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INFORMATION TECHNOLOGY IN EVOLUTIONARY STRATEGIC MANAGEMENT: DECISION SUPPORT SYSTEM IN SMART UNIVERSITY

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Abstract

Decision Support Systems (DSS) refer to computerized information systems that encompass knowledge-based systems and knowledge management to provide assistance for decision-making in businesses or organizations. DSS tools have created from the evolutionary concept of data processing and management information system (MIS). In the connection of strategic management, SS combines human intellectual resources with computer capabilities to enhance the quality of decision-making. A manager/leader and computers must work together as a problem-solving team in organization. Despite the evolutionary strategic management issue of DSS in a company, the utilization of DSS in smart university management are still interesting topic to be studied. Due to tighter competitiveness in higher education, the universities must apply Information and Communication Technologies (ICT) to support their competitive advantage and brand themselves as a smart university. The novelty of the research is in combining DSS in the framework of smart university. Although the concept of Smart in the education area involves the emergence of technologies such as DSS, as the consequence of various terminology in the domain of IT-based university, the elements of smart university are widespread and fragmented. This paper aimed to define how DSS works in diverse explicit circumstances or settings by investigating its smart university readiness index. The method use analysis descriptive and DSS of a private university was analysed as a model in this research. The results showed that DSS has a strong relation with term "smart university" and effective to be used as strategic management tools and to help top management decide an appropriate decision making. Thus, ICT is gradually becoming very imperative for assisting the processes of decision making, especially in smart university domain.

Keywords: Information technology, Decision support system, Strategic management, Smart university.

1. Introduction

In the framework of strategic management, Information technology (IT) innovation have been used to support university competitive advantages both for learning and service activities [1]. Innovative universities recognize the importance of technological transformation that enables digitally connected ecosystems. Students need universities that serve intuitively and innovative practices that leverage technology. The task of utilizing ICT to achieve the desired goal can be quite challenging. Proper and thorough planning and analysis are two crucial elements required to be successful. Unfortunately, many universities are unable to leverage ICT due to several factors, such as inadequate planning, lack of trained personnel, insufficient infrastructure, inadequate funding, and inconsistent ICT utilization policies [2]. While one of the goals the use of ICT in higher education is difference and reduced operational costs. Thus, transformation towards a smart university is necessary to create integrated efforts including well preparation of university resources and governance, removing all obstacles through organizational reform, management innovation, and the implementation of autonomy at the university level. Smart universities require strategic frameworks, connected ecosystems and technology. The evolution of the new concept of Smart University allows for a smart learning process, which implies the implementation of an adaptive educational model using smart information technologies [3].

Decision Support System is a certain set of classes on the system computerized information that supports activities business or organizational decision making [4]. DSS usually used at top level management as a recommendation based on derived information from raw data or documents obtained and has been processed. In the domain of university, DSS can provide input on the current condition of the study program, acceptance from the existing market share / labour market, competition with other competitors, conditions and suitability the existing curriculum with the competency needs of graduates in the workforce. All of this cannot be maximally displayed and given input through the usual management information system but can be presented in Real Time by DSS, especially those that have been integrated either through the existing Intranet Network or Internet Online. Smart context is appropriate to be juxtaposed with the DSS since DSS not only display raw data or just disaggregated data information, but also can provide input or a choice of conditions that can be taken by university's top management as a decision maker. Previous research showed that DSS not only displays competitor data and alumni tracer studies on a regular basis, but also provides input on the current condition of study programs on the development of local work needs and competencies through the curriculum [5], as well as a simulation tool for new study programs or old study programs [6]. In addition, the development of this DSS model can provide input on the feasibility conditions of study programs, also produces simulation applications for study program accreditation [7], and updates data on competitors, employment opportunities, and predictions of prospective students [8, 9]. DSS is a program that can assist the managerial leadership of higher education institutions in their efforts to develop study programs at the universities they lead. However, the use of DSS in the domain of smart university is still confusing and fragmented [10]. Variety terminology such as digitalized campus, smart campus, cyber university etc creating lack of understanding in how DSS utilization in diverse explicit circumstances or settings namely smart university. Thus, the novelty of the paper

is combining DSS in the framework of smart university. The method used was descriptive analysis and literature studies.

