

IT Environment Analysis to Design Smart Campus System for Private University in Surabaya Based on Green Computing

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Abstract: *The implementation of education is carried out in a modern way by applying the technology in the concept of smart campus. It is a means to win competition, in terms of providing various facilities for stakeholders and the academic community. In this study, an IT environment analysis was conducted to design a smart campus system at a private university based on green computing. This analysis in both internal and external IT condition. The internal IT environment analysis by using McFarlan Strategic Grid analysis and the external IT environment by using IT trend analysis. These analyzes are made by considering the concept of green computing, in the context of reducing costs and energy saving. The result of the study is a Current Application Portfolio and External IT Trend. This current portfolio shows the role and contribution of applications in university business operations. The current application portfolio divided into four quadrant namely strategic, key performance, support and key operation.*

Keywords: *Green computing, IT environment analysis, IT trend analysis, McFarlan Grid, smart campus.*

1. Introduction

The idea of smart campus is inspired from smart city. Smart campus is an attempt to apply intelligent technology to a university. Basically, the use of smart campus technology aims to provide ease of service for the entire academic community. Smart campus not only support learning and teaching process but also support all aspect of campus life such as environment, building, social life, health and university governance. (Muhammad et al, 2017). According the work of Plagiario (2016), the smart campus framework is including people and living, economy, environment, energy, and mobility.

The investment cost of implementing smart campus is quite expensive especially for Private Universities (Cordiaz, 2017), so the concept of green computing must be applied to reduce costs. In the context of green computing, each component in the smart

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campus system not only considers energy consumption, but also how to use computers, devices, various tools and its content, with more efficient and clear benefits (Chauhan and Saxena, 2013). Before implementing smart campus system, what needs to be done is to make a situation analysis of the IT environment. In this study, an IT Environment analysis was conducted to design a smart campus system at a private university based on green computing. This analysis in both internal and external IT condition. The internal IT environment analysis is performed by using McFarlan Strategic Grid analysis and the external IT environment by using IT trend analysis.

The result of the study is a current application portfolio and external IT trend, where these documents are used as a reference in mapping the readiness of the institution in developing the smart campus system. Further studies are needed to create an IT master plan to be used as a basis for the development and selection of IT investment priorities to align with the strategic objectives of the institution.

2. Theoretical Framework and Hypothesis Development

Information Technology (IT) strategic planning is the process of compiling plans for making, using and implementing information systems and information technology (IS/IT) comprehensively in an organization. This planning is in line with the organization's business strategy to support the achievement of organizational goals effectively and efficiently. IT strategic planning aims to build an integrated system, to produce accurate information, which can be used as a consideration in making decisions. One of the stages in making an IT Strategic Planning is to analyze business and information needs. IT environment analysis is used to map current applications and its contribution to the business activities of organization. The results of this analysis provide input for the activities of making the IT strategy and its future development.

The main purpose of smart campus is to develop the campus by utilizing resources efficiently. It also provides high-quality services for the academic community. The implementation of smart campus systems also reduces operational costs from business process activities. Other benefits provided such as an interactive and creative learning environment for students, enables smart energy management, business process

automation, provides a secure payment system, transparent selection system, efficient parking system, reducing energy consumption, etc. (Alghamdi and Shetty, 2016)

Energy saving is in line with the concept of green computing. (Chauhan et al, 2013). In economic principles, energy saving means reducing cost. This cost reduction comes from the efficient use of IT equipment, greening every stage of the system development, paperless and cloud computing systems (Vikram, 2015; Singh and Sidhu, 2016).

Green computing can be done in many ways, namely by saving energy at every stage of the development of a system. Energy savings are carried out at the design, implementation, testing and maintenance stages.

Green computing issues include two aspects, namely greening IT and greening through IT (Sierszecki et al, 2014). Greening IT means making every stage of making IT systems green like reducing debugging, cloud computing, due to minimizing physical PCs. While greening through IT means making IT as a tool to make the environment greener, including using IT equipment responsibly such as turning off the PC or leaving it in stand-by mode when not in use, automating the use of lights and Air Conditioning.

3. Research Method

In this section will be describe about research method for this study. There are four steps to conduct this study, namely literature review, data acquisition, internal and external IT environment analysis, result of this study is current application portfolio.

Literature studies are conducted to enrich research. Literature materials used as a reference in this study are textbooks, journals or other sources. Literature study related to IT strategic planning, analysis tools, system analysis and design, smart campus systems, green computing and portfolio systems.

The case study used in this study is University of Wijaya Kusuma Surabaya (UWKS). The research method was carried out using a qualitative approach. It is performed by interpreting the results based on descriptive data obtained from interviews, observations and literature studies. The data used are primary data and

secondary data. The Primary data obtained by conducting interviews the related section. While secondary data, obtained from document analysis of Institution Strategic Document, document from the IT department and existing system or application from the official website.

