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THE INFLUENCE OF DIGITAL TALENT DEVELOPMENT AND GREEN INNOVATION AND THE USE OF GREEN INNOVATION AS MEDIATION TO MEASURE DATA CENTRE PERFORMANCE

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Abstract:

Background: Data Centre industry activity in Asia Pacific is experiencing significant growth, driven by the increasing adoption of cloud technology and data-driven solutions. Telkom Group faces the biggest challenges in data centre development in the form of compliance with increasingly stringent sustainability regulations, increasing demand for skilled and experienced talent, as well as the challenge of adopting green innovation as a solution to sustainability issues. Data Centre Managers need to encourage talent who are capable of developing innovations to reduce carbon emissions, as well as the need for very high electrical power.
Purpose: The purpose of this study is to examine how data center performance is impacted by green innovation and digital talent development. It also looks at how green innovation may help data center companies become more competitive, increase operational sustainability, and improve energy efficiency in the face of regulatory obstacles and a lack of skilled digital workers.
Design/methodology/approach: The research uses Partial Least Square (PLS) analysis using SmartPLS software to test various related variables. Data collection used a survey method which included in-depth interviews and questionnaires. Respondents are Data Center Managers, Digital Talent Development Experts, Data Center Operational and Technical Teams, and Experts and Consultants in the Field of Green Technology and Data Centers.
Findings/Result: By increasing energy efficiency and reducing negative impacts on the environment, green innovation greatly impacts data centre performance. Data centres can significantly reduce their energy consumption and carbon emissions by implementing renewable energy and efficient cooling systems. This research emphasizes the importance of green innovation and digital transformation to improve data centre performance, and emphasizes the positive benefits of green innovation on data centre performance. The research also shows that incorporating environmentally friendly practices and advanced technologies into data centre operational strategies can provide major benefits in terms of energy efficiency, resource efficiency and cost efficiency
Conclusions: Through modern technology, carbon reduction, and energy efficiency, digital transformation and green innovation greatly improve data center performance. Reliability, cost effectiveness, and sustainability are increased by integrating automation, efficient cooling, and renewable energy. According to this survey, green innovation is essential for streamlining operations and encouraging eco-friendly data center practices.
Originality/value (State of the art): This study highlights the unique role of green practices in boosting energy efficiency, operational sustainability, and competitiveness in the data center business despite regulatory and talent shortages by using renewable energy and modern technologies.

Keywords: data centre performance, digital transformation, digital talent, green innovation, green energy

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INTRODUCTION

Data Center industry activity in Asia Pacific, especially in Indonesia, has experienced significant growth in recent years. Indonesia, through the growth in the number of Internet users and strong Internet network penetration, has become an important market for Data Center service providers. By 2023, the number of Internet service providers in Indonesia will reach 909 companies. This figure has increased from 564 companies in 2019, while also showing significant growth in digital infrastructure in Indonesia (Mordor Intelligence, 2024). In addition, Internet traffic reflected in the Indonesia Internet Exchange (IIX) has reached 4.5 Terabytes per second. This achievement figure has increased by 47.2%/per year, indicating increasing demand for Data Center capacity and services (Mordor Intelligence, 2024). This growth is driven by the increasing adoption of cloud technology and data-based solutions, which are increasingly becoming the operational standard for many companies in Indonesia. With government support and private sector investment, the data center sector in Indonesia is expected to continue to grow and make a significant contribution to Indonesia's digital economy. This study focuses on data centers in Indonesia, a quickly expanding industry propelled by rising cloud adoption and digital transformation. It is imperative to solve issues with green innovation, talent shortages, and sustainability requirements. Insights from this study can boost competitiveness, operational sustainability, and energy efficiency, all of which contribute to long-term industrial growth.

Data center performance is greatly influenced by the quality of talent owned by the company and the implementation of green innovation as part of the operational strategy. Previous research conducted by (Yuwono et al. 2021) explained that companies that have a good talent management strategy, accompanied by a corporate culture that supports innovation, have an impact on improving employee and organizational performance as a whole. This article emphasizes the importance of talent management as a foundation for supporting technological innovation, including green innovation that aims to increase energy efficiency and reduce environmental impacts in data center operations.

