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The role of strategic leadership and Internet of Things monitoring on organisational performance with innovative work behaviour as a moderator at PTPN IV Regional III-Riau

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Abstract
PTPN IV Regional III is a state-owned enterprise where this research was conducted, operating in Riau to produce palm oil and palm kernel. In this study, Organisational Performance refers to the performance of the palm oil mill, measured by the achievement of palm oil yield from fresh fruit bunches in the nucleus plantation. Strategic Leadership refers to all decisions and policies made by senior employees regarding factory operations. IoT Monitoring is supervision with digital output via the Internet of Things (IoT), focused on factory processes, with Innovative Work Behaviour as a moderating variable. This study used SEM WarpPLS analysis. Respondents to the questionnaire were all senior employees involved in factory operations, located at the Head Office, District Offices, and factories of PTPN IV Regional III, for a total of 102 people. The results of this study conclude that Strategic Leadership and IoT Monitoring have a positive and significant effect on Organisational Performance. Strategic Leadership and IoT Monitoring have a significant effect on Organisational Performance, moderated by Innovative Work Behaviour.
Keywords: Organisational Performance, Strategic Leadership, IoT Monitoring, Innovative Work Behaviour.

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INTRODUCTION

The organisational performance referred to in this study is the operational performance of palm oil mills in achieving the target palm oil yield from fresh fruit bunches originating from their nucleus plantations, namely plantation areas managed, from planting, maintenance, and harvesting, under the control of PTPN IV Regional III. Palm oil yield from their nucleus plantations is a Key Performance Indicator (KPI) for the company because it indicates the success of palm oil management across planting, fertilisation, harvesting, and mill processing. The actual mill performance for achieving palm oil yield from their nucleus plantations from 2018 to 2024 is presented in the following table:

Table 1. Achievement of Palm Oil Yield from Core Plantations at PTPN IV Regional III PKS

Year	Target (%)	Real (%)	Achievement (%)
2018	22,24	22,25	100,04
2019	23,25	22,93	98,62
2020	24,00	22,57	94,04
2021	22,72	22,73	100,04
2022	23,57	23,39	99,24
2023	23,30	23,49	100,81
2024	23,28	23,45	100,73

Source: LHP PKS PTPN IV Regional III – PKS Online

The failure to achieve palm oil yields over several years should prompt the company to take strategic steps to improve future yields. Clear causes must be identified to ensure appropriate decisions can be made to achieve CPO productivity per hectare, namely by combining production performance between on-farm (plantations) and off-farm (factories). The higher the CPO productivity achieved, the better the operational performance of the plantations and factories.

To advance PTPN IV Regional III, a strategic leadership model is needed to accelerate positive change through sustainable programs. Internet of Things (IoT) monitoring, as defined in this study, involves monitoring factory operations through internet-based digital and visual technologies. To support organisational performance, innovative employee work behaviour is needed to meet the demand for more flexible work patterns and address the challenges of the times, especially amid rapidly advancing technology.

Previous related research by Novita et al. (2016) found that Strategic Leadership has a positive and significant effect on competitive advantage in manufacturing companies; the better the strategic leadership, the higher the company's competitive advantage. Kholilah et al. (2019) stated that leadership, organisational climate, and work motivation are important factors influencing company performance at the PTPN VII Betung Unit. Kartika et al. (2023) stated in their research that strategic leadership positively influences organisational performance across government, public organisations, and businesses. Assegaf et al. (2021) reported that the monitoring system can measure temperature and humidity with very high sensor accuracy and automatically display the data. Then, Gerry D. Utomo et al. (2021) explained that a monitoring system with Internet of Things (IoT) infrastructure can be applied in the plantation industry to control fertilisation and watering of oil palm seedlings remotely. Etikariena (2020) demonstrated in their research that various leadership styles have a positive and significant relationship with employees' innovative work behaviour in digitally based organisations. Surjo Hadi et al. (2020) in their research stated that innovative work behaviour has a positive and significant influence on employee performance in a company.

