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Smart Campus Design Strategic Using Critical Success Factor Analysis at the Private University in Surabaya

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ABSTRACT
This research conducted an analysis of the internal business environment using critical success factor analysis. The critical success factor analysis based on strategic document data that contains the vision, mission, strategic goals, and organizational structure of the university. This critical factor analysis aims to interpret the university's goals more clearly to determine the critical factors or activities that must be carried out and the information needed. In the smart campus strategic planning, the role of CSF is as a link between the university's business strategy and its smart campus strategy. The CSF analysis also focuses on the smart campus strategic planning process in accordance with the six smart campus domains. The results of this study are the recommendation of smart campus solutions in accordance with the university's strategic goals.

Keywords – business strategy, critical success factor, internal business environment, smart campus, strategic planning

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I. INTRODUCTION

Smart campus aims to support and ease life on campus. Thus, activities which include learning, management, service, maintenance of infrastructure can run effectively and efficiently. In the end the application of smart campus aims to improve the performance of universities in competing with others [1]. Based on these reasons, becoming a smart campus is a choice that must be taken by universities. Although in its application is not an easy thing and also requires a large investment cost. To implement a smart campus system requires a careful planning in order to provide optimal benefits. In [2] proposed a methodological framework using smart planning to implement smart campus. There is a popular method for making strategic planning is the Ward and Peppard method [3][4]. In this method an interpretation of the internal business environment data will be carried out to support the formulation of strategic planning.

There are many methods used to conduct internal business environment analysis, one of which is CSF analysis. CSF analysis is a preliminary analysis to determine business needs based on institutional goals. This goal is then spelled out to get the key success factors. And then determine the measuring indicators including data and information needs. So that, this study conducted a CSF analysis to identify data and information needs used in the formulation of smart campus design strategies.

II. SMART CAMPUS

In its development, the concept of smart campus is divided into three approach [5] namely based on the development of business process, based on the technology being used, and based on the concept of smart city.

First, smart campus arises because there are developments in business processes at the university. System development is done by optimizing existing applications or systems. This optimization is done by applying artificial intelligence to an existing system so that it can save system investment costs. Besides that, from the existing application, functionality is made into an application to facilitate services in campus life to become better and easier.

Smart campus is developed using latest technology, such as IoT (internet of thing) [6][7], cloud computing [8][9], smart card [10][11][12], mobile technology [13], 3D visualization including augmented reality (AR) and virtual reality (VR) [14]. This technology is used to support and facilitate the learning process, service, management and maintenance of campus facilities.

Last, smart campus starts from the concept of smart city [1][2]. Like a miniature of a city, university also has many functions. At a university, its main function is to provide a learning process, research and community service. In addition, the functions that must be carried out are management, providing services to the academic community,

namely students, lecturers and employees, as well as maintaining its infrastructures.

Based on that definition, thus obtained some of the characteristics of smart campus is an integrated system, providing solutions for the ease of living on campus, using the latest technology, using advanced IT applications that are embedded artificial intelligence. There are six intelligent domain in the smart campus [1][2][5], namely learning, management, environment, social, health and governance. In [5], smart campus applications are grouped into six domains above. For each domain there are various application or system that can be made.

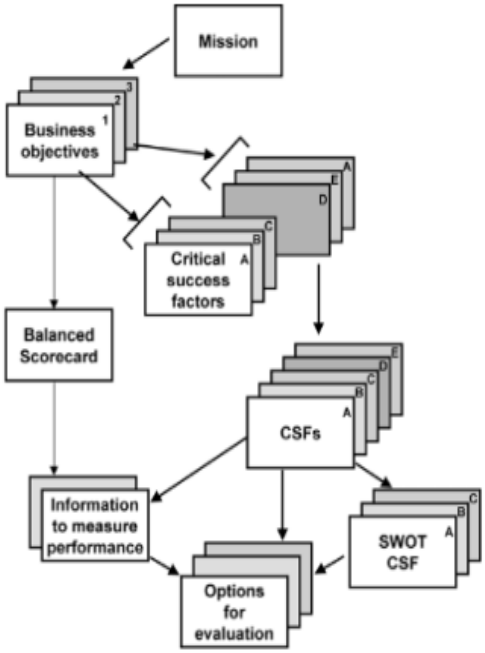

Fig. 1. The CSF analysis schema in [15]