Fakhira et al. 2023, in their research explained that in green banking one of the key factors developed is the use of digital technology. The purpose of using this digital technology is to reduce energy consumption and physical resources. This research is in line with the objectives of this research on Likewise in data centers, the use of technologies such as server virtualization, cloud computing, and renewable energy resources can significantly reduce energy consumption and carbon emissions. Telkom, through the initiative to build a hyperscale data center in Batam that uses renewable energy, is trying to follow the global trend in implementing green innovation, similar to how banks in Jabodetabek adopt environmentally friendly technology in their operations. This approach helps explain how effective talent management, combined with green innovation, can make a significant contribution to data center performance measurements, particularly in terms of sustainability and operational efficiency. Digital transformation is an issue that continues to be designed and developed for all companies, especially telecommunications companies, such as the Telkom Group. Kristianto et al. (2023) explained that the right strategy is needed to carry out digital transformation, one form of digital strategy needed is strategic flexibility. This strategy is needed by organizations in terms of operational adjustments, utilizing new technologies, and adopting green innovations, which not only increase efficiency but also ensure compliance with sustainability regulations. Along with the rapid development of technology, such as 5G and cloud computing, telecommunication companies must have the ability to make strategic adjustments quickly to remain competitive. With this flexibility, companies can respond to market demands more effectively, while optimizing resources to improve operational performance. Brown and Wilson (2021) also stated that the implementation of digital innovation not only focuses on operational efficiency but also on enhancing data security and sustainability.

The PT Telkom Indonesia (Persero) Tbk (Telkom Group) Group of Companies as one of the telecommunications companies in Indonesia is currently aggressively expanding its Data Center business to strengthen its position as a regional market leader. Currently, the company has operated 30 data centers, covering 25 locations in Indonesia and five other locations in countries such as Singapore, Hong Kong, and Timor Leste. One of Telkom's strategies to improve infrastructure capabilities is to build strategic partnerships. The partnership can be seen from Telkom's collaboration with Singtel in the hyperscale data center development program in Batam with an investment

value of around $581 million. The facility is designed using renewable and environmentally friendly energy, in line with Telkom's goal of creating a sustainable digital ecosystem (Indonesia Business Post).

In developing the Data Center business, companies such as Telkom Group face various challenges. First, Telkom Group faces the biggest challenge in data center development in the form of compliance with increasingly stringent sustainability regulations. In various regulations regarding sustainability, data centers must be able to reduce carbon emissions, energy consumption, and optimize energy efficiency. One of the most important issues is related to the issue of cooling. Data centers need to achieve efficiency in cooling issues in order to reduce electricity consumption and reduce carbon emissions. Second, the rise of Data Centers has increased the demand for skilled and experienced talent. Therefore, Data Center managers need to find effective ways to attract, retain, and enhance the capabilities of skilled digital talent (CGS Talent, 2023). This problem is increasingly prominent because the shortage of digital talent in the Data Center sector has not shown any signs of abating and is expected to continue to be a challenge in the years to come. Talent working in Data Centers also need to equip themselves with various skills such as digital skills, sustainability, and various other supporting skills. Third, the problem of green innovation as a solution to sustainability problems is a very relevant Data Center challenge. Data Center managers need to develop innovations to reduce carbon emissions, as well as very high electricity needs.

This study is related to PT Telkom Indonesia (Persero) Tbk's anticipation in overcoming the three challenges of the Data Center business that has been built. Considering the importance of the three challenges above, this study analyzes the influence of digital talent and green innovation on the data center business.

METHODS

PT Telkom Indonesia (Persero) Tbk was chosen as the research object on the grounds that it is a State-Owned Enterprise and the best telecommunications service operator in 2023 in Indonesia according to CNBC Indonesia Research. This study was carried out at the data centre at PT Telkom Indonesia (Persero) Tbk in the Jabodetabek area. The research involves 3 variables, namely digital talent, green innovation and data centres using quantitative research. Respondents in this study are Data Center Managers, Digital Talent Development Experts, Data Center Operational and Technical Teams, and Experts and Consultants in the Field of Green Technology and Data Centers".