The next step is to make an IT environment analysis of the data that has been collected. IT environment analysis is made, in both internal and external IS/IT conditions. The internal IT environment analysis is performed using McFarlan's strategic grid analysis tools. Whereas, external IT environment analysis is carried out using IS/IT trends analysis.

McFarlan Strategic Grid is used to map information system applications based on their contribution to the university. To perform this analysis, there are three analyzed aspects considered, namely hardware, software, network and information system that are used today. Mapping is carried out on four quadrants, namely strategic, high potential, key operations, and support.

IS/IT trends is the process trying to identify current IS/IT trends for higher education in order to predict future. This analysis considers several aspects, especially IT applications that are being used at many colleges. There are several IT applications which has become a trend, among others are cyber campus/smart campus and government's application for higher education.

4. Results and Discussion

4.1 Internal IT Environment Analysis

The analysis tools that is used in this section is McFarlan Strategic Grid. The internal IT environmental assessment consists of general identification of hardware used for both servers and clients, operating systems, network and applications that are currently running and being developed. The hardware, software and network used are shown in Table 1. The applications that are owned by UWKS can be grouped into two namely web-based as listed in the Table 2 and desktop-based as shown in Table 3. The applications and their contributions mapped with McFarlan Grid.

Table 1.

Hardware, software, and network used in UWKS

Aspect	Usage detail
Hardware	PC with LCD monitor, laptop, server, LED display,
Software	Operating System using Windows for server and client, Linux for Server, DBMS using SQL server and MySQL, MS Office Professional Plus, antivirus
Network	LAN, majority using wireless network

Table 2.

Desktop Application in UWKS

Application	User	Data handled
Academic Information System	Administrative section (BAA and Faculty), Information Technology department (UPT TIK)	master data of students, lecturers, courses, new semester registration data, course schedule, semester planning and reporting, curriculum, grade transcripts, graduation administration data.
Student Admission Information System	Registration section	new student entrance examination data, new student admission data
Financial Information System	Financial department (BAKeu)	student tuition payments data, employee payroll data
Library Information System	Library as Technical Service Unit (UPT Perpustakaan)	Book catalog, library book lending data
Staffing Information System	Personnel Department (BAU)	data related to lecturers and employees, including job transfers, history of functional positions and structural positions only

According the study of Muhamad (2017), there are some difference between digital campus and smart campus seen from the hardware infrastructure, networks, applications, and management systems used in the internal IT environment. The internal IT conditions of UWKS are classified as digital campus, also known as e-campus. Digital campus is characterized by the use of the internet in the process of learning and teaching. UWKS already has an e-learning application, despite the fact that the use of e-learning by its academic community is still not optimal.

Digital campus can be upgraded to campus intelligence or smart campus. The transformation from digital campus to smart campus requires serious effort. Some of the changes that need to be made are plugging various intelligences into the application

Table 3.

Web-based Application in UWKS

Information System	User	Data handled
Online registration system https://pmb.uwks.ac.id/	Public, Prospective new student	Online registration form, registration requirements, basic assessment criteria, online registration instructions, tuition fee, faculties and courses offered
Academic portal https://akademik.uwks.ac.id/	registered student	Semester planning and reporting
e-Learning http://elearning.uwks.ac.id/	Lecturer, Student	Online courses, lecturer, courses participant, schedule, material and assessment
e-Library http://library.uwks.ac.id/	Public, Member and non member	List of book, journal and material collections, contact and service hours of library, tracking history of collection lending exclusively for member
e-Journal http://ejournal.uwks.ac.id/	Public	e-journals that published by various courses of UWKS
Jafa jafa.uwks.ac.id/index.php?r=site/index	Lecturer	Lecturer data
Official Website http://uwks.ac.id/	Public	News, event, information all about university
e-Repository http://erepository.uwks.ac.id/	All academic community	Lecture or academic materials
Lecturer's portal https://enam6.uwks.ac.id/	Lecturer	Lecturer data, lecturer's courses, guardian's student
Career center http://alumni.uwks.ac.id	Graduated student	Alumni profil

Table 4.

Current Application Portfolio of UWKS

Strategic	High Potential
Lecturer's Portal (web) e-Repository (web)	Online Registration System (web) e-Journal (web) e-Learning (web) Career Center (web)
Key Operational	Support
Academic Portal (web) Library Information System (desktop application) Financial Information System (desktop application) Academic Information System (desktop application)	Official Website e-Library (web) Staffing Information System New Student Admission information system (desktop application) Jafa (web – under construction)

that has been owned, as well as the speed of adaptation and response in meeting the needs and desires of the user on the application. The current portfolio of the existing system is mapped using McFarlan Strategic Grid that shown in Table 4.

4.2 External IT Environment Analysis

Entering the Industry 4.0 era, universities competed to become technology-based campuses. The term cyber university or cyber campus becomes one of the focus directions for the development of higher education in Indonesia, for that the campus must be responsive to all changes that may occur in the digital age.

The application of information technology in all learning processes and supporting processes in institutions, starting from the learning system, curriculum, services, facilities, and infrastructure. It will facilitate all elements of the academic community, especially students, lecturers and campus management.