2. Research Method

The research methodology employed in this study is descriptive quantitative, which is also commonly known as a survey approach. We use DSS in a private university as case study which is Universitas Komputer Indonesia (UNIKOM) as one of Smart University considering UNIKOM won ASEAN ICT Awards in 2021 and won the Microsoft Awards in 2023. This study utilized both primary and secondary data. The primary data was collected through conducting in-depth interviews with the top management of Universitas Komputer Indonesia. The secondary data was obtained from various sources such as academic journals and reports. Questionnaire was also distributed to 200 person consists of top management in the university level, and lecturers and staff who hold positions at the faculty and study program levels. As for the secondary data obtained by analysing Executive Information System (EIS) as one of DSS, as well as study of literature on various sources and various relevant directorate.

The research employed an instrument based on the ICT Pura program model to explore how DSS operates in various specific situations or settings by evaluating its readiness index for a smart university. The instruments were organized based on four components, namely, ICT Readiness, ICT Use, ICT Impact, and five dimensions, namely: process and governance dimension, the dimension of need and alignment, community dimension, technological resources dimension, and output and benefit dimension [11].

3. Results and Discussion

The design of the UNIKOM EIS Decision Support System model is essentially an integrated reporting system. The EIS consists of a database management system, model base management system, knowledge base management system, central processing system, and dialogue system. The system is developed to assess working performance of the lecturers and staffs. This is in line with the prior studies that IT is created in order to make non-routine decisions that are crucial for strategic outcomes [12-14] and necessary for the creation of competitive advantages, the use of intelligent systems is beginning to grow in unstructured environments [15]

EIS of UNIKOM is basically done by adapting the model. Therefore, in the EIS Decision Support System model UNIKOM has 3 system components, namely: Knowledge Base Management System, Management System Database, and Model Base Management System. The three systems developed in the UNIKOM EIS Decision Support System model are designed in such a way as to allow interaction between one system and other systems reciprocally through the system processing center. In the development of a database management system, it will be done using Microsoft Access, while for the development the system as a whole will be done with Visual Basic.

The construction of the models and the study of the problems now take center stage. After the issue has been identified, mathematical models are constructed based on the issue to enable the development of alternative solutions, and models are then developed to analyse the various solutions. Accuracy, ease and speed in

decision making are a very important thing in the fund management business process. This will get improve competitiveness for business processes and management so that they will survive in increasingly competitive conditions. Thus, it is necessary a decision support system designed based on knowledge, theories, and the views of related experts. Based on these conditions, then it is very appropriate if the Universitas Komputer Indonesia developed a model Decision Support System (Decision Support System) in the form of Executive Information System (EIS).

In general, the decision support system model for EIS at the Universitas Komputer Indonesia has two inputs, namely static input and input dynamics. Static input is input that is already available in the system (level of importance and weight of criteria for potential study programs). While dynamic input is the input given by the user when interacting and having a dialogue with the system.

Figures 1-3 shown that the reporting systems owned by universities are numerous and most of them have been used to support higher education activities, but the systems owned and utilized by each department have different separate servers, and data accuracy is still relatively low, therefore the data held by one department may differ from another and this situation often occurs. This complicates the integrated reporting system [12]. In addition, status of students also can be known from the EIS. EIS as part of DSS may help the decision to give the scholarship or other financial aid to a student.

Fig. 1. EIS: Data of active students.

The problems faced were as follows: (1) the hardware that was previously owned, particularly the servers, had restricted memory capacity and various storage locations, (2) there were disparities in the data across various departments, (3) the lecturers, as well as the employees, were unsure of who was responsible for data input, updates, and evaluations, (4) the university's business processes were not clearly defined, resulting in inadequate management coordination and information system utilization. Consequently, the data's reliability for decision-making by university leadership may be jeopardized, and it may necessitate time to reprocess the data before it can be used for decision-making.

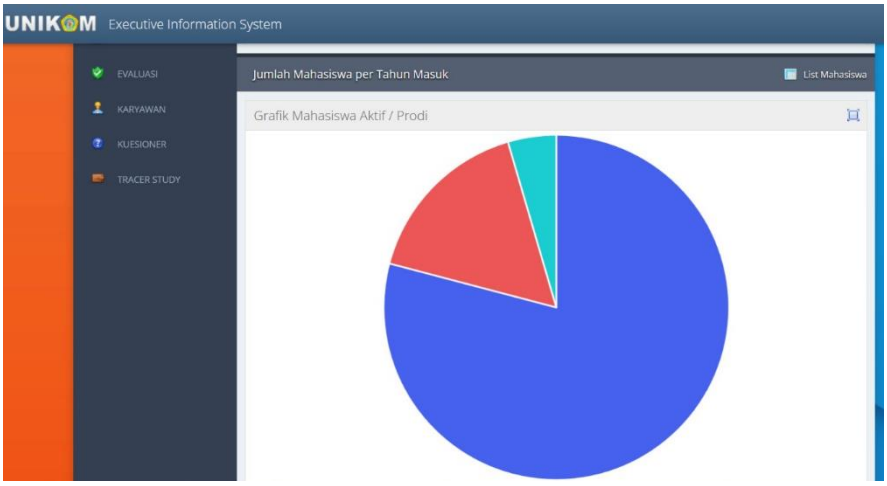

Fig. 2. EIS: Total student per year.

