< .001
Residuals	37.657	71	0.530		

Note. Type III Sum of Squares

Source: Data Processing Results PLS-SEM, 2025

DISCUSSION

Results of this study are interpreted within the operational context of intensive vannamei shrimp pond cultivation, where each statistical variable represents mechanisms operating in the field. The dominant influence of supervisor leadership reflects the need for unified command when facing biological crises. On the other hand, anomalies in the influence of team competence and formal decision quality indicate that, in shrimp pond operations, theoretical knowledge often conflicts with rapidly changing field realities. Procedurally sound decisions on paper may not yield positive outcomes if they lose momentum in biological execution. This explanation provides a basis for understanding why the management model at CP Prima must balance procedural compliance with managerial responsiveness.

Directive Authority as a Determinant of Biological Continuity in Pond Units

Results of this study confirm that in the shrimp aquaculture industry, which is characterized by high biological uncertainty, supervisory leadership functions as a critical control mechanism determining the biological continuity of pond units. The significant direct influence of leadership on organizational performance indicates that operational effectiveness is not solely determined by procedures or the technical competence of the team, but rather by the presence of directive authority capable of centralizing decision-making under time pressure. In conditions where fluctuations in water quality, shrimp health dynamics, and disease risks can change within hours, the need for clear and rapid direction becomes dominant. These findings indicate that leadership does not merely play a coordinative role but acts as an operational command system that minimizes fragmentation in operational responses. Thus, supervisory leadership functions as a primary buffer against the escalation of biological risks at the work-unit level.

The Paradox of Operational Competence: The Phenomenon of Premature Discretion Among Field Operators

The findings reveal a critical paradox: team competence does not contribute positively to organizational performance but instead exhibits a significant negative effect. In the biologically sensitive

context of shrimp aquaculture, high individual technical capability may lead to a phenomenon referred to as premature discretion. This occurs when operators, driven by strong confidence in their technical knowledge, initiate uncoordinated field interventions such as abrupt feed adjustments or water treatments without awaiting centralized command. Such uncoordinated technical actions disrupt operational consistency and trigger instability in the pond's biological environment. Accordingly, these findings suggest that technical competence can become an organizational liability when it is not governed by strict procedural discipline and a clear leadership authority structure.

Limitations of Formal Decision-Making in Conditions of Biological Urgency

The analysis demonstrates that formal decision-making quality fails to mediate the relationship with organizational performance, indicating the presence of procedural rigidity. In environments that demand rapid responses to sudden biological crises such as sharp declines in dissolved oxygen or pathogen spikes a highly analytical and data-intensive decision-making process can induce execution delays. Supervisors seeking cognitive completeness and thorough procedural evaluation may inadvertently lose the critical momentum required for timely biological intervention. This suggests that decisions which are logically high in quality may become operationally ineffective due to a lack of agility, thereby confirming that formal deliberative processes are less adaptive in addressing the rapid and volatile dynamics of living biological systems.

Cognitive Load and the Maladaptive Effects of Information Quality

The moderation analysis presents a counter-intuitive dampening effect, where high information quality significantly weakens the positive influence of leadership on decision-making quality. The abundance of highly detailed, comprehensive pond parameter data generates substantial cognitive overload for supervisors. In high-pressure situations, this excessive data granularity functions as informational noise rather than a strategic asset, forcing leaders into prolonged analytical validation and obscuring immediate operational priorities. Consequently, this maladaptive effect of information overabundance paralyzes rapid crisis leadership, proving that without effective data filtration and prioritization mechanisms, superior information quality degrades rather than enhances decision execution.

Contingency-Based Managerial Synthesis in the Shrimp Aquaculture Industry

Synthesis of the study results indicates that organizational performance in shrimp pond units is determined by a contingency configuration among leadership, competence, decision-making processes, and information management, rather than by the superiority of any single element in isolation. Directive supervisory leadership emerges as the primary driver of performance due to its ability to centralize action and maintain execution consistency in biologically volatile environments. In contrast, the technical competence of operational teams does not automatically enhance performance when it is not

embedded within a framework of strict coordination, as it may introduce action variability that undermines operational stability. These findings suggest that in high biological risk contexts, centralized command and procedural discipline are more effective than the uncontrolled distribution of technical autonomy.

The empirical findings call for a paradigm shift in aquaculture management practices. First, organizations must transition from procedural management toward adaptive crisis leadership. Given the extreme biological volatility of shrimp farming, supervisors should be positioned as authoritative field commanders, where clear directive authority and rapid execution take precedence over prolonged deliberation. Second, operational competence requires recalibration. High technical capability among operators must be governed by strict procedural discipline and adherence to chain-of-command protocols to prevent uncoordinated premature discretion that disrupts biological stability. Finally, management should redesign digital infrastructure to function as an effective information filtration system. Rather than overloading supervisors with highly granular data, information systems should prioritize, filter, and synthesize critical parameters to enable rapid, agile, and effective crisis decision-making.

CONCLUSION

Organizational performance in shrimp pond cultivation units is primarily determined by the effectiveness of supervisor leadership in providing firm, clear, and adaptive direction when coordinating operational actions in a high-risk and time-sensitive environment. The technical competence of the team does not automatically improve performance if it is not directed through strong leadership authority and consistent procedural discipline. In addition, overly formal decision-making processes may slow the response required to maintain the biological stability of shrimp ponds, making timeliness and clarity of direction more critical than the completeness of analytical procedures. Likewise, high information quality will only support leadership when it is presented in a concise, relevant, and decision-oriented manner. Therefore, the operational success of shrimp ponds depends largely on the alignment between managerial practices and the characteristics of the biological environment, which emphasize directive leadership, operational discipline, and response agility rather than excessive procedural formalization or unmanaged information abundance.

This study shows that operational performance in shrimp pond cultivation is strongly influenced by the alignment of managerial practices with the dynamic and high biological risk environment. From a theoretical perspective, these findings confirm that the effectiveness of leadership, team competence, decision-making processes, and information management is contingent upon time pressure and the need for rapid responses in the field. Adaptive directive leadership, operational discipline, and accurate information filtering become more critical factors than complex formal procedures. From a practical

perspective, organizations need to strengthen the role of supervisors as operational command centers, simplify decision-making processes, align operator competence with leadership authority, and design information systems and performance indicators that support rapid response and biological stability in pond operations.

This study has several limitations that should be acknowledged. First, the research object is limited to operational units of PT Central Proteina Prima in the West Area (Bangka Belitung and Kalimantan), so the findings are contextual in nature. Second, the study design uses a cross-sectional approach that does not capture long-term dynamic changes. Third, the measurement of variables is based on respondents' perceptions, which may introduce subjective bias. Fourth, the data were collected through the aggregation of various work roles within a single unit of analysis, so differences in perspectives between supervisors and operators may not be fully captured.

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