






Integrating Green Information Technology Practices into the Information Technology Service Management Framework for Sustainable Digital Transformation in Vocational Higher Education

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Abstract. The increasing need for digital transformation in vocational higher education requires universities to improve the management of Information Technology (IT) services and, at the same time, implement sustainable practices. This research examines integrating the green IT concept within the Information Technology Service Management (ITSM) framework to facilitate sustainable digital transformation at Politeknik Negeri Bali (PNB). This research employs the Design Science Research method to assess current IT service conditions, identify gaps in accordance with the Information Technology Infrastructure Library (ITIL) 4 standard and green IT principles, and subsequently develop a comprehensive model. The suggested approach integrates ITSM principles from ITIL 4 with essential green IT elements, including cloud computing, e-waste management, and paperless administration. The research results indicate that the integration model improves IT service efficiency, reduces energy use, and strengthens sustainable IT governance. Model validation through Focus Group Discussions (FGD) confirmed that the model is relevant, pragmatic, and appropriate in vocational education institutions. This integrated strategy offers a strategic framework for educational institutions to improve IT service delivery while aligning with environmental sustainability goals.

Keywords: Green Information Technology, Information Technology Infrastructure Library 4, Information Technology Service Management, Sustainable Digital Transformation

1 Introduction

Digital transformation has now become one of the key elements to improve the quality of higher education services, both in academic universities and vocational education institutions. Digital transformation in higher education, such as cloud services, artificial intelligence, and big data, reshapes the educational experience and institutional structure (Kuzu, 2020). Digital transformation in vocational learning can encourage

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improvements in the quality of education (Xu et al., 2024), data governance, and student learning experiences (Guo Xiaoqian et al., 2024). Comprehensive digital development that covers various dimensions, such as the application of technology and innovation of educational models, shows the critical need for a structured strategy in vocational education (Wang, 2024).

Vocational higher education, such as polytechnics, requires adaptive, efficient, and sustainable information technology (IT) service management to support practice-based learning processes, administration, and collaboration with industry (Ghozi et al., 2024). Bali State Polytechnic (PNB), as one of the vocational higher education institutions in Indonesia, especially in Bali, has developed various IT service systems or applications to support the digital transformation of the campus. PNB has implemented 19 IT service applications that cover various internal and external needs of the institution, both in academics, correspondence, student affairs, organizations, and complaints. This step also strengthens the center of excellence for green tourism. It manifests the Green Information Technology (IT) concept, supporting the paperless initiative (Hernandez & Hernandez, 2020). In addition to developing IT service applications, PNB has begun implementing Green Information Technology (Green IT) practices.

Green IT is defined as the use of IT that can directly or indirectly reduce the negative impacts of business processes on the environment (Attori et al., 2020). The fundamental aspect of Green IT in higher education is the emphasis on integrating information and communication technology (ICT) with emerging technologies, especially cloud computing. Research conducted (Godla et al., 2024) highlights that developing green IT services through cloud computing increases resource efficiency while providing quality educational services, marking it as a new approach for educational institutions to reduce their ecological impact. Server virtualization can significantly reduce physical hardware requirements while increasing energy efficiency in educational environments (Koratagere et al., 2023). A comprehensive information system centered around cloud computing and virtualization can support sustainable growth and operational effectiveness in educational institutions (Mingyang & Asutria, 2024).

The application of Green IT at PNB, such as the use of cloud computing to host some applications, thereby reducing the use of physical servers, digitalization of administrative processes (paperless) in correspondence services, scholarship applications, financial management, and lecture monitoring, the use of energy-efficient electronic devices in several units and a significant reduction in paper use in academic services and lecture administration. However, based on the results of the internal evaluation, the implementation of Green IT at PNB still faces several challenges, such as the unavailability of a real-time energy consumption monitoring system, limited e-waste management SOPs, and the lack of awareness programs to strengthen the Green IT culture in all campus work units. On the other hand, IT services management at PNB is still partly based on traditional management, where incident management, service requests, and application development are carried out manually, with documentation limited to the SIPOL internal complaint application.