Data collection in this research was carried out using a survey method which included in-depth interviews and questionnaires. In the in-depth interview process, the researcher communicates directly with the respondent with the aim of gaining a comprehensive understanding of the respondent's views and experiences on the topic under study. The interview method allows researchers to obtain deeper information and be able to identify situations that may not appear in the questionnaire. Apart from interviews, researchers also used questionnaires to systematically collect data from respondents. The construction of the questionnaire in this study followed the guidelines suggested by McLeod (2018). First, the questionnaire is prepared in accordance with the research objectives to ensure the appropriateness of the questions. Second, each question is structured in concise, clear language and is directly related to the information you want to collect, namely digital talent, environmentally friendly innovation and data centres. Third, the questionnaire has been tested first so that respondents have the same understanding as the researcher, so they can avoid misunderstandings. Fourth, checks are carried out to ensure that there is no duplication of questions, so that each question is unique and not repeated. Fifth, the words and expressions used in the questionnaire are carefully selected so that they are easily understood by respondents, thus ensuring that respondents can provide accurate and precise answers. By following these steps, it is hoped that the questionnaire can produce valid and reliable data.

In this research, the author used Partial Least Square (PLS) analysis using SmartPLS software when testing various related variables. Of all the latent variables in PLS in the path analysis model there are several components, namely outer model, convergent validity and discriminant validity. The next step is to test and assess the reliability of the structural model which includes the coefficient of determination (R2 value), effect size (f2), and predictive relevance (Q2 value). Various testing steps were carried out in the analysis to ensure that the model used in this research was valid and reliable, so that it could provide accurate and appropriate results to answer the questions in the research.

The following is an overview of the framework for thinking in research (Figure 1). The independent variables are digital talent (X1) and green innovation (X2). Meanwhile, the dependent variable is digital transformation (Y) and is moderated by the model variable with the data centre business model (Z).

Researchers put forward a hypothesis in the analysis, namely:

H1: There is a direct influence of digital talent on Digital Transformation
H2: There is a direct influence of green innovation on Digital Transformation
H3: There is a direct influence of digital talent on data centre performance
H4: There is an influence of green innovation on data centre performance
H5 : There is a direct influence of Digital Transformation on data centre performance
H6 : There is an influence of digital talent on data centre performance through Digital Transformation as a mediator
H7: There is an influence of Green Innovation on data centre performance through Digital Transformation as a mediat

RESULTS

Validity and Reliability Test

Validity testing is carried out with the aim of determining the accuracy of the measuring instrument. A total of 150 data were used for validity testing, which was carried out using SmartPLS software. According to Hair et al. (2017), the research Average Variance Extracted (AVE) value must be more than 0.5, as shown in Table 1, for the variables of business performance, competitive advantage, product innovation and digital marketing. Therefore, the results of the validity test on all variables are considered valid. Table 1 shows the results of the reliability tests carried out. All the variables tested, namely data centres, digital talent, digital transformation and green innovation, have a Cronbach's Alpha value of more than 0.6, so the closer to value 1, the higher the reliability value. Apart from that, the composite reliability value of all variables shows results of more than 0.7. These results indicate that each variable shows a sufficient level of internal consistency to measure a construct with the conclusions of this research being reliable.

The reliability test results indicate that variables like data centers, digital talent, digital transformation, and green innovation are consistent and reliable for measuring constructs. This is crucial for Telkom Group, which manages data centers, as it underscores the importance of reliable measurement in evaluating strategies to enhance operational performance, innovation, and sustainability.

Use the Outer Model

This research is structured in two main stages, namely measurements outside the model (outer model) and measurements within the model (Inner model). The results of the external model test using SmartPLS 4.0 show that the data collected from respondents meets research validity and reliability standards with a minimum Cronbach's Alpha value of 0.6.