III. CRITICAL SUCCESS FACTOR ANALYSIS

Critical Success Factor analysis was put forward by John Rockhart in 1979, used to obtain critical factors that influence the success and failure of institutions based on the main goals of the institution which are carried out by each department [15][16]. CSF represents a managerial area that must receive special and continuous attention in order to produce high performance.

The CSF analysis scheme is shown in Fig. 1. In the context of information systems strategic planning, CSF functions as a link between the institution's business strategy and its information system strategy. Each institutional strategic goal is determined by its activities and measurement indicators as a critical success factor. Furthermore, from its factor, the business strategy is determined to be implemented, including determining the information needs. From this information need, an information system strategy was made.

IV. PROPOSED WORK

This section discusses about the research method used. There are some steps to conduct this study, namely literature study and problem identification, data acquisition, CSF analysis, IS/IT solution.

Problem identification is obtained by conducting a literature study. Literature study is carried out by collecting, studying and making reviews of books, journals, previous research that are relevant to the research topic. The topic covered include smart campus, information system strategic planning and CSF analysis.

This research uses a case study at Surabaya Wijaya Kusuma University, hereinafter referred to as UWKS. UWKS is a private university in Surabaya. The data used in this study are primary data and secondary data. Primary data obtained by conducting interviews and observations of related parties and observations on the existing application or information system owned by UWKS. While secondary data comes from strategic documents, IS/IT strategic planning documents from IT department.

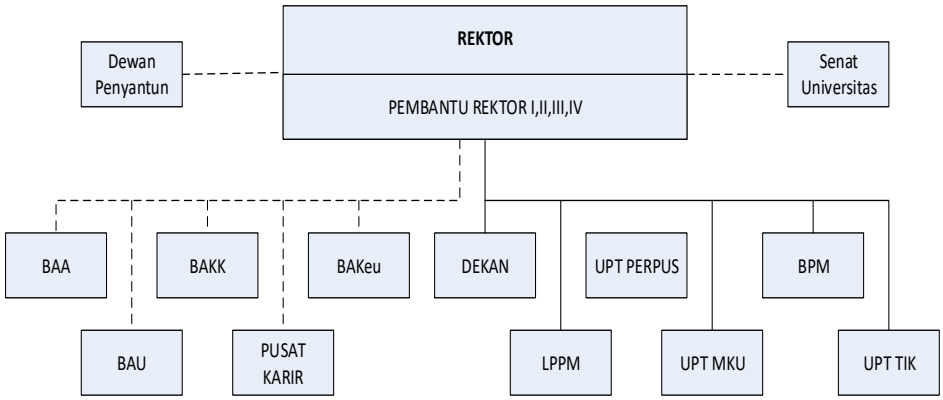

Fig. 2. The UWKS organizational structure

Based on UWKS strategic documents there is a vision, mission and strategic goals. There are 7 strategic goals, each of these strategic goals has strategic targets and strategic programs. This strategic program is an institution's business needs. This business needs measurement indicators are made to get the key success factors. Furthermore, from these key factors, the business strategy is determined in accordance with the characteristics of the smart campus and determines its information needs. From this information need, a smart campus design strategy was formulated.

V. RESULT AND DISCUSSION

The UWKS organizational structure is presented by Fig. 2. The function descriptions of each unit are as follows: The Chancellor, as the head of the university, is responsible for organizing education throughout the university. Assisted by Deputy Chancellor I for academic fields, Deputy Chancellor II for administration and general affairs, Deputy Rector III for student affairs and public relations, and Vice Rector IV for collaboration, Deans and heads of institutions and heads of bureaus.