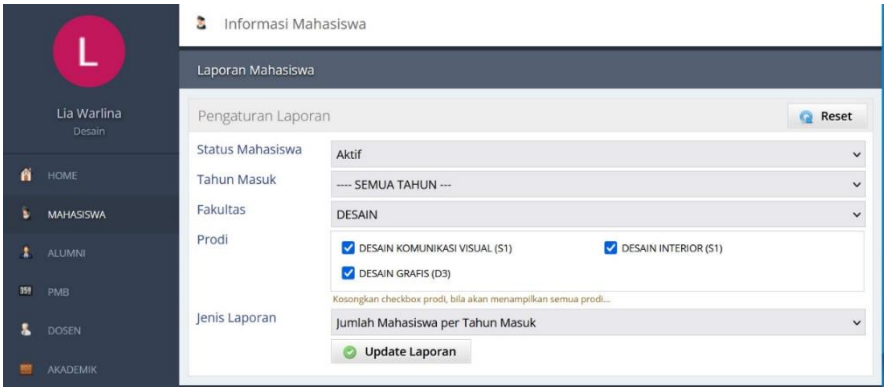

Fig. 3. Report download page.

Information system analysis was conducted to analyse the EIS [16]. It is expected that the additional information systems to be developed and the changes in system needs and devices that may occur in the next ten years can be accommodated. The IT Directorate initiated the system design process by creating blueprints, developing prototypes, designing the full system, and constructing it based on the analysis mentioned above. The team strives to maintain the current information system while introducing new systems as needed and integrating old and new systems afterwards. Each research program leader conducts a validation review, and authorization to input data into the new system is granted based on the most relevant data for that input. Tier-based authorization is implemented by each study program and faculty to determine who can access and use the data. For example, the Rector has access to all information on the Executive Information System, while the dean can only access information about their own faculty, and the head of the study program can only access information about their own program.

In the construction of a DSS, several components must be included, such as: (1) Data Management, which includes a database containing relevant data for various situations, governed by software called Database Management Systems (DBMS);

(2) Model Management, which involves financial models, statistics, management science, or various other quantitative models that provide the system with analytical capabilities, and necessary software management [13, 17].

In the context of Smart university, to define how DSS works in its circumstances, readiness index is calculated. In addition, the purpose of calculating the index is to determine the readiness of university in implementing DSS as a part of system in the Smart University. ICT Use, ICT Readiness, ICT Capability, and ICT Impact are measured as part of the calculation [14]. Given that all activities are dependent on university leadership policies, rules, and decisions, the weighting calculation for ICT Use is 40%. ICT Readiness has been given a 20% weighting. The assessment of infrastructure availability is the fundamental building block for ICT deployment in higher education [15-18]. 25% of the weight is allocated to the ICT Capability component. The idea is that if you have enough resources and competencies, your university will grow. Given that the academic community will immediately profit from the existence of ICT, the ICT Impact component is weighted 10%. Table 1 shows the weighting values for each component, dimension, and subdimension mentioned above.

The ecosystem's position and condition, which encompasses 5 (five) dimensions, is the primary emphasis of the entity mapping domain. These dimensions are: First, consider the need for and alignment with the goals and objectives of all college stakeholders. Second, the process and governance components oversee implementation, which is divided into 4 (four) activities: organizing and planning, developing and procuring, implementing, and managing and controlling. Infrastructure in the third dimension includes hardware, databases, software, network, and information, in addition to human resources. Fourth; The community's dimensions are Top university administrators, professors, college students, and members of the TIPD unit (Information Technology and Database) staff. The senior management will find it easier to run the institutions thanks to the fifth dimension of output and outcome: the system. The Table 1 displays the five dimensions.

