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Analysis of Technology-Based Human Capital towards Increasing Innovation at PT PLN (Persero) UP3 Palopo

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ABSTRACT

Purpose: *This study aims to analyze the effect of technology-based human capital management on increasing innovation at PT PLN (Persero) UP3 Palopo.* ***Methodology:*** *Using a quantitative approach with a causal design, this study examines the relationship between technology in human capital management and the resulting innovation. Data were obtained through questionnaires and analyzed by simple linear regression method using statistical software.* ***Results:*** *The results showed that technology-based human capital management has a positive and significant impact on innovation in the company.* ***Findings:*** *This finding confirms that the application of technology in the human resource management system can improve work effectiveness and encourage a more innovative environment.* ***Novelty & Originality:*** *The novelty of this study lies in its focus on technology-based human capital management within a regional service unit of a state-owned electricity company in Palopo, a context that has received limited empirical attention in prior research. Its originality emerges from the examination of how digital human resource systems directly influence innovation outcomes in the energy sector, specifically within the Indonesian state-owned enterprise environment.* ***Conclusions:*** *The practical implications of this study include the need for greater investment in human capital management technology as well as improved training programs to create a more adaptive and collaborative work culture in the energy sector. The study concludes that integrating technology into human capital management is a strategic imperative for fostering innovation and organizational competitiveness.* ***Type of Paper:*** *This paper is an empirical research paper.*

INTRODUCTION

Technological developments in the era of the Industrial Revolution 4.0 require companies to adapt, especially in the management of human resources (HR). PT PLN (Persero) UP3 Palopo is faced with the challenge of increasing innovation through technology-based human capital management. Therefore, this study aims to analyze how the application of technology in human capital management affects innovation in the company.

Most of the previous studies related to technology-based human capital management have focused on the technology sector and creative industries, while few have examined this aspect in the context of energy companies, especially in Indonesia. Research conducted by Novianti (2021) shows that technology-based HR management can increase innovation, but has not examined in depth the implementation of technology as a whole in HR management. Research by Harahap and Kurniawan (2022) also provides an overview of the use of e-HRM in energy companies, but does not link it directly to the impact of innovation. Therefore, this study tries to fill the gap by more deeply exploring the effect of technology-based HRM on innovation in the context of PT PLN (Persero) UP3 Palopo.

This research has novelty because it not only examines the application of technology in HR management, but also connects it directly to the innovation produced by the organization. Previous studies have focused more on the use of technology to improve operational efficiency, but not many have examined the impact of technology on innovation creation in the context of energy companies in Indonesia. Therefore, this research offers a significant contribution by providing insights into how technology can drive innovation through more strategic and integrated HR management.

The reason why this research needs to be conducted is because the energy sector, especially in PT PLN (Persero) UP3 Palopo, has a vital role in supporting economic and social sustainability in Indonesia. In the face of global competition and demands for innovation, companies must ensure that HR management runs optimally. Technology applied in the HR management system can be the key to increasing employee productivity and creativity, which in turn can produce innovations that support the company's competitiveness. This research is expected to provide practical and theoretical contributions to overcome the challenges faced by PT PLN (Persero) UP3 Palopo in managing technology-based HR.

This research is focused on analyzing how technology-based human capital management can affect innovation improvement at PT PLN (Persero) UP3 Palopo. In addition, this research will also identify various factors that influence the successful implementation of technology in human resource management in the company. By understanding these factors, this research is expected to provide recommendations on the best strategy for integrating technology into the HR management system to support sustainable innovation.

Technology-Based HR Management

Along with the rapid development of technology, many companies have begun to adopt technology in human resource management, also known as e-HRM (electronic Human Resource Management). Research by Wahyudi and Sutrisno (2020) entitled “The Effect of Technology-Based HR Management on Employee Performance in Technology Companies” shows that the application of technology in HR management processes such as recruitment, training, and performance appraisal can significantly improve employee performance. The results of this study emphasize the importance of technology in optimizing HR-related managerial processes, which leads to improved individual and organizational performance. These findings are relevant to the current research, which aims to examine how technology-based HR management at PT PLN (Persero) UP3 Palopo can improve innovation and company performance.Teknologi dan Inovasi.