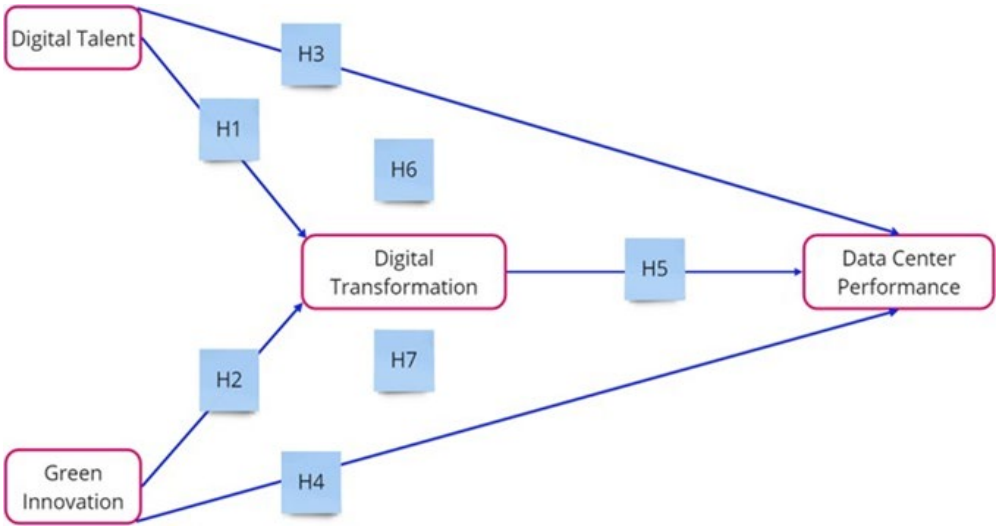

Figure 1. Research framework

Research validity can be measured through the outer loading value of the reflective construct, where the value is considered valid > 0.7 (Ghozali & Latnan, 2018). Table 2 shows that all variable indicators meet the convergent validity criteria because the values of the outer loading for all variables are above > 0.7, so it can be stated that all variables in this study are valid and can be used for further tests.

Cloud integration refers to the process of connecting various applications, systems and IT services into public or private cloud platforms to ensure better interoperability, flexibility, and scalability. In the context of outer loadings analysis, a value of 0.880 indicates a strong level of relationship between the indicator variable (Cloud Integration) and the construct it measures. This value can show that Cloud Integration is an important part and represents this concept. These values demonstrate good construct validity, high indicator reliability, and the importance of cloud integration in assessing the flexibility and scalability of cloud services. This high level of integration also reflects an organization's ability to leverage the cloud to meet flexibility and scalability needs, enable dynamic workload management, and optimize resource utilization while reducing operational costs.

In the Digital Talent variable, completion of planned maintenance (Scheduled Maintenance Completion) as an indicator of the digital talent variable with a value of 0.804 can indicate a strong and significant relationship between the completion of planned maintenance tasks and the performance of digital talent in the data centre. This value indicates that digital talent's ability to complete maintenance on time is a valid and appropriate measure of their efficiency and effectiveness. Indicators can consistently and reliably reflect the work efficiency, professionalism and discipline of digital talents in carrying out daily routine tasks. The Scheduled Maintenance Completion level ultimately has a positive impact on data centre operations, as well as proof that the IT team can prevent incidents and ensure business continuity without disruption. This capability is critical to maintaining optimal data centre reliability and performance.

The Energy Efficiency Ratio (EER) indicator in the Green Innovation variable is a ratio for measuring the energy efficiency of a cooling system by calculating the cooling capacity per unit of electrical energy used. In the outer loadings analysis, the value of 0.821 indicates a strong relationship between EER and the latent variable green innovation, making EER an important component that reflects the level of green innovation in the data centre. This value shows that EER is a valid and consistent measure of energy efficiency and sustainability, as well as consistent and reliable. A high level of energy efficiency indicates a data centre's ability to optimize energy consumption for cooling, which has a positive impact on reducing carbon emissions and operating costs, as well as increasing system performance and reliability.

The Room Capacity indicator in the data centre performance variable refers to the data centre's ability to accommodate IT equipment in the available physical space. This space capacity includes floor, rack and other space capacity. The Room Capacity value of 0.840 in the outer loadings analysis shows a strong relationship between Room Capacity and data centre performance variables. This value also shows that Room Capacity is a valid and relevant measure of a data centre's ability to operate effectively and efficiently, as well as consistently and reliably. A Room Capacity value that is close to 1 indicates the level of efficiency in design and space management, namely that the data centre is able to optimize the use of available physical space to accommodate all IT equipment, to maximize capacity and reduce operational costs. Additionally, it shows that data centres have the ability to add or remove IT equipment as needed, which is important for operational flexibility and scalability.