The purpose of this study is to analyse the influence of strategic leadership and IoT monitoring on organisational performance and to examine the moderating role of innovative work behaviour. It is hoped that this research will be useful for the development of management science, especially the implementation of strategic leadership, IoT monitoring, and innovative

work behaviour in organisations, both in practice and in academia. It can also be applied in the workplace as a learning material for analysing existing problems in organisations.

LITERATURE REVIEW

Organizational Performance

Organisational performance is the concept of evaluating managers and the organisation. This can be measured through efficiency and effectiveness, including workforce, materials, time, and other capabilities, by minimising human resource costs from the initial concept or input and implementing them correctly to achieve the desired output (Rumawas, 2021). According to Nawawi (2017), organisational performance is the totality of work results achieved by an organisation. Employee performance and organisational performance are closely related.

Strategic Leadership

Strategic leadership is a leadership approach focused on developing and implementing organisational strategies to achieve long-term goals. Strategic leadership requires a deep understanding of the organisation's vision, mission, and values, as well as the ability to plan and manage the strategic steps necessary to achieve long-term success. Strategic leadership is not only about formulating plans, but also about ensuring the effective implementation of those strategies and managing changes that may occur along the way to achieving the organisation's long-term goals (Gilang et al., 2023).

IoT Monitoring

Monitoring is the routine process of collecting data and measuring progress towards program objectives, including changes in processes and outputs. Today, technology has made almost anything possible, for example, the development of mobile phone technology over the past decade, the emergence of cloud services, sensor technology, Big Data analysis capabilities, and the Internet of Things (Royyana, 2018).

Innovative Work Behaviour

Innovative work behaviour is the deliberate individual behaviour of introducing and applying, within a role, group, or organisation, ideas, processes, products, or procedures that are new to the relevant unit and designed to significantly benefit the individual, group, organisation, or wider society. These innovations include the development of technological products, changes in work procedures, and the implementation of new technologies, methods, and work processes (Sujarwo & Wahjono, 2017).

RESEARCH METHOD

The research method used was a survey approach. This research was conducted in Pekanbaru City at the Head Office of PT. Perkebunan Nusantara IV - Regional III - Riau. The research period was from February 2023 until completion. The required data types were primary data, in the form of respondents' responses recorded in questionnaires, and secondary data obtained from the literature. This study employed a quantitative design with SEM (Structural Equation Modelling) analysis using the WarpPLS approach, a multivariate dependency analysis that analyses several variables simultaneously. SEM analysis with WarpPLS can examine the relationships between variables and determine whether exogenous variables influence endogenous variables (Ishmah, 2018). The study population comprised 102 management employees involved in palm oil mill operations, spread across the Head Office, District Offices, and the PTPN IV Regional III – Riau mill. Data collection techniques included questionnaires, observation, and literature review.

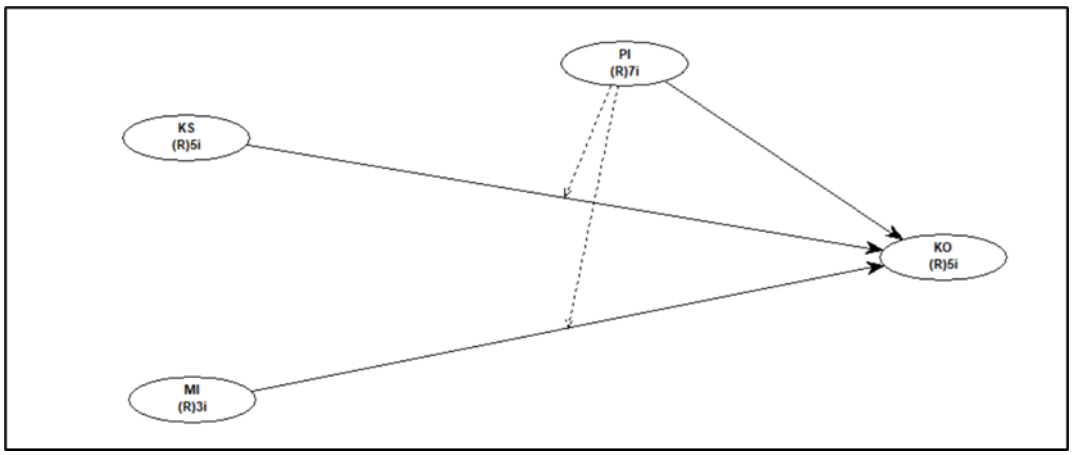

Figure 1. Research Framework
Source: Data from the Author, 2025

This study analyses Strategic Leadership and IoT monitoring as exogenous variables and Organisational Performance as an endogenous variable moderated by Innovative Work Behaviour. Variable analysis uses a measurement model (Outer Model) consisting of validity and reliability tests, a structural model (Inner Model), and Hypothesis Testing.