Technology and Innovation

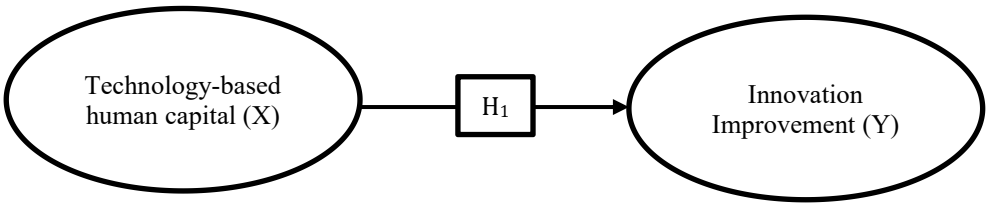
Information technology is also recognized as an important catalyst in driving innovation in organizations. Haris and Yuliana (2022) in their research entitled "Process Innovation in HR Management through Information Technology in the Manufacturing Industry" found that the application of information technology not only optimizes administrative efficiency in HR management, but also accelerates the creation of innovation in business and operational processes. With technology, collaboration between departments in the organization becomes more effective, creating an atmosphere conducive to the birth of innovative ideas. This research shows that information technology applied in HR has a direct impact on innovation in the organization. Therefore, this research is an important reference in understanding how technology in HR management can affect innovation at PT PLN (Persero) UP3 Palopo.Pengembangan Hipotesis.

In this study, the hypothesis proposed is related to the impact of technology-based HR management on innovation in the company. Based on the literature review, Haris and Yuliana (2022) revealed that the application of information technology in HR management can accelerate innovation through increased collaboration and work process efficiency. These findings support the hypothesis that technology in HR management plays an important role in encouraging organizational innovation.

With more efficient and technology-based HR management, companies can create a work environment conducive to innovation. Therefore, technology-based HR management is believed to encourage the creation of better innovation at PT PLN (Persero) UP3 Palopo.

H1: The implementation of technology-based human capital management has a positive effect on increasing innovation at PT PLN (Persero) UP3 Palopo.

Figure 1. Framework Technology-Based Human Capital towards Increasing Innovation



METHOD

Population and Sample

This research uses a quantitative approach with a causal research type. Causal research was chosen to identify the cause-and-effect relationship between the independent variable (technology-based human capital) and the dependent variable (increased innovation).

The population in this study were all employees of PT PLN (Persero) UP3 Palopo, totaling 70 people. To determine a representative sample size, a simpler approach is used without complex statistical calculations.

In addition, another approach used is the population percentage method, where generally quantitative research takes 80% of the population if the population is relatively small. Thus, out of 70 permanent employees, 56 people can be sampled, but to maintain data validity and ease of processing, the sample size is adjusted to 60 people.

The sampling technique used is probability sampling, with a simple random sampling method that provides an equal opportunity for each permanent employee to be selected as a sample. The data was collected using a questionnaire distributed directly to respondents, the variables in this study were measured using a Likert scale with a range of 1-5, where 1 = strongly disagree and 5 = strongly agree. the variables measured include:

1. Technology-based human capital management (X): Measured through three main indicators: technology implementation in recruitment, training, and performance management.
2. Innovation (Y): Measured through three main indicators: process, product, and service innovation.

Data analysis was conducted using IBM SPSS 25 software, which was chosen for its informative ability to facilitate interpretation of results with a high degree of accuracy. Tests conducted include:

Descriptive Data Analysis Test

In descriptive statistical analysis, data is explored to provide clear and easy-to-understand information. Descriptive statistics include mean, median, mode (the most frequently occurring value), standard deviation, and maximum and minimum values of the observed data (Wijayanti, RR et al., 2022).