The consideration board is the Wijaya Kusuma foundation. University Senate

There are four bureaus namely BAA (Academic Administration Bureau), BAKK (Student and Public Relations Administration Bureau), BAKEU (Financial Administration Bureau) and BAU (General Administration Bureau).

BAA carries out general administrative and credit score functions, academic administration, and computerized academic administration. BAKK carries out student administration and public relations functions. BAKEU carries out financial, accounting and budgetary functions within the university. And BAU carries out the functions of administrative services of personnel, administration, and operational of the university and facilities and infrastructure within the university.

There are three UPT (Technical Implementation Unit), namely Library, MKU (General Course) and TIK (Information and Communication Technology). UPT Library, providing library material services for educational, research and community service needs. UPT MKU, carries out functions related to the coordination of general subjects, national curriculum and local content curriculum. UPT TIK implements ICT service management that is anticipatory to the needs of the university and responsive to user complaints.
And special unit, Career Center, carries out functions related to alumni and tracer studies. LPPM

(Institute for Research and Community Service), implements, coordinates, monitors and evaluates the implementation of Research and Community Service activities organized by lecturers, as well as PKM (Student Creativity Programs) by students. BPM (Quality Assurance Agency), plans, implements and develops an internal quality assurance system within the university and disseminates it to the academic community. Prepare organizational instruments and documents needed in the framework of implementing quality assurance, monitoring and evaluating the implementation of quality assurance

Table 1. The strategic goals of UWKS

Code	Strategic goals
T1	The university's vision, mission, aims and goals are aligned up to the study program
T2	Improving the quality of governance, leadership, management systems, and quality assurance
T3	Improving the services quality of new students and students as well as intensive communication with graduates (alumni)
T4	Improving the quality of lecturers and staff
T5	Improving the quality of education and academic atmosphere
T6	Improving the efficiency and effectiveness of budget management, facilities and infrastructure, and transparency and accountability of financial information systems
T7	Improve the quality and quantity of research, community service and collaboration

The strategic goals of UWKS is presented in Table 1. For each goal has some strategic programs. The strategic programs for the first goal (T1) are

i) Improving the quality of higher education, to international standards (P1.1)
ii) Building networks with overseas education institutions (P1.2)
iii) Publish and disseminate the vision and mission of the university to the entire academic community (P1.3)
iv) Integrating the vision and mission of the faculty and department with the university's vision and mission (P1.4)

The strategic programs for the second goal (T2) are

i) Evaluate existing governance and leadership (university strategic plan document) guidelines, and make improvements if deemed necessary. (P2.1)
ii) Improve the effectiveness and efficiency of an integrated ICT-based management information system, towards Total Quality Management. (P2.2)

Table 2. The mapping of strategic programs (goal T1 until T4), critical success factor, data and information needs, smart campus solutions.