Table 1. Validity and reliability test results

Variabel	Composite Reability	Cronbach's Alpha	Average Variance Extracted (AVE)
Data Centre	0.931	0.916	0.629
Digital Talent	0.917	0.897	0.582
Digital Transformation	0.933	0.914	0.700
Green Inovation	0.926	0.909	0.611

Table 2. Outer loading results

Variabel		Variabel Code	Outer Loadings	Result
Data Centre Perfromance	Power Usage Effectivebess (PUE).	DC2	0.721	Valid
	Pusat Data Infrastructure Efficiency(DCIE)	DC3	0.764	Valid
	Service Level Aggrement	DC4	0.826	Valid
	WUE (Water Usage Effectiveness)	DC5	0.801	Valid
	CUE (Carbon Usage Effectiveness)	DC6	0.824	Valid
	Room Capacity	DC7	0.840	Valid
	Utility Server	DC8	0.787	Valid
	Redundansi	DC9	0.776	Valid
Digital Talent	Key Performance Indicator (KPI)	DT1	0.752	Valid
	Performance dashboards	DT2	0.723	Valid
	Feedback Users	DT3	0.773	Valid
	Utilization Rate	DT4	0.743	Valid
	Cycle Time	DT5	0.704	Valid
	Mean Time To Recovery	DT6	0.796	Valid
	Ticket Resolved	DT7	0.802	Valid
	Scheduled Maintenance Completion	DT8	0.804	Valid
Green Inovation	Renewable Energy Utilization	GI1	0.802	Valid
	On-site Renewable Energy Production	GI2	0.774	Valid
	Energy Efficiency Ratio (EER)	GI3	0.821	Valid
	Waste Recycling Rate	GI4	0.819	Valid
	Green Building Materials	GI5	0.723	Valid
	Carbon Usage Effectiveness (CUE)	GI6	0.732	Valid
	ISO 14001 Compliance	GI7	0.791	Valid
	Server Density	GI8	0.787	Valid
Digital Tansformation	Number of New Services Launched	DTrans1	0.792	Valid
	Cloud Integration	DTrans2	0.880	Valid
	Elasticity	DTrans3	0.867	Valid
	Resource Provisioning Time	DTrans4	0.830	Valid
	Latency and Throughput	DTrans5	0.838	Valid
	Automation Level	DTrans6	0.811	Valid

Test the Inner Model

R-Square Test Results

R-square is a measure in regression analysis that is used to assess the extent to which the independent variable explains the variability of the dependent variable, with values ranging from 0 to 1 (Ghozali, 2018). A value of 0 indicates that the independent variable cannot explain the variation in the dependent variable, while a value of 1 indicates that the independent variable can explain all of the variation in the dependent variable. A high R-square value indicates a model that is good at explaining various variations in the data, while a low R-square can indicate the opposite. R-square helps assess the suitability of a regression model in research, although it is not the only indicator in evaluating a model.

In Table 3, the R-Square value is 0.752 in the context of data centre performance with indicators such as Power Usage Effectiveness (PUE), Data Centre Infrastructure Efficiency (DCIE), Service Level Agreement (SLA), Water Usage Effectiveness (WUE), Carbon Usage Effectiveness (CUE), Room Capacity, Server Utility, and Redundancy can explain that 75.2% of the variation in data centre performance can be explained by these indicators. Thus, the regression model that uses various data centre performance indicators is able to explain most of the variation in data centre performance. These results reflect energy use efficiency (PUE and DCIE), compliance with service standards (SLA), water use efficiency (WUE), environmental impact (CUE), physical space capacity (Room Capacity), server efficiency (Utility Server), and Operational resilience (Redundancy) are important factors that

influence data centre performance. However, there is still 24.8% of variation in data centre performance that is not explained by these indicators, indicating that there are other factors that also influence data centre performance and need to be further identified.