Data Quality Test

1. Validity Test
2. Reliability Test

Classical Assumption Test

1. Normality Test
2. Heteroscedasticity Test
3. Multicollinearity Test

Simple Linear Regression Analysis

This method is used to determine whether there is an influence between the independent variable and the dependent variable. This is done using the regression equation using the following formula: Y = a + bX

Description:
Y = increased innovation
a = regression constant
b = regression coefficient
X = technology-based human capital
e = errore = error

Hypothesis Test

The hypothesis test used is the Partial Test (t test). This hypothesis testing is to determine whether the effect of the independent variable (technology-based human capital) on the dependent variable (innovation improvement) is meaningful or not. The test is conducted by comparing the t value of the independent variable with the t value of the dependent variable table with an error degree of 5% (α 0.05). If the value of t count ≥ t table, then the independent variable gives a meaningful influence on the dependent variable.

RESULTS AND DISCUSSION

Descriptive Analysis

Table 1. Descriptive Data Test

	N	Minimum	Maximum	Mean	Std. Deviation
Human capital technology-based	60	11	25	18,27	3,188
Increased innovation	60	13	25	19,33	3,112
Valid N (listwise)	60				

Source: Primary data processed with SPSS 25, 2024

Technology-based human capital (X) ranges from 11 to 25, with an average of about 18.27 and a standard deviation of 3.188. This indicates that technology-based human capital tends to be relatively high. Then, the increase in innovation (Y) has a value between 13 and 25, with an average of about 19.33 and a standard deviation of 3.112, indicating a relatively high increase in innovation.

Data Quality Test Validity

Table 2. Validity test results

No.	Variables and Statement Items	r-count	r-table	Description
1	X.1	,788	0,254	Valid
2	X.2	,809	0,254	Valid
3	X.3	,724	0,254	Valid
4	X.4	,769	0,254	Valid
5	X.5	,693	0,254	Valid
No.	**Variables and Statement Items**	**r-count**	**r-table**	**Description**
1	Y.1	,704	0,254	Valid
2	Y.2	,771	0,254	Valid
3	Y.3	,780	0,254	Valid
4	Y.4	,726	0,254	Valid
5	Y.5	,743	0,254	Valid

Source: Primary data processed with SPSS 25, 2024

Based on the table of validity test results above, it can be seen that the questionnaire data is 100% valid, where the r value of each statement item is greater than the r table value, this indicates that the questionnaire can calculate and reveal all detailed variable data.

Reliability Test

Table 3. Reliability Test Results

No	Variable	*Cronpach's Alpha*	Reliable Standard/Criteria	Description
1	Human capital technology-based	,808	0,60	Reliable
2	Increased innovation	,797	0,60	Reliable

Source: Primary data processed with SPSS 25, 2024

Based on the table of reliability test results above, it can be seen that the Cronbach alpa value of each variable is at a value above 0.60. This means that the level of reliability of all variables is good or the questionnaire used can be declarea reliable.

Table 4. Normality Test Results

One-Sample Kolmogorov- Smirnov Test		
		Unstandardized Residual
N		60
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	2.39532937
Most Extreme Differences	Absolute	.102
	Positive	.089
	Negative	-102
		.102
Asymp. Sig.(2-tailed)		.197[c]

a.Testdistribution is Normal.

b.Calculate from data

c.Lilliefors Significance Correction.

Source: Primary Data Processed with SPSS 25, 2024

In the table above, it can be seen in the Unstandardized Residual column that the Kolmogorov-Smirnov value is 0.102 and significant 0.197 and where the value is greater than or above 0.05, it can be concluded and the residuals of the variables entered are normally distributed.