Strategic program	Indicator	Related department	Critical success factor (CSF)	Data and information need	Smart campus solutions
International accreditation (P1.1)	University accreditation scores B	All department	Applying outcome base education, consistent in applying quality management	All of academic data	iGovernance (SPMI and SPME)
Official website and vision, mission socialization (P1.3, P1.4)	Visitor statistic, update, number of visitor feedback	IT department, BAKK	Website content, institution's profile, vision, mission and goals, IS/IT blue print, update content	Statistic visitor's feedback, news, visitor response, feedback and comment, guestbook	iGovernance (official website)
IS/IT strategic planning (P2.2, P6.7)	Availability of IS/IT master plan	IT department	Supporting university, adequate IS/IT infrastructure	Strategic document, network and IS/IT infrastructure, internet connection, IT staff profile	iGovernance
Quality Assurance System (P2.1, P2.3, P2.4, P2.5)	The number of created SOP, written policy, IS for quality assurance process	BPM, Faculty, Program Study	Legality of policy, quality standard and SOP, commitment in implementing quality standard	Quality standard and SOP from all of department, imple-mentation of learning process, research, and community ser-vices, activity report	iGovernance (SPMI, quality assurance system)
Promotion (P3.1, P3.2)	Range of promo-tion target, the number of offi-cial channel of media social, content, follower, number of high school partner	BAA, BAKEU Faculty, Program study	Method and target screening method, collaboration with high school	High school partner, learning center data, statistic of social media channel, the number of members from high school student	iSocial (official website, media social channel)
Admission of new student (P3.3)	Number of registrars, number of regis-tration booth, registration tool-kit, number of service complaint	BAA, BAKK, BAKEU	Standard operating procedures (SOP) for new student re-gistration, Human Resource, Admis-sion information system	Prospective new student, registration booth, the number of registrations, person in charge	iGovernance (Admission system)
Student activity (P3.4, P3.5, P3.6, P3.7, P3.8)	Updated guidelines, availability of integrated student activity system	BAKK	guidelines for student activity, student organiza-tion, health services, scholarship, student creativity, student activity information system, graduation system	Student profile, student organization data, student organi-zation membership, student activity data, scholarship, graduate profile	iSocial (student organization system) iHealth (medical IS)
Alumni database (P3.9)	Verified and updated alumni data, number of alumni data, num-ber of active members	Career Center	Graduation system, Alumni information system, alumni asso-ciation, alumni official social media channel	Alumni profile, alumni association activities, annual meeting	iSocial (alumni IS, tracer study, social media channel)
The role of alumni in im-proving and graduate com-petence (P3.10, P5.10)	tracer study system, online questionnaire system, number of accessing stakeholders	Career Center	Intensive communication with alumni, stakeholder	Alumni profile, questionnaire for alumni, stakeholder data, questionnaire for stakeholder	iSocial (alumni information system)
Effective staff recruitment (P4.1)	SOP for recruit-ment, integrated recruitment information system	BAU	Recruitment guidelines, supporting recruitment infor-mation system	Human resource needs, curriculum vitae	iManagement (recruitment system)
Human resource development (P4.2, P4.3, P4.4, P4.5, P4.6, P5.7, P5.8)	Updated guidelines, availability of integrated staffing system	BAU, BAA	guidelines for promo-tion, mutation, incen-tive policy, functional position, HR and com-petency development, written policy, suppor-ting integrated staffing system	Staff and lecturer profile, staffing history	iManagement (SISTER, Staffing information system)

Table 3. The mapping of strategic programs (goal T5 until T7), critical success factor, data and information needs, smart campus solutions

Strategic program	**Indicator**	**Related department**	**Critical success factor (CSF)**	**Data and information need**	**Smart campus solutions**
e-learning (P5.2, P5.3, P5.4)	Number of online courses, internet connection, lecturer skills, diversity of online learning media	Program study, faculty, BAA	Legality of policy, LMS availability, supporting from IT department, lecturer skills using LMS	Meeting learning plan, semester learning plan, student data, course schedule, grade, log history	iLearning (e-learning)
Academic administrative process (P5.5)	Student data uniform for all university application	BAA, BPM Faculty, Program Study	SOP for academic administrative processes, her-registration, graduation, academic information system	Student data, her-registration lecturer data, courses data, new semester registration data, course schedule, semester planning and reporting, curriculum, grade transcripts, tuition payment, graduation administration data.	iManagement (Academic Information system, pddikti)
Learning process monitoring (P5.6)	The availability of quality standards and SOP for lectures, using quality assurance information system	Program study, Faculty, BPM	Quality standards and SOP for lectures, implementation of internal quality assurance systems	Curriculum data, lecture data, lecture activity, lecture evaluation, attendance	iGovernance (SPMI, internal quality assurance system)
Language center, Research center, publisher (P5.9, P6.5, P7.7)	Decree of chancellor, organizational structure	BAKK, LPPM, BAU	Support from university, written policy, human resource, guideline for operational	Person in charge, authority and responsibility description	iManagement (e-library, e-research)
Improve the curriculum (P5.10)	Legality of policy, availability of questionnaire information system,	Program study, Faculty	Method and media evaluation, End of semester evaluation, validity and reliability of questionnaire	Student data, course schedule, evaluation result, feedback from alumni and stakeholder	iGovernance (SPME, end of semester evaluastion system, Alumni and Stakeholder system)
Financial management (P6.1, P6.2, P6.3)	Budget planning method, standard cost per line item, integrated financial system, skills in using financial system	BAKEU	Budget policy, supporting financial information system, financial human resource	Budget line item and nominal, realization, budget variation analysis, sources of income	iManagement (financial management system)
Asset management (P6.6)	Decree of chancellor, availability of standard and SOP for asset management	BAU	Written policy, standard for asset management, SOP for asset management	Asset profile, inventory profile, facilities and infrastructure list, use of inventory	iManagement (Asset management IS)
Environmental management (P6.8)	Clean, safe, comfortable environment	BAU	Human resource for cleaning management, security management, energy saving, waste management	Coverage area, job schedule	iGreen, iManagement (security management system, energy saving)
Research, community service, student creativity program (P7.1, P7.2, P7.4, P7.5)	Number of proposal and report, online monitoring and evaluation system, absorption budget	LPPM	University support, research center commitment, supporting facilities	Proposal dan report research, community service and PKM, lecturer data, student data	iManagement (SIMLITABMAS, SINTA, research management system)
e-Journal (P7.3)	Number of journals, number of publications	LPPM, program study	Support from university, journal supporting system, human resource	Journal profile, publication data	iManagement (e-Journal (OJS))
Collaboration (P1.2, P6.4, P7.6)	The number of collaborations and realized collaborations	BAKK	University support, partner satisfaction	Partner, collaborations, realized collaboration	iSocial (Collaboration information system)