The Goodness of Fit (GOF) Results

The Goodness of Fit (GOF) test is used to statistically evaluate the extent to which the sample regression function can predict actual values (Ghozali, 2018). In research, Hair et al., (2010) explained GOF as a matrix used to measure the suitability of the proposed model. The evaluation criteria in the GOF test can be proven in the Standadized Root Mean Square Residual (SRMR) value, namely the average convariance residual value based on the transformation of the sample convariance metric to the predicted convariance metric into a relationship matrix where a value <0.10 or 0.08 means there is The match between the correlations in the research and if the Normed Fit Index (NIF) value is closer to 1, then the research model is considered to be better.

Table 4 shows that the SRMR value is 0.071, which means <0.10 and the NFI value is 0.771, close to 1, which means the research model can be said to be appropriate and meets the GOFI criteria.

T-Test Results

The T-test was carried out to assess whether the independent variables had a significant influence on the dependent variable according to (Ghozali, 2018). If the P value < 0.05, T-Statistics > 1.645, and the original sample is positive then it can be concluded that there is a significant influence of variable.

Based Table 5, H1 has a P value of 0.114, which means the hypothesis is rejected because the P value is greater than the significance level of 0.05. These results indicate that there is insufficient statistical evidence to support the hypothesis that digital talent significantly influences digital transformation. Several possible reasons why H1 is rejected are due to the existence of intermediary variables that have not been included in the model. Therefore, next steps could include reviewing the data, adding other relevant variables, and developing better models to explore these relationships further.

According to the H1 hypothesis, digital talent does not directly have a significant impact on digital transformation. The study also indicates that the mediating or moderating variable may have an impact on the relationship. According to research by Hinz et al. (2020), the impact of digital talent on digital transformation is frequently mediated by organizational culture or technological adoption that encourages innovation. In addition, research by Hughes et al. (2019) highlights the importance of digital leadership as a term used to describe the relationship between digital talent competency and digital transformation success. This can also be attributed to a lack of agreement in the adjustment of the variable or a lack of cooperation among departments or technological proficiency within the organization. Because of this, this study can help to better understand the more complex relationship between digital talent and digital transformation.

Table 3. R-Square Test Results

	R-Square	R-Square Adjusted
Data Centre Performance	0.752	0.751
Digital Transformation	0.148	0.144

Table 4. GOFI Test Results

	Saturated	Estimated Model
SRMR	0.071	0.071
d_ULS	2.344	2.344
d_G	1.029	
Chi-Square	2277.813	2277.813
NFI	0.771	0.771

Table 5. T-test results

Hipotesis	Original Sampel (O)	Sampel Mean (M)	Standard Deviation	T Statistics (|O/STDEV|)	P Values
Digital Talent → Digital Transformation (H1)	0.148	0.149	0.094	1.585	0.114
Green Innovation → Digital Transformation (H2)	0.250	0.251	0.093	2.696	0.007
Digital Talent → Data Centre Performance (H3)	0.361	0.363	0.053	6.832	0.000
Green Innovation → Data Centre Performance (H4)	0.367	0.366	0.051	7.230	0.000
Digital Transformation → Data Centre Performance (H5)	0.310	0.309	0.034	8.995	0.000
Digital Talent → Digital Transformation → Data Centre Performance (H6)	0.046	0.046	0.030	1.523	0.128
Green Innovation → Digital Transformation → Data Centre Performance (H7)	0.077	0.078	0.030	2.569	0.010

Hypothesis H2 which states that "Green Innovation" has a significant direct effect on "Digital Transformation" can be accepted. This means that it can be concluded that green innovation significantly influences digital transformation. This relationship shows that efforts to implement green innovation, such as energy efficiency, reducing carbon footprints, and using environmentally friendly technology, play an important role in driving digital transformation in organizations or companies. Hypothesis H2 is in line with sustainable data centre digital transformation efforts through green technologies such as the use of renewable energy (such as wind and solar), water- based cooling, and e-waste management can reduce the energy consumption and carbon footprint of data centres (Cheng et al. 2014). Additionally, the development of energy-saving and environmentally friendly technologies, such as energy management software and low-power servers, is driven by green innovation. These technologies can increase operational efficiency and reduce costs (Ren and Li, 2022). Therefore, incorporating green innovation into digital transformation strategies helps companies meet environmental goals and improve their performance and competitiveness in the global market.