Formal IT service management standards based on the Information Technology Service Management (ITSM) framework, such as the Information Technology Infrastructure Library (ITIL 4), which is oriented towards holistic, efficient, and

customer-centric service management, have not been fully adopted. The best practices for managing IT services in a company are ITSM standards and frameworks (Permatasari et al., 2024; Hayadi et al., 2021; Widiyanto & Subriadi, 2022; Mora et al., 2021; Sarwar et al., 2023). ITSM is a customer-centric approach that enables businesses to create shared value using IT services (Ramakrishnan et al., 2020). At the same time, ITIL is a collection of best practices for managing information technology and developing IT support and service quality levels (Al-Ashmoery et al., 2021; Moudoubah et al., 2021). ITIL 4 offers a service value system (SVS) approach that enables organizations to optimally integrate services, processes, and resource management (Axelos, 2019; Hossain et al., 2020). Integration between ITIL 4-based ITSM and Green IT practices is considered crucial in directing the digital transformation of higher education institutions towards a more sustainable direction in terms of service efficiency, energy management, and reducing the environmental impact of IT. There are still limited specific studies on the development of ITIL 4-based ITSM models integrated with Green IT in the vocational education sector, especially polytechnics.

Based on these problems, this study compiles a conceptual model of Green IT integration into an ITIL 4-based ITSM framework in supporting sustainable digital transformation in the polytechnic environment. The resulting model can provide scientific contributions and practical recommendations for IT service managers in vocational higher education institutions to strengthen efficient, integrated, and environmentally friendly IT service management.

2 Methodology

The study uses a Design Science Research (DSR) approach that focuses on developing a conceptual model. The stages of this study can be explained as follows:

Literature study. At this stage, ITSM, ITIL 4, and Green IT references from ITSM standards are collected, as well as previous studies related to the implementation of ITSM and sustainability in higher education.

Existing Condition Analysis. At this stage, observations, interviews, and documentation are carried out on PNB IT services, with a focus on the green IT aspect and ITSM management at the Polytechnic, particularly the Politeknik Negeri Bali.

Gap Analysis. Based on the existing condition analysis results, a gap analysis compares the existing conditions with the ideal ITIL 4 and green IT standards.

Preparation of the Conceptual Model. The next stage involves preparing an integration model that refers to the ITIL 4 service value system, incorporating a green IT layer.

Initial Internal Validation. The integration model that has been built is discussed with PNB's internal IT manager for initial refinement.

Model Finalization. Prepare the final model based on field data synthesis and Focus Group Discussion (FGD) results.

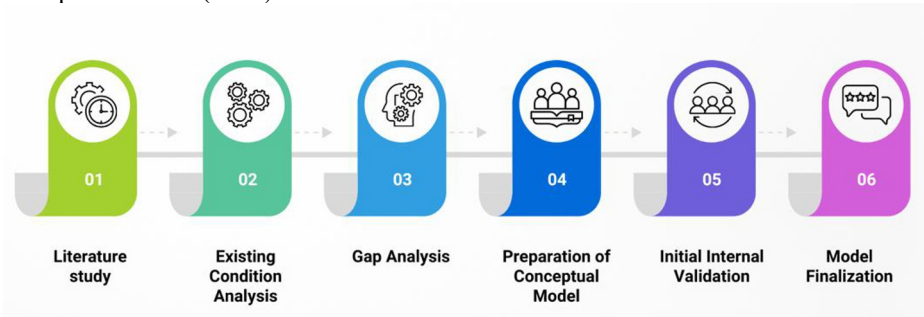


Figure 1. Research Stages

3 Result and Discussion

3.1 Result

Existing green IT practices at PNB. Based on the observation results, PNB has implemented several aspects of green IT as seen in Figure 2.