RESULTS AND DISCUSSION

RESULT

The measurement model evaluation (outer model) was conducted to assess the validity and reliability of the indicators forming the latent construct (Jogiyanto & Abdillah, 2015).

Convergent Validity Test

Convergent validity aims to examine correlations among indicators measuring a construct. In other words, convergent validity aims to confirm the construct's measurement (Jogiyanto & Abdillah, 2015). The results of the convergent validity test, which examines the Loading Factor, P-Value, and AVE values for each indicator within the construct and dimensions of all variables in this study, are shown in Table 2 below:

Table 2. Loading Factor, P-Value and AVE Indicator Values

Variable	Indicator	Loading Factor		P Value		AVE	
		Value	Validity	Value	Validity	Value	Validity
Organizational Performance (KO)	CPO Yield	0.816	Valid	<0.001	Valid	0.686	Valid
	Fruit Quality	0.812	Valid	<0.001	Valid		
	CPO Production	0.868	Valid	<0.001	Valid		
	Process Norms	0.850	Valid	<0.001	Valid		
	Factory Stagnation	0.789	Valid	<0.001	Valid		
Strategic Leadership (KS)	Determining Strategic Direction	0.711	Valid	<0.001	Valid	0.570	Valid
	Managing Resources	0.807	Valid	<0.001	Valid		
	Organisational Culture Values	0.732	Valid	<0.001	Valid		
	Subordinate Ethics	0.740	Valid	<0.001	Valid		
	Controlling Organization	0.781	Valid	<0.001	Valid		
I.O.T Monitoring (MI)	Main Parameters	0.911	Valid	<0.001	Valid	0.836	Valid
	Operational Procedures	0.938	Valid	<0.001	Valid		
	Data Collection	0.894	Valid	<0.001	Valid		

Variable	Indicator	Loading Factor		P Value		AVE	
		Value	Validity	Value	Validity	Value	Validity
Innovative Work Behaviour (PI)	Creating New Ideas	0.711	Valid	<0.001	Valid	0.666	Valid
	Simple Work Methods	0.745	Valid	<0.001	Valid		
	Implementative and Solution-Oriented	0.873	Valid	<0.001	Valid		
	Latest Innovation Ideas	0.839	Valid	<0.001	Valid		
	Obtaining Approval	0.850	Valid	<0.001	Valid		
	Innovative Ideas	0.885	Valid	<0.001	Valid		
	More Applicable Ideas	0.795	Valid	<0.001	Valid		

Source: Processed Primary Data, WarpPLS 2025

Table 2 above shows that the indicator loading (loading factor) values for all indicators in the research constructs are above 0.70. Each indicator has a p-value below 0.05, and the average variance extracted (AVE) is above 0.50, indicating that all reflective indicators are correlated with their respective constructs.

Discriminant Validity Test

Discriminant validity aims to assess whether indicators from two constructs are not highly correlated (Jogiyanto & Abdillah, 2015). To assess the results of the discriminant validity test, the correlation (cross-loading) values between indicators within the constructs are compared. Good discriminant validity is indicated when the square root of the AVE exceeds the correlations between latent constructs in the model. This means that the square root of the AVE is greater than the correlation between the latent constructs (Ghozali & Latan, 2014), as shown in Table 3 below:

Table 3. Cross Loading and Square Roots AVE Indicator Values

Variable	Indicator	Cross Loading				Square Roots AVE				Validity
		KO	KS	MI	PI	KO	KS	MI	PI	
Organizational Performance (KO)	CPO Yield	**0.816**	0.425	0.354	0.478	**0.828**	0.481	0.479	0.540	Discriminant
	Fruit Quality	**0.812**	0.252	0.269	0.313					
	CPO Production	**0.868**	0.413	0.447	0.505					
	Process Norms	**0.854**	0.418	0.449	0.482					
	Factory Stagnation	**0.789**	0.484	0.460	0.455					
Strategic Leadership (KS)	Determining Strategic Direction	0.311	**0.711**	0.274	0.331	0.481	**0.755**	0.459	0.523	Discriminant
	Managing Resources	0.422	**0.807**	0.357	0.438					
	Organisational Culture Values	0.377	**0.732**	0.385	0.382					
	Subordinate Ethics	0.394	**0.740**	0.357	0.391					
	Controlling Organization	0.310	**0.781**	0.358	0.427					
I.O.T Monitoring	Main Parameters	0.467	0.419	**0.911**	0.820	0.479	0.459	**0.915**	0.787	Discriminant
	Operational	0.413	0.364	**0.938**	0.847					

Variable	Indicator	Cross Loading				Square Roots AVE				Validity
		KO	KS	MI	PI	KO	KS	MI	PI	
(MI)	Procedures									
	Data Collection	0.435	0.479	**0.894**	0.766					
Innovative Work Behaviour (PI)	Creating New Ideas	0.532	0.500	0.515	**0.711**	0.540	0.523	0.787	**0.816**	Discriminant
	Simple Work Methods	0.465	0.486	0.545	**0.745**					
	Implementative and Solution-Oriented	0.469	0.386	0.658	**0.873**					
	Latest Innovation Ideas	0.311	0.377	0.666	**0.839**					
	Obtaining Approval	0.481	0.409	0.688	**0.850**					
	Innovative Ideas	0.417	0.365	0.694	**0.885**					
	More Applicable Ideas	0.434	0.502	0.665	**0.795**					

Source: Processed Primary Data, WarpPLS 2025

From Table 3 above, it can be seen that the correlation values (cross-loadings) and the square roots of AVE (Square Roots AVE) for all construct variable indicators are higher than those for other construct variables. This indicates that all indicators of the construct variables meet the requirements for discriminant validity.

Reliability Testing

The reliability of a measurement indicates the stability and consistency of the instrument used to measure a concept and is useful for assessing the "goodness" of the measurement (Sekaran, 2006). Reliability testing is conducted using two criteria: indicator reliability, measured by Cronbach's alpha, and internal consistency reliability, measured by composite reliability. These are presented in Table 4 below:

Table 4. Cronbach's Alpha Value and Composite Reliability Value of Construct Variables

Criteria	Organizational Performace	Strategic Leadership	IOT Monitoring	Innovative Work Behavior	Rule Of Thumbs	Reliability Test
Cronbach's Alpha	0.885	0.915	0.902	0.885	0,70	*Reliability*
Composite Reliability	0,916	0,869	0,939	0,933	0,70	*Reliability*

Source: Processed Primary Data, WarpPLS 2025

Table 4 shows that all Cronbach's Alpha and Composite Reliability values for the latent construct variables are above 0.70. This indicates that all construct variables meet reliability requirements.

Structural Model Evaluation (Inner Model)

A structural model (inner model) is a model for predicting causal relationships between latent variables (Ghozali, 2021).

R-Squared Reliability Test

The coefficient of determination, R-squared, indicates the percentage of the variation in an endogenous/criterion construct explained by the construct hypothesised to influence it (exogenous/predictor). R-squared is only available for endogenous variables (Sholihin & Ratmono, 2013). The R-squared values can be seen in Table 5 below:

Table 5. R-squared Value

Parameter	Organizational Performance
R-squared	**0.57**

Source: Processed Primary Data, WarpPLS 2025

Table 5 shows an R-squared value of 0.447 for the Organisational Performance variable. This means that Strategic Leadership and IoT Monitoring influence 44.7% of the Organisational Performance variable.

Model Fit and Quality Indices

To evaluate model fit, several fit indicators can be used; the results of which are shown in Table 6 below.