The hypothesis stating that "Digital Talent" has a significant direct effect on "Data Centre Performance" (H3) is acceptable. With a P value of 0.000, this hypothesis is accepted because the P value is much smaller than the significance level of 0.05, which indicates that the relationship is highly statistically significant. Additionally, the T Statistics value of 6.832 indicates that the relationship between digital talent and data centre performance is very strong and well above the common threshold for statistical significance (usually 1.96 for a 0.05 significance level). This means that the higher the quality and capability of the digital talent possessed by PT Telkom Indonesia (Persero) Tbki, the better the performance of their data centre. This indicates that investments made by companies in developing and improving the digital skills of the workforce directly have a positive impact on the efficiency and effectiveness of data centre operations, such as in terms of resource management, response to disruptions, and infrastructure maintenance.

Digital talent has a significant impact on data centre performance. The expertise and skills possessed by digital talents are highly relevant in managing, optimizing and maintaining complex data centre operations. Competent digital talent is apparently able to implement the latest technology and adopt best practices in data management, which in turn increases the efficiency and reliability of data centres (Huang and Rust, 2018). Additionally, they can drive innovation in data centre operations by using AI-based solutions and automation to reduce downtime and increase data processing capacity, which is critical in meeting evolving business needs (Deloitte Insights, 2019).

With a P value of 0.000, H4 can be accepted because this value is much smaller than the significance level of 0.05. These results show that the relationship between green innovation and data centre performance is highly statistically significant. Additionally, the T Statistics value of 7.230 indicates that the relationship between green innovation and data centre performance is very strong and well above the common threshold for statistical significance. Thus, implementing green innovations that impact energy efficiency, reducing carbon footprints and using environmentally friendly technologies directly has a positive impact on data centre performance.

Green innovation has a significant impact on data centre performance by increasing energy efficiency and reducing environmental impact. For example, the use of renewable energy such as solar and wind power can reduce data centre energy consumption by up to 30%, as well as reduce carbon emissions by up to 70% (Wang et al. 2016). Additionally, green innovations such as efficient cooling systems and intelligent energy management also improve operational efficiency and sustainability of data centres (Singhal et al. 2017).

Hypothesis 5 states that "Digital Transformation" has a significant direct impact on "Data Centre Performance" (H5). With a P value of 0.000, H5 can be accepted because the P value is much smaller than the significance level of 0.05 and shows that the relationship is very statistically significant. In addition, the T Statistics value of 8.995 can explain that the relationship between digital transformation and data centre performance is very strong and far above the general threshold for statistical significance. Thus, the implementation of digital transformation, such as the use of advanced technologies, automation and digitization of processes, has a significant positive impact on data centre performance. Digital transformation increases data centre operational efficiency, responsiveness, and flexibility, which in turn improves quality of service, reduces downtime, and increases the ability to handle higher workloads more efficiently.

Data centre performance is greatly impacted by digital transformation, especially in terms of scalability, operational efficiency, and the ability to manage large volumes of data. Zang & Liu (2020) explain that data centres can improve service reliability, reduce downtime, and optimize operations by using advanced technologies such as automation, artificial intelligence (AI), and machine learning. In addition, digital transformation can enable data centres to adapt to changing business needs by offering more flexible and scalable solutions. Digital transformation also makes it possible to manage increasingly large amounts of data more efficiently, which enables fast data access and processing (Marston et al. 2011).

In the hypothesis T test (H6), the P value is greater than the 0.05 significance level. Thus, this hypothesis is rejected. Additionally, the T statistic value of 1.523 is below the general threshold for statistical significance (1.96) for a significance level of 0.05. This value shows that the relationship between data centre performance through digital transformation and digital talent is not strong enough. This means that, based on existing data, it cannot be concluded that digital talent significantly influences data centre performance through digital transformation as a mediator. This suggests that although digital talent and digital transformation may have a significant individual influence on data centre performance, the mediating relationship between the two is not statistically proven in this model. Therefore, it is important to reevaluate the role of digital transformation mediators and consider other factors that may influence data centre performance.

