Executive information system lecturer mobility and scientific reputation of higher education

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Abstract. Lecturer mobility and scientific reputation is one of the key indicators for the establishment of world class university. The total number of papers published in the academic journals indexed by Elsevier's Scopus database per scholar, and scholarly publications are one of the parameters for universities in the world are ranked. Those are challenges for the Executives Boards in universities to develop strategies of the existing conditions in order to plan programs to support the vision of universities. Executive Information System is required to display information strategically based on the existing data conditions. The present research identified a web-based Executive Information Systems called SIMORI. It is the system development method using System Development Life Cycle (SDLC) approach through system investigation step with feasibility study, system analysis, design analysis, and implementation. Critical factors for the success of the system are good data governance, while the data currently displayed still need to be completed and improved. The strategy to be developed will be managing mobility data of scientific reputation by involving all Faculties and the Departments of university to update data through Academic Management Information System, to be verified by the executive and will be presented as strategic information for the university communities.

Keywords: Information system, System development life cycle

1. Introduction
The deepening of globalization and tough competition will increase performance of universities to improve their higher education systems and build world-class universities (WCU). According to [14] WCU can be achieved by utilizing three key indicators: a) high concentration of talented lecturers, students, researchers in internationalization activities, b) abundant resources in terms of funding so as to provide a comfortable learning environment and advanced research, c) favorable governance that fosters strategic vision, innovation, leadership and flexibility and enables institutions to make decisions and manage resources without being burdened by bureaucracy. The results of synergizing these three indicators are highly qualified graduates, widely published national and international research results, and technology exchange. According to [13], those indicators are used by international agencies in conducting surveys to rank the world's reputable university. [6] study stated that WCU is universally understood to mean achieving a globally ranked institution. Further, he compared indicators used by Times Higher Education Supplement (THES) and Shanghai Jiao Tong University (SJTU) for world class university rankings, among others are students, scholars, visiting lectures from abroad, as well as the use of information and communication technology. QS World University Ranks the world's top universities in individual subject areas, covering scientific reputation, alumni's working reputation,
student and staff ratios, number of scopus-indexed citation works and student mobility. Another ranking that is also a concern of universities in the world is webometrics that assess the activities of universities through the use of the website as a storefront of information and number of papers published in the academic journals indexed by Elsevier's Scopus database per scholar.

An Executive Information System is really required to manage the data. According to [8] Executive Information System (EIS) incorporates various management information systems and decision support systems that facilitates and supports senior executive information and decision-making needs. It provides easy access to internal and external information relevant to organizational goals, and critical success factors (CSF). The System is equipped with a drill down menu to display detailed information in attractive interfaces, and is presented in the graphs and tables. With reference on the above statement, it is necessary to examine how to develop an executive lecturer's mobility and scientific reputation information system at universities. The System is expected to provide information for planning, controlling, reporting and evaluating mobility data (inbound and outbound) and university’s scientific reputation and displaying information based on Systems Development Life Cycle approach. It is a term used in systems engineering, information systems and software engineering to describe a process for planning, creating, testing, and deploying an information system.

2. Research Method

The research was conducted at the Directorate of Data Integration and Information System of IPB, Office of Cooperation and International Program, Directorate of Student Affairs, and Directorate of Research and Innovation IPB, in April-November 2017. This research used descriptive qualitative research method with case study approach. The method used in the development of Executive Information System using System Development Life Cycle (SDLC) was [7] method. It is an Executive Information System (EIS) characterized by business oriented compared with transactional requirement, apply strategic decision, focus analysis to strategic business requirement, and the development process of SIE that focuses upon a cyclical process for assessment success rates.

Stages for the development of SIE with SDLC approach were focused on the description process and combined perfectly with object oriented approach. The stage of development of executive information system adopted system development cycle according to [9] consisting of following stages:

2.1. Stage of System Investigation

This stage includes the identification of business opportunities and priorities. They were developed in the system development of feasibility study and information needs to provide a framework for technical and non-technical activities to deliver a quality system which meets or exceeds a business or institution expectations or manage decision-making progression. It was executed through interviews, document review and direct observation of lecturer and student mobility as well as the scientific reputation of higher education through related units. The life cycle approach is used so users can see and understand what activities are involved within a given step. Feasibility studies in the investment stage include:

a. Organizational Feasibility: it will analysis how well the proposed system supports the company's business priorities;

b. Technical Feasibility: includes ability, reliability, and availability of hardware, software and network;

c. Operational Feasibility: it will analyze employee acceptance, management support, and government requirements and other requirements;

d. Economic Feasibility: it relates to cost savings, increased revenues, increased profits, reductions of necessary investments and other benefits expected to exceed the development costs and operating costs of the proposed system; and