Table 6. Model Fit and Quality Indices

No	Model Fit and Quality Indices	Value	Criteria Fit	Category
1	Average Path Coefficient (APC)	APC=0,266, P = 0,001	Acceptable if P<0,05	Accepted
2	Average R-squared (ARS)	ARS= 0,447, P<0,001	Acceptable if P<0,05	Accepted
3	Average Adjus R-squared (AARS)	AARS=0,425, P<0,001	Acceptable if P<0,05	Accepted
4	Average Block VIF (AVIF)	AVIF = 2,009	Acceptable if <=5, Ideally if <=3,3	Ideally
5	Average Full Collinearity VIF (AFVIF)	AFVIF =2,822	Acceptable if <=5, Ideally if <=3,4	Ideally
6	Tenenhous GoF (GoF)	GoF = 0,596	Small >=0,10, Medium >=0,25, Large>=0,36	Large
7	Simpson's Paradox Ratio (SPR)	SPR = 1,000	Acceptable if >=0,7, Ideally if	Ideally
8	R-squared Contribution Ratio (RSCR)	RSCR = 1,000	Acceptable if >=0,9, Ideally if	Ideally
9	Statistical Suppression Ratio(SSR)	SSR = 1,000	Acceptable if >=0,7	Accepted
10	Nonlinear Bivariate Causality Direction Ratio (NLBCDR)	NLBCDR = 0.875	Acceptable if >=0,7	Accepted

Source: Processed Primary Data, WarpPLS 2025

In Table 6 above, it can be seen that the average path coefficient (APC) value is 0.266 with a p-value <0.001, the average R-squared (ARS) is 0.447 with a p-value <0.001, and the average adjusted R-squared (AARS) is 0.425 with a p-value <0.001, this can be interpreted that the researcher's model has a good fit. Then, the average variance inflation factor (AVIF) is 2.009, and the average full collinearity variance inflation factor (AFVIF) is 2.822, which is <3.3. This can be interpreted as indicating that there is no multicollinearity problem among indicators or among exogenous variables. Moreover, the tenenhaus goodness-of-fit value is 0.596 > 0.36, indicating that the model's predictive power is strong or the fit is very good. To evaluate the quality indices, Symson's paradox ratio (SPR) index values can be determined by a value of 1 > 0.70 (ideal), an R-squared contribution ratio (RSCR) of 1 > 0.90 (ideal), a statistical suppression ratio (SSR) of 1 > 0.70 (acceptable), and a nonlinear bivariate causality direction ratio (NLBCDR) of 0.875 > 0.70 (acceptable). These indices indicate no causality issues in the model.

Hypothesis Testing

The research results for the structural equation model (SEM WarpPLS) can be seen in Figure 2 below:

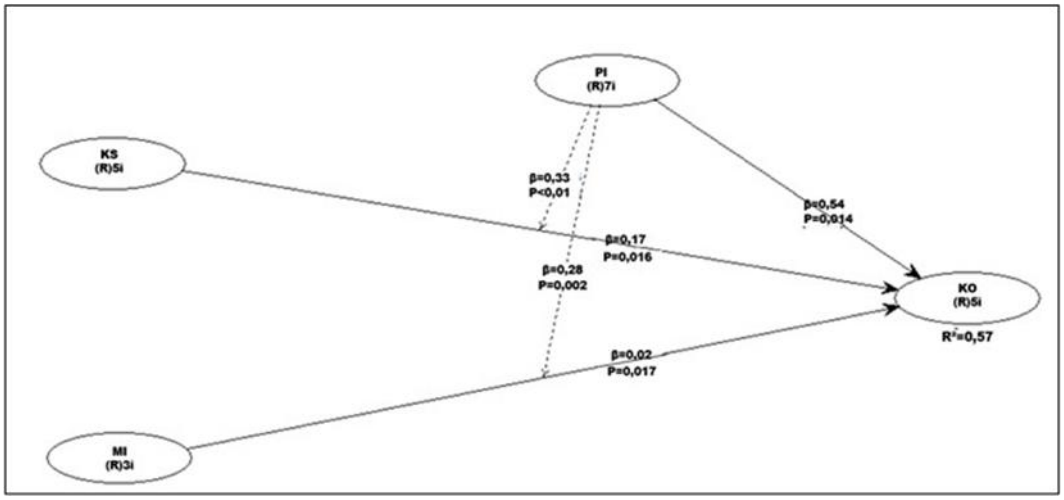

Figure 2. Structural Equation Model with Path Coefficients, P Values and R² Values
Source: Processed Primary Data, WarpPLS 2025