In H7 "Green Innovation" can impact "Data Centre Performance" through "Digital Transformation". Hypothesis H7 can be accepted based on the P value of 0.010 which is smaller than the significance level of 0.05. This value indicates that the relationship is statistically significant. In addition, the T statistic value is 2.569, which is above the general threshold for statistical significance of 1.96. Thus, it can be concluded that green innovation as a mediator significantly influences data centre performance through digital transformation. The results of this T Test show that apart from directly improving data centre performance, green innovations implemented by companies such as energy efficiency, reducing carbon footprints, and using environmentally friendly technology also help improve data centre performance through digital transformation. In digital transformation, advanced technologies and automation are integrated to improve operational efficiency and data centre sustainability.

Managerial Implications

Telkom Group should focus on integrating green innovation and digital transformation to enhance data center performance. Prioritizing the adoption of renewable energy technologies, efficient cooling systems, automation, and artificial intelligence is essential to optimize energy consumption and sustainability. Continuous training programs to develop skilled digital talent are critical to addressing the challenges posed by talent shortages. Additionally, collaboration with regulators and industry stakeholders is necessary to ensure compliance with sustainability standards. Strategic partnerships, such as the hyperscale data center development in Batam, should be strengthened to enhance infrastructure capabilities and competitiveness. This approach supports operational efficiency and ensures long-term sustainability.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The digital transformation process of data centres is strongly influenced by green innovation, such as energy efficiency, reducing carbon footprints, and using environmentally friendly technologies. Green innovation practices must be incorporated into digital transformation strategies to improve organizational sustainability and performance. Additionally, digital transformation improves data centre performance, as demonstrated by increased service reliability and operations optimization. The use of advanced technology, automation, and process digitization in digital transformation can increase the efficiency, responsiveness, and flexibility of data centre operations. By increasing energy efficiency and reducing negative impacts on the environment, green innovation greatly impacts data centre performance. Data centres can significantly reduce their energy consumption and carbon emissions by implementing renewable energy and efficient cooling systems. This research emphasizes the importance of green innovation and digital transformation to improve data centre performance and emphasizes the positive benefits of green innovation on data centre performance. This research also shows that incorporating environmentally friendly practices and advanced technologies into data centre operational strategies can provide major benefits in terms of energy efficiency, resource efficiency and cost efficiency.

Recommendations

Based on the conclusions of this study, the following are recommendations that can be given to strengthen digital transformation and improve data centre performance through green innovation. (1) Integrating renewable energy technology; data centres must invest in renewable energy sources, such as solar and wind power to reduce dependence on fossil fuels. This investment step will help reduce carbon footprints and ensure long-term sustainability, (2) Optimizing efficient cooling systems; more efficient cooling technologies should be a priority, such as the use of liquid cooling systems or natural air cooling. The use of this technology can significantly reduce energy consumption in data centres, (3) Automation and use of smart technology; data centres must utilize automation and AI to monitor and optimize energy usage and other operations. The use of automation technology, real-time monitoring of energy consumption and workloads can increase overall efficiency, (4) Improving sustainable digital infrastructure; data centres must continue to integrate green technologies into digital transformation, with a focus on digital infrastructure that reduces the use of resources, including water and electricity, (5) Collaboration with government and industry; data centre service providers should collaborate with government and industry bodies to comply with environmental regulations and participate in global sustainability initiatives. This will ensure that data centres not only meet minimum standards but also become leaders in green innovation, (6) Training and education for employees; data centres should provide training for staff on green practices and the latest technologies. This recommendation is in line with the research conducted by Khristianto et al. (2023), regarding the importance of investing in digital technology and employee training to utilize that technology to improve operational efficiency.

Continuous education will ensure the proper implementation of green innovations and environmental awareness throughout the organization. Incorporating the proposed recommendations from the research findings into the digital transformation strategy can improve operational efficiency, strengthen corporate sustainability, and provide significant competitive advantages for Telkom data centres.

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