Multicollinearity Test

Table 5. Multicollinearity Test Results

Independent variable	Tolerance	VIF	Description
technology-based human capital (X)	1.000	1.000	Free Multicollinearity

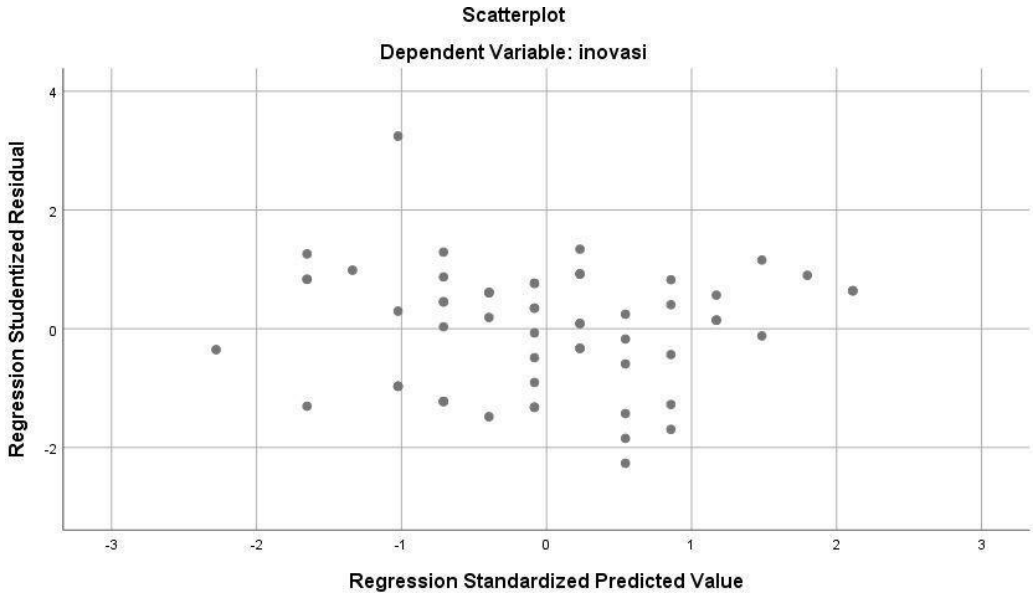
Source: Primary Data Processed with SPSS 25, 2024

Based on the table above, it can be obtained the VIF (variance inflation factor) result of 1.000 and a tolerance value of 1.000. A regression equation model is said to be free from

multicollinearity if the value of the VIF (variance inflation factor) is below or less than 10 and the tolerance value is above or more than 0.1. Based on table 5, it is known that the VIF value of variable X is 1.000 below or less than 10 and the tolerance value is 1.000 above or more than 0.1, so the data does not occur multicollinearity.

Heteroscedasticity Test

Figure 2. Heteroscedasticity Test Results



Source: Primary Data Processed with SPSS 25, 2024

From the results of the heteroscedasticity test, the results in Figure 2 show that the points spread randomly above and below the Y axis. So it can be concluded that there is no heteroscedasticity deviation.

Simple Linear Regression Test

Table 6. Simple Linear Regression Analysis Test Results

independent variable (X)	B	Beta	T	Sig.	Descriptions
constant	7,952		4,348	,000	Significant
Human capital based technology	,623	,639	6,316	,000	positive
R = ,638					
R Square = ,407					
F = 39,889 significance,000					

Source: Primary data processed with SPSS 25, 2024

Based on table 4.10 (Simple Linear Regression Calculation Results) above, it can be seen that the simple linear regression equation is as follows:

Y = a + bX

Y = 7.952 + 0.623 * X

The coefficients of the simple linear regression equation above can be interpreted that the regression coefficient for a constant of 7.952 indicates that if the variable. Technology-based human capital variable is zero or fixed, it will increase the increase in innovation by 7.952 units. The coefficient value of the technology-based human capital variable of 0.623 indicates that if the technology-based human capital variable increases by one unit, it will increase the innovation improvement by 0.623 units or 62.3%.