From Figure 2 above, the results of the Hypothesis Test can be presented as follows:

Table 7. Hypothesis Test Results

Hypothesis	*Path Coefficients*	*P-Value*	Decision
KS → KO	0,168	0,016	Positive and Significant
MI → KO	0,018	0,017	Positive and Significant
PI → KO	0,537	0,014	Positive and Significant
PI*KS → KO	0,328	<0,01	Strengthen and significant influence
PI*MI → KO	0,281	0,0017	Strengthen and significant influence

Source: Processed Primary Data, WarpPLS 2025

1. **The Influence of Strategic Leadership on Organisational Performance**

Based on Table 7, the influence of Strategic Leadership on Organisational Performance is significant, with a coefficient of 0.187 and a P-value of 0.025. This indicates a positive relationship between strategic leadership and organisational performance. Therefore, the hypothesis that "strategic leadership has a positive and significant influence on organisational performance" is accepted.

2. **The Effect of IoT Monitoring on Organisational Performance**

Based on Table 7, the effect of IoT Monitoring on Organisational Performance is significant, with a coefficient of 0.383 and a P-value < 0.001, indicating a positive and statistically significant relationship. Therefore, the hypothesis "IOT monitoring has a positive and significant effect on organisational performance" is accepted.

3. **The Effect of Strategic Leadership on Organisational Performance, Moderated by Innovative Work Behaviour**

Based on Table 7, the effect of Strategic Leadership on Organisational Performance, moderated by Innovative Work Behaviour, is significant (P-value < 0.001), indicating an influence between Strategic Leadership and Organisational Performance, moderated by Innovative Work Behaviour. Thus, it is stated that "strategic leadership has a significant effect on organisational performance, moderated by innovative work behaviour."

4. The Effect of IoT Monitoring on Organisational Performance, Moderated by Innovative Work Behaviour

Based on Table 7, the effect of IoT Monitoring on Organisational Performance, moderated by Innovative Work Behaviour, is significant (P = 0.042), indicating an influence of IoT Monitoring on Organisational Performance, moderated by Innovative Work Behaviour. Thus, the hypothesis "IOT monitoring has a significant effect on organisational performance, moderated by innovative work behaviour" is accepted.

Discussion

a. The Influence of Strategic Leadership on Organisational Performance

This indicates that Strategic Leadership can determine the success rate of Organisational Performance. This means that the better the Strategic Leadership, the higher the Organisational Performance. The indicator with the highest score is employee statements that leaders can determine the company's strategic direction for the better. Leaders have provided their subordinates with direction on the company's strategy to achieve established targets. Meanwhile, the indicator with the lowest score is leaders prioritising their subordinates' ethics. This means that leaders pay close attention to their subordinates' ethics, but subordinates expect leaders to exemplify ethical conduct and serve as role models in every task.

Good strategic leadership will establish targets for every policy, provide employees with the broadest possible career development opportunities so that every effort is recognised, and foster a positive, conducive work environment where employees remain comfortable while working. Strategic leadership plays a crucial role in improving employee performance, as effective leadership directs workers' efforts to achieve organisational goals. The findings of this study are consistent with those of Kholilah et al. (2019), which show that leadership positively influences the performance of PTPN IV Regional VII Betung.

b. The Impact of IoT Monitoring on Organisational Performance

The average respondent's answer regarding the impact of IoT Monitoring on Organisational Performance fell within the strongly agree range. This indicates that IoT Monitoring is crucial in determining Organizational Performance. Therefore, the better the IoT Monitoring, the higher the Organisational Performance.