Based on the weight value that has been set, the ICT or smart campus implementation index can be obtained using the following Eq. (1).

$$\text{Index} = \text{NRIU} * 40\% + \text{NRIR} * 20\% + \text{NRIC} * 25\% + \text{NRII} * 15\% \quad (1)$$

where NRIU stands for "Network Resources In Use," NRIR for "Network Resources In Readiness," NRIC for "Network Resources In Capability," and NRII for "Network Resources In Impact." Based on magnitude value, rating The formula above is used to calculate the smart campus implementation index. The scoring system, which ranges from 0 to 5, employs the Likert scale model.a foundation for the use of ICT in higher education [15-18]. A weight of 25% is assigned to the ICT Capability component. The idea is that if the university has sufficient resources and competencies, it will grow. The academic community will immediately benefit from the existence of ICT; hence the weighting of the ICT Impact component is 10%. Table 1 shows the weighting values for each of the aforementioned components, dimensions, and subdimensions.

The 0 in the Likert model is the Smart Campus implementation failed / not ready; while 1 means that Smart Campus implementation is not ready; 2 means that Smart Campus implementation almost ready; 3 means that Smart Campus implementation is ready /succeed; 4 means that Smart Campus implementation is

ready and able to compete; lastly, 5 means that Smart Campus implementation is very good succeed.

Table 1. Dimension and subdimension weighting.

Dimension	Sub dimension	%
Need and alignment		100
Process and governance	Planning and organizing	20
	Development and procurement	20
	Implementation and management	20
	Controlling	20
	Network	35
	Hardware and access channel	25
Technology resource	Software and program Data, information and knowledge	25
Community	Top management	50
Output and benefit		100

With this ranking, the management will be able to see their university position in the implementation of Smart campus. The distribution of scores for the four components can be seen in Fig. 4. Value of smart campus development consist of ICT Use 1.466, ICT Readiness 2.719, ICT Capability 1.802, and ICT Impact 2.950 (see Fig. 4).

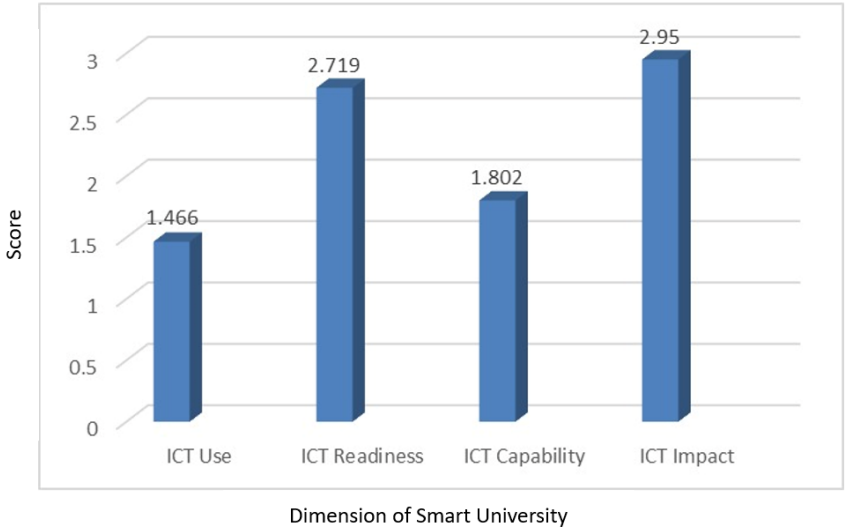

Fig. 4. Score of smart university dimension.

Based on the four components of the development of the smart campus model that have been discussed previously, it can be seen that the overall component of UNIKOM received a score of 2.234, this number indicates that the overall development of the smart campus model at UNIKOM is almost successful and has entered the successful stage.

Based on the research conducted, eight instruments are related to the dimensions of need and alignment. The score obtained from the research is 2.875, indicating that this dimension is almost ready and considered ready as it falls within the previously set range of 2-3. According to the research results, EIS as one of DSS is closely related to the term "smart university" and can be utilized as a strategic management tool to help senior management make the right choices. The results are in line with the previous research, stated that ICT is consequently gradually playing a bigger role in supporting decision-making processes, especially in smart universities [16-20].

4. Conclusion

Although the notion of smart in education implies the advent of technologies such as DSS, the aspects of smart university are extensive and fragmented as a result of various terminology in the domain of IT-based university. This research sought to clarify how the use of information systems aids decision-making in a variety of explicit circumstances or settings, such as a smart university. In this study, a private university's technique usage analysis descriptive and DSS was used as a model. The findings revealed that DSS has a strong link to the phrase "smart university" and can be used as strategic management tools to assist top management in making suitable decisions. As a result, ICT is gradually becoming more important in helping decision-making processes, particularly in smart universities.

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