iii) Restructuring the Research and Community Service department, Quality Assurance Unit, IT department (P2.3)
iv) Improve faculty and department performance (P2.4)
v) Improve the implementation of the Quality Assurance System, to obtain an ISO 9001-2008 certificate. (P2.5)

To achieve the third goal (T3), prepared strategic program:

i) Conduct publications and promotions to build the image / brand of the university (P3.1)
ii) Improve university ranking, Webbometric version (P3.2)
iii) Improve the new student registration and selection system (P3.3)
iv) Improving services in the development of interests and talents (extracurricular), soft skills, and health services for students (P3.4)
v) Enhancing the role of Student Activity Units (P3.5)
vi) Increase student creativity through organizing sports and arts festivals (P3.6)
vii) Increase student involvement in academic activities (P3.7)
viii) Adding types of scholarship services and the number of students receiving scholarships (P3.8)
ix) Integrate alumni databases with university information systems so they can be accessed by alumni, making communication between alumni and universities easier (P3.9)
x) Enhancing the role of alumni in improving graduate competence (P3.10)

The strategic programs for the fourth goal (T4) are

i) Improve lecturer and staff recruitment systems (P4.1)
ii) Improve the system of promotion, transfer, incentives and welfare of educators and education staff (P4.2)
iii) Develop a system for managing lecturers and staff (P4.3)
iv) Develop human resource development programs, especially lecturers through postgraduate advanced study (P4.4)
v) Developing HR competencies, through academic activities (seminars, workshops, training) (P4.5)
vi) Encourage lecturers to improve academic functional positions (P4.6)

To achieve the fifth goal (T5), prepared strategic program:

i) Improve the accreditation of study programs (P5.1)
ii) Developing the learning process through e-learning for all study programs (P5.2)
iii) Develop two-way learning methods and student-centered learning (P5.3)
iv) Enriching the substance of learning by expanding access to learning resources (P5.4)
v) Integrate Academic Information Systems with University Management Information Systems (P5.5)
vi) Improve the system of monitoring and evaluating learning activities (P5.6)
vii) Improve the ability of lecturers in the use of e-learning (P5.7)
viii) Conduct periodic and tiered training and / or workshops to improve the ability of lecturers and staff (P5.8)
ix) Establish a language institution as a medium for developing foreign language skills, especially English for lecturers and students (P5.9)
x) Evaluate and refine the curriculum regularly, based on input and needs from stakeholders (P5.10)