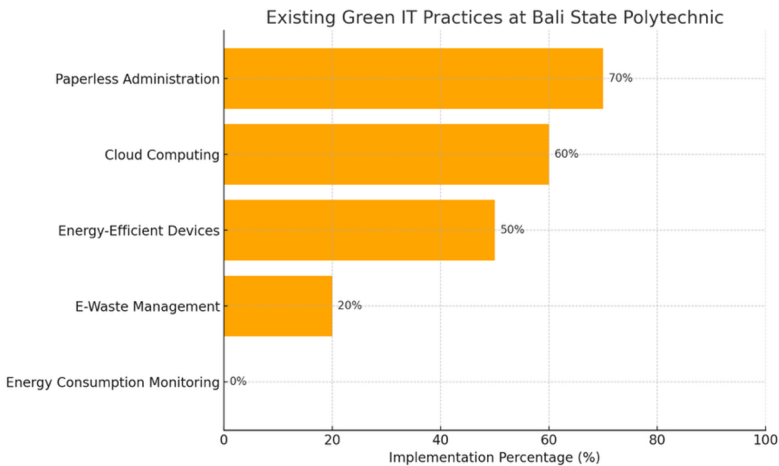


Figure 2. Current Green IT Practices at PNB

Figure 2 shows the level of implementation of various green IT practices that have been applied at PNB. Green IT practices aim to support environmental sustainability by

applying environmentally friendly technology in information system management. The level of paperless administration of 70% is the most dominant green IT practice at PNB, where digital documents have replaced most physical documents, which helps reduce paper consumption and environmental impact. The level of cloud computing usage is 60%, whereas the use of cloud technology is already relatively high. Using the cloud helps reduce the need for local hardware and increases energy efficiency. The level of energy-efficient devices is 50%, and some devices used at PNB are included in the energy-efficient category. Replacing old devices with more efficient devices still needs to be improved. E-waste management accounts for 20%, and electronic waste management remains minimal. This requires responsibly strengthening the management, recycling, or disposal of electronic waste. Energy consumption monitoring is 0%, indicating that no system is implemented to monitor energy consumption in a measurable and real-time manner. This is a potential area for future development to optimize energy efficiency. Based on this, green IT practices at PNB have begun to be implemented, but not yet comprehensively. The current focus is still on reducing paper use and increasing cloud computing. Electronic waste management and energy consumption monitoring systems need to be prioritized for further development.

Gap Analysis. Based on Observations, Interviews, Existing and Ideal Conditions, The Gap Analysis of Green IT Practices.

Table 1. Gap Analysis of Green IT Practices

Aspect	Existing condition	Ideal standard	Gap
Cloud Computing	Partially implemented	Optimal cloud adoption	Still, a combination of on-premise
Paperless	Paperless Partially	Already Full digital administration	Some manual services
E-Waste	No SOP yet	There is a management SOP	Not formally managed
Energy Monitoring	None	Energy dashboard	Not yet available

Conceptual Model Development. The model's components are first defined at the conceptual model development stage. The model components can be explained as follows

Input. Gap analysis, organizational policy, digital roadmap.

ITSM Core (ITIL 4). Service value chain, practices (incident, change, service desk, continual improvement).

Green IT Layer. Cloud optimization, paperless service, energy-efficient hardware, e-waste management SOP, energy monitoring dashboard.

Output. Optimal IT service platform, service efficiency, energy saving.

Outcome. Sustainable digital transformation in vocational education.

Visualization of the ITSM-green IT integration model for polytechnics can be seen in Figure 3.