e. Benefit Analysis; consists of tangible benefits (tangible benefits) and intangible benefits (intangible benefits).
2.2. Stage of System Analysis
In this stage, eliciting system functional requirements based on business requirements based on business object components as defined by UML (Unified Modeling Language). According to Wikipedia UML is an industry-standard language for visualizing, designing and documenting software systems and offering a standard for designing a system model. By using UML we can create models for all types of software applications, where they can run on any hardware, operating system and network, and written in any programming language [16]. But because UML also uses class and operation in concepts basically, it is more suitable for writing software in object-oriented languages such as C++, Java, C# or VB.NET. The system analysis phase with UML approach generates the system model depicted in 13 different diagrams. The diagram of object approach (object oriented model) according to [1] and [11] which include:

a. Context Diagrams
It is a diagram that defines the boundary between the system, or part of a system, and its environment, showing the entities that interact with it to;
b. Use case diagrams
It describes an interaction between the system and its environment; the expected functions of a system. It also expresses the externally visible behaviour of the system and its interactions with actors, i.e. users or different systems.
c. Activity diagrams
Activity diagrams, which are related to program flow plans or flowcharts, are used to illustrate activities. In some circumstances users the use activity diagrams for the description of business processes that describe the functionality of the business system;
d. Class diagrams (class diagrams; names, attributes, methods)
Class diagrams is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects. Class diagrams can be utilized by analysts, business modelers, developers, and testers throughout the software development lifecycle; and
e. Sequence diagrams, is the diagram that shows the interaction between the actors with the system and between system components.

2.3. Stage of System Design
System design determines how the system will meet the objectives of information system development. In the system design the three activities performed are data identification, user interface design, and process design. Outputs generated from this stage are screen design, report and dialog box, data structure, and programs / procedures design.

![Figure 1. Stage of System Design](image)

2.4. Stage for System Implementation
The system implementation stage is a process of transforming the system design into an application or software system. The present study showed that the application was developed for working prototype with development platform based on php programming language with sqlserver based database using query data from integrated database IPB. System testing is testing conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements as desired. Testing the output
of program packages and functions in the application using black box test. The test step includes the analysis of needs specifications, design specifications, model description, for each model with input parameters and outputs, for each parameter included range of data, and test cases for system functions developed (Bhasin et al 2014).

3. Results and Analysis

3.1. General Description

In the grand design of IPB ICT development 2013-2017 as reported by Seminar (2012), that to ensure secure operations of information systems and thus safeguard assets and the data stored in these systems, and to ensure that applications achieve their objectives in an efficient manner, an organization needs to institute a set of policies. Which will control directly the achievement of the objectives of Information Systems of the organization which include Value, Productivity, Quality, Simplicity, Efficiency & Effectivity, and Go Green. Integrated information system is supported by data, and any concerns on the integrating databases. They are arranged in an integrated database architecture which has the main function of integrating the data collection owned by universities and then the data is used as needed by the existing systems. So the systems do not need to reassemble the master data for the transaction process because the data has been integrated and consistent. The integrated database used by several systems are divided into 3 groups: Personnel System, Academic System, and Finance system. It is also used by single sign on (SSO) system and strategic information system such as SIMAKER, MSS, SIE and many others. Management of lecturer and student mobility data includes inbound and outbound activities currently inputted through the application of performance management information system (SIMAKER) and the data stored in the integration database for transactional and operational activities. However historical data are stored in the data warehouse to facilitate strategic information system displaying historical information as strategic decision making materials. Scopus-indexed scientific and google scholar reputation data is not yet integrated with existing information systems and even data is stored in spreadsheets in the work unit. The integrated university database is presented in figure 2.

![Integrated Database Architecture](image)

**Figure 2. Integrated Database Architecture**

Lecturer mobility both inbound and outbound programs for lecturers is managed by Directorate of Cooperation and International Program (Directorate of KSPI). It is stated in Article 68 that one of the functions of the international program sub-sector is to carry out the function of coordinating the implementation of international program activities and the provision of administrative services and travel information abroad for lecturers, education staff, students and alumni. The lecturer mobility activity is divided into 3, namely seminars (conferences), visiting professor, and follow-up actions of Memorandum of Understanding (MoU). While other academic activities include academic competitions / entrepreneurship / cultural / sports, internships / practical / teaching / coaching activities other than
curricular activities. Moreover, Presentations in seminars / workshops / conferences, Exchange / credit earnings / summer course, Research, Others (Voluntary, service learning program, etc.) are also the responsibility this Directorate.

Scientific Reputation or also known as academic reputation which means that the university is widely known. A very good academic reputation was the most important factor influencing college decisions. Scientific reputation is important for all of us, but this come slowly, step by step and through the hard work, it is acquired over a lifetime and is akin to compound interest, the more you have the