The strategic programs for the sixth goal (T6) are

i) Establish a transparent and accountable financial and asset management system (P6.2)
ii) Integrating Financial Information Systems with university management information systems (P6.3)
iii) Increase acquisition of government grants (P6.4)
iv) Expanding access to collaborate with other parties in order to obtain alternative funding sources (P6.5)
v) Established a publication (WIJAYA KUSUMA PRESS) to encourage lecturers to write textbooks (P6.5)
vi) Providing adequate facilities and infrastructure for learning and student affairs (P6.6)
vii) Increase internet connection capacity (P6.7)
viii) Provide a clean, beautiful and comfortable campus environment (P6.2)

To achieve the seventh goal (T7), prepared strategic programs are

i) Arranging research trees to compile leading institutions of research (P7.1)
ii) Develop a research roadmap for universities and faculties / departments / study programs (P7.2)
iii) Facilitating the publication of journals as a publication media of research results, periodically (P7.3)
iv) Socializing and applying research results in community service activities (P7.4)
v) Increase student involvement in academic activities such as seminars, discussions, research and community service (P7.5)
vi) Establish cooperation with third parties, especially the users of the results of research and community service (P7.6)
vii) Creating a Research Center (P7.7)

The CSF analysis performed by using goals strategic data and its strategic programs also job

descriptions and functions data from each department. From each strategic goal have strategic programs that is as business needs of the university. Every business need must be determined the measurement indicators and its key success factors[15]. Furthermore, from its factor the smart campus design strategy is determined, including determining the data and information needs. Table 2 and 3 present the mapping of strategic programs as business need, critical success factor, data and information needs, smart campus solutions. The smart campus solution is tailored to the six intelligent domains as described in [5]. The CSF analysis results in Tables 1 and 2 show that smart campus solutions are formulated based on data and information needs of each strategic program.

From the analysis result, the strategic of smart campus design for the first goal is iGovernance with the official website application, SPMI (internal quality assurance system) and SPME (external quality assurance system). SPMI and SPME are systems owned by the Ministry of Research, Technology and Higher Education for monitoring and evaluation of quality assurance processes in each university in Indonesia. The smart campus solution for the second goal is iGovernance, namely IS/IT management, SPMI, and quality assurance system.

Then, smart campus solution for the third goal is iSocial, namely official website, media social channel, student organization system, alumni information system, tracer study, social media channel for alumni association. iGovernance domain is Admission system and iHealth domain is medical information system.

The smart campus solution for the fourth goal are iManagement, namely recruitment system, staffing information system, SISTER, nd iGovernance domain is admission system. SISTER is integrated lecturer data systems owned by the Ministry of Research, Technology and Higher Education.

Next, smart campus solution for the fifth goal are for iLearning domain is e-learning. iManagement domain are academic information system, e-library, e-research. The iGovernance domain are SPMI, internal quality assurance system, SPME, end of semester evaluastion system, alumni and stakeholder system. The smart campus solution for the sixth goal is iManagement, namely financial management system, asset management IS, security management system, energy saving and iGreen domain.

Last, smart campus solution for the seventh goal iManagement is SIMLITABMAS, SINTA, research management system, e-Journal and iSocial is Collaboration information system. SIMLITABMAS and SINTA is system owned by the Ministry of Research, Technology and Higher Education. SIMLITABMAS is system for research and community services management, SINTA is record the publications and citations of academics and researchers in Indonesia.

VI. CONCLUSION

The Critical Success Factor analysis is performed to get performed by internal institution data, namely strategic document that contains the vision, mission and strategic goal. The CSF analysis is a preliminary analysis to determine business needs based on institutional goals. From each strategic goal have strategic programs that is as business needs of the university. Every business need must be determined the measurement indicators and its key success factors[15]. Furthermore, from its factor the smart campus design strategy is determined, including determining the data and information needs. From this information need, the smart campus solutions are formulated. The smart campus solutions are grouped based on six intelligent domains, namely learning, management, environment, social, health and governance.

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