Hypothesis testing

Table 7. Results of t-test

Independent variable	T	significance
Human capital-based teknologi (X)	6.316	0,000

Source: Primary data processed with SPSS 25, 2024

Based on table 7, which is obtained from the results of data processing using SPSS (Statistical Package for Social Science) version 25, the t-test of variable X is obtained, namely in the calculation of SPSS (Statistical Package for Social Science) it can be seen that the t count of the technology-based human capital variable (6.316) > t table (2.00172) and the significant value is 0, 000 <0.05, so that H_1 which reads the technology-based human capital variable has a positive and significant effect partially on increasing innovation is accepted, while H_0 which reads the technology-based human capital variable does not have a positive and significant effect partially on increasing innovation is rejected. So, it can be concluded that technology-based human capital has a positive and significant effect partially on increasing innovation.

DISCUSSION

After analyzing the data, the next step is to discuss the results of the data that has been obtained about the effect of technology-based human capital on increasing innovation. Testing of the hypothesis stating that there is an influence between technology-based human capital on increasing innovation is proven. This can be seen from the results of SPSS 25 output with regression analysis on variables that show a positive correlation coefficient (R) (0.638) and the t value of the technology-based human capital variable (6.316) > t table according to the 5% significant level (2.00172). The results of this study indicate that technology-based human capital management has a positive and significant influence on increasing innovation at PT PLN (Persero) UP3 Palopo.

The results of this study support the findings of Wahyudi and Sutrisno (2020) which state that the application of technology in HR management, such as recruitment and training, increases the effectiveness of performance which ultimately encourages innovation in the company. Thus, technology integration in human capital management is an important key for energy companies to maintain competitiveness in the Industrial Revolution 4.0.

In addition, research by Haris and Yuliana (2022) also shows that the use of information technology can create synergies between divisions in the organization, which is a key factor in increasing innovation.

This research makes a significant contribution to the human resource management literature, especially in the context of energy companies in Indonesia. The capital- and technology-intensive energy sector is in dire need of innovation to maintain competitiveness and business sustainability. By utilizing technology in human capital management, companies such as PT PLN (Persero) UP3 Palopo can accelerate adaptation to changes in the external environment, strengthen a culture of innovation, and improve overall performance.

Research Limitations

This study has several limitations that need to be considered for further research development. First, the scope of the research is limited to one organizational unit, namely PT PLN (Persero) UP3 Palopo, so the findings cannot be generalized to other PLN units or other energy sector companies. Second, data was collected using a cross-sectional approach, which only describes conditions at a specific point in time and cannot capture the long-term dynamics of technology implementation in human resource management.

Third, the use of questionnaires as the sole data collection instrument has the potential to produce respondent perception bias, especially if there is a gap between perception and actual practice. Fourth, the study only uses one independent variable, namely technology-based human capital, without considering other factors such as organizational culture, leadership style, or digital readiness that may also influence innovation.

Recommendations for Further Research

Based on these limitations, there are several recommendations for future research. First, expanding the research object to several PLN units or other energy sector companies will help improve the generalization of the findings. Second, the use of longitudinal methods can provide a more complete picture of the development of the influence of technology on innovation over a certain period of time.

Third, combining quantitative and qualitative methods (mixed-method) would allow for a deeper exploration of the context, motivations, and barriers in the implementation of human resource-based technology. Fourth, the addition of other variables such as innovation culture, transformational leadership, and employee digital competencies would enrich the research model and provide a more comprehensive understanding of the factors determining organizational innovation.

CONCLUSIONS

This study concludes that technology-based human capital management has a positive and significant influence on increasing innovation at PT PLN (Persero) UP3 Palopo. The analysis shows that the application of technology in HR management can increase employee effectiveness and productivity, which in turn encourages innovation in the company. With a positive regression coefficient value (0, 623), the correlation coefficient value (R) is positive (0.638), the t test results found that t count> t table (6.316 > 2.00172) and a significant value

smaller than 0.05 (0.000 <0.05), it is proven that the technology-based human capital variable makes a significant contribution to innovation.

PT PLN UP3 Palopo is advised to increase investment in technology that supports HR management, such as an integrated e-HRM system. In addition, periodic training for employees on the use of this technology is needed so that the implementation of technology runs effectively and provides maximum results. In addition, the company needs to strengthen a work culture that supports innovation by encouraging cross-divisional collaboration and more intensive use of technology.

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