Mahfud Nurnajamudd et al. (2025) stated in their research that implementing IoT technology enables real-time monitoring of raw material distribution and usage, thereby reducing operational costs and increasing company profitability. Loso Judijanto et al. (2024) in their research confirmed that IoT adoption positively impacts the efficiency and effectiveness of decision-making, optimising resource allocation, mitigating risks, and capitalising on emerging opportunities. This study highlights the strategic imperative for companies to leverage technology by investing in IoT infrastructure and talent development, establishing robust governance mechanisms, and fostering collaboration to realise the potential of IoT integration fully.

c. The Influence of Strategic Leadership on Organisational Performance with Innovative Work Behaviour as a Moderator

This indicates that Innovative Work Behaviour is crucial in determining the influence of Strategic Leadership on Organisational Performance. A strategic leadership style, combined with positive employee Innovative Work Behaviour, will improve Organisational Performance. The indicator with the highest score is employees' efforts to gain approval for innovative ideas, indicating that employees consistently contribute their ideas to the company. Adopting technology has positive impacts, such as faster, more accurate decision-making and the optimisation of the strategic planning process. In contrast, negative impacts include dependence on and uncertainty about technology, as well as challenges with data privacy. Technology can assist strategic leadership in decision-making, strategic planning, and the implementation of economic policies (Aulia & Aslami, 2023).

Organisations need innovation to survive in business competition. To achieve this, organisations must focus on their human resources and productive outcomes (Siyal et al., 2021). Innovation can also be defined as behaviour or attitudes aimed at improving the organisational or individual environment through change. Failure to develop innovation can reduce competitiveness and increase work stress. However, if an organisation can encourage or support employee innovative behaviour, it can achieve organisational goals (Na-Nan & Arunyaphum, 2021).

d. The Effect of IoT Monitoring on Organisational Performance with Innovative Work Behaviour as a Moderator

This indicates that Innovative Work Behaviour is crucial to the influence of IoT Monitoring on Organisational Performance. Monitoring with real-time data across various economic sectors significantly assists decision-making by quickly identifying opportunities and threats and optimising resource allocation based on accurate data (Ardiansyah, 2023).

Technological innovation refers to the application of new ideas, concepts, or discoveries to develop products, services, or processes that utilise technology to create added value (Sepriani et al., 2022). The implications of technological monitoring innovation for operational efficiency in the manufacturing sector are significant. The use of sophisticated hardware and software, enabled by monitoring innovation, enables more efficient management of economic resources. Improved operational efficiency can lead to cost reductions and increased productivity.

CONCLUSION

Strategic Leadership has a positive and significant impact on Organisational Performance. This indicates that leaders can more effectively determine the company's strategic direction, meaning they have provided their subordinates with guidance on how to achieve established targets. The better the Strategic Leadership, the higher the Organisational Performance.

IoT Monitoring has a positive and significant impact on Organisational Performance. This indicates that process oversight via IoT Monitoring of key parameters in CPO production facilitates traceability when discrepancies are detected, enabling more precise and rapid process improvement programs to achieve established targets. The better the IoT Monitoring, the better the Organisational Performance.

Innovative Work Behaviour significantly moderates the effect of Strategic Leadership on Organisational Performance. This indicates that Innovative Work Behaviour among employees, which involves seeking approval for innovative ideas and material support from leaders, positively impacts Organisational Performance through the Strategic Leadership model.

Innovative Work Behaviour significantly moderates the effect of IoT Monitoring on Organisational Performance. This indicates that employee Innovative Work Behaviour, which involves constantly striving to generate new ideas and seeking the simplest work methods, has a positive impact on Organisational Performance through IoT Monitoring.

IoT Monitoring has proven very helpful to company management in overseeing production processes. Research is needed on other monitoring models that leverage digital technologies and information to provide more reliable approaches aligned with technological developments. This study has sampling limitations due to its focus on the factory's production segment. However, it describes the main business processes at PTPN IV Regional III, namely, process inputs at the plant and process outputs at the factory. It is recommended that further research be expanded to include supporting business processes such as Partnership Patterns, CSR (Corporate Social and Environmental Management), and Procurement of Goods or Services.

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