In the learning system, such as the use of presentation software at this time is no longer something special in learning and presenting in class. The use of other digital learning media such as the use of augmented reality and virtual reality technology makes the learning process more interesting and enjoyable learning experience. E-learning tools will help accommodate distance learning and make students more active and comfortable in the learning process. Academic Information System is a system that students can do online trusteeship, by making study planning anywhere and anytime without having to face-to-face with their advisor. Not only filling semester planning, students can also see the learning outcomes presented in the study reporting, see the acquisition of cumulative courses and even check the presence. The official website no longer contains only one-way information, but has shifted to a two-way information container and functions as a virtual campus.

There is several government's system for Higher Education that are owned by the Ministry of Research, Technology and Higher Education. Among others is the Quality Assurance System (SPM) aims to improve the quality of higher education systemically and continuously through planning, implementing and evaluating the achievement of the Higher Education Standards, so as to grow and develop a quality culture.

The Integrated Information System (SISTER) that serves all the needs related to lecturer data in an integrated application. This system can be accessed at sister.ristekdikti.go.id.

Indonesia's Online Learning System (SPADA) is a system was developed to answer some of the challenges of higher education such as the limited capacity of university; the low affordability of university due to uneven distribution; there are still many universities that do not yet have adequate and quality educational resources.

Tracer Study Information System has been developed to track the graduated activities after graduation. Information about transition from the world of University to the world of work (including the waiting period of work and the first job search process), the last work situation, and the application of competencies in the world of work. And also used to evaluate the learning process and the contribution of higher education to the acquisition of competencies.

Research and Community Service Management Information System (SIMLITABMAS) is used to support the preparation of the formulation, coordination and synchronization of the implementation of policies, monitoring, evaluation and reporting in the field of research and community service.

Science and Technology Index (SINTA), aims to record the publications and citations of academics and researchers in Indonesia, assess the performance of journals based on accreditation and citation standards, display ratings of institutions, authors and journals also monitor the performance of lecturers and researchers' publications.

5. Conclusion, Implication and Limitation

5.1. Conclusion

Internal IT environment analysis using three IT condition above, hardware, software and information system or application. Based on the hardware and software is used today, the internal IT conditions of UWKS are classified as digital campus. The current portfolio of the existing system is mapped using McFarlan Strategic Grid is shown in Table 4. Based on IS/IT Trends which are widely used in higher education in

Indonesia, almost all systems have been created and managed by the Ministry of Research, Technology and Higher Education.

5.2. Implication and Limitation

The Current Application Portfolio and External IT Trend, are used as a reference in mapping the readiness of the institution in developing the smart campus system. Further studies are needed to create an IT master plan to be used as a basis for the development and selection of IT investment priorities to align with the strategic objectives of the institution.

Reference

- Anonym, 2008. TELKOM Smart campus, Direktorat EWS – SUBDIT Enterprise.
- Alghamdi, A., & Shetty, S. (2016, August). Survey toward a smart campus using the internet of things. In 2016 IEEE 4th *International Conference on Future Internet of Things and Cloud (FiCloud)* (pp. 235-239). IEEE.
- Arifani, I. N., & Darmawan, A. 2017. Perencanaan Strategis Sistem Informasi Dan Teknologi Informasi SI/TI Pendidik Dan Tenaga Kependidikan (Studi Kasus: Pada Disdikbudpora Metro). *Jurnal Teknologi Informasi Magister*, 2(01), 41-51.
- Chauhan, N. S., & Saxena, A. (2013). A green software development life cycle for cloud computing. *IT Professional*, 15(1), 28-34.
- Cordiaz, M. (2017). Penerapan Smart Campus sebagai Pendukung Kegiatan Pendidikan dalam Tri Dharma Perguruan Tinggi. *Jurnal Informatika Universitas Pamulang*, 2(2), 77-80.
- Muhamad, W., Kurniawan, N. B., & Yazid, S. (2017, October). Smart campus features, technologies, and applications: A systematic literature review. In 2017 *International Conference on Information Technology Systems and Innovation (ICITSI)* (pp. 384-391). IEEE.
- Pagliaro, F., Mattoni, B., Gugliermenti, F., Bisegna, F., Azzaro, B., Tomei, F., & Catucci, S. (2016, June). A roadmap toward the development of Sapienza Smart Campus. In 2016 IEEE 16th *International Conference on Environment and Electrical Engineering (EEEIC)* (pp. 1-6). IEEE.
- Sierszecki, K., Mikkonen, T., Steffens, M., Fogdal, T., & Savolainen, J. (2014). Green software: Greening what and how much?. *IEEE software*, 31(3), 64-68.
- Singh, M., & Sidhu, A. S. (2016). Green Computing. *International Journal of Advanced Research in Computer Science*, 7(6).
- Vikram, S. (2015, October). Green computing. In *Green Computing and Internet of Things (ICGCIoT)*, 2015 International Conference on (pp. 767-772). IEEE.