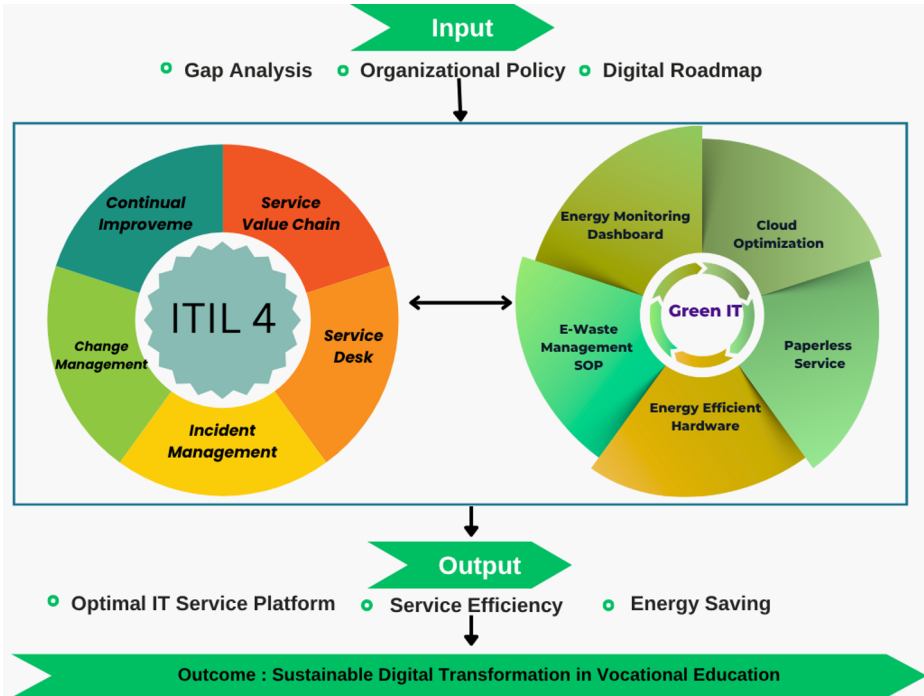


Figure 3. ITSM-Green IT Integration Model for Politeknik Negeri Bali

This model illustrates the integration of green IT practices into an ITSM framework based on ITIL 4 to drive sustainable digital transformation in vocational higher education. The description of the model can be explained as follows:

Input. Input components are the basis of the ITSM and green IT development process, which include:

Gap Analysis. Identifying gaps between current IT service conditions and expected standards.

Organizational Policy. Internal policies that regulate the direction and limitations of IT service development.

Digital Roadmap. A digital roadmap containing strategic plans for developing and implementing digital technology.

ITSM Core (ITIL 4). The core part of an IT service management system based on ITIL 4, consisting of:

Service Value Chain. A series of activities to create end-to-end service value.

Practices: Handling IT incidents effectively.

Change Management. Managing change to minimize risk.

Service Desk. The main point of contact between service providers and users.

Continual Improvement. Continuous service improvement to improve quality.

Green IT Layer. The green IT layer is the primary reinforcement for environmentally friendly digital transformation. The green IT layer that strengthens system efficiency and sustainability.

Cloud Optimization. Optimizing the use of cloud services to reduce energy consumption.

Paperless Service. Digitalizing documents to reduce paper use.

Energy-Efficient Hardware. Using energy-efficient devices.

E-Waste Management SOP. Operational standards for responsible electronic waste management.

Energy Monitoring Dashboard. Real-time energy consumption monitoring system.

Output. Direct results of ITSM and Green IT integration:

Optimal IT Service Platform. An optimal IT service platform that fits organizational needs.

Service Efficiency. Faster, more effective, and quality services.

Energy Saving. Savings on energy consumption from green IT practices.

Outcome. The long-term impact of implementing this model is sustainable, efficient, and environmentally friendly digital transformation in vocational education institutions.

3.2 Discussion

Initial Internal Validation. Initial internal validation was conducted to confirm that the conceptual model developed was to the needs and operational context at Politeknik Negeri Bali (PNB). This validation process involved PNB's internal IT managers through Focus Group Discussions (FGD) and focused discussions. Based on the results of the initial validation, it can be concluded that:

1. The developed model has been assessed as appropriate and in line with PNB's needs for digital transformation and green IT practices.
2. The IT manager stated that the model's structure and components do not need to be changed because all important aspects, such as the ITSM Core, green IT Layer, and Outcome, have been well accommodated.
3. The discussion focused on strengthening technical implementation and operational planning aspects, such as preparing SOPs, periodic monitoring, and internalization programs for green IT culture in the campus environment.
4. The IT management team assessed that the proposed model could be continued to the implementation stage without revisions to the conceptual design.

Model Finalization. Model finalization was carried out based on the results of field data synthesis, gap analysis, and feedback from the initial validation. The conceptual model was declared final without changes to its structure and elements. Finalization added technical planning, supporting documents, and implementation strategies in the field.

4 Conclusion

This study develops a green IT integration model within ITSM, grounded in ITIL 4, and applies it explicitly in vocational higher education. The resulting model integrates ITSM best practices with cloud-based green IT strategies, including paperless processes, e-waste management, and energy monitoring. Initial internal validation shows that the model can be implemented without structural changes, with a continued focus on strengthening implementation strategies and operational monitoring. The study results show that the integration model improves IT service efficiency, reduces energy use, and strengthens sustainable IT governance. Further research can be directed at measuring Service Level Agreements (SLAs) and performance indicators (KPIs) based on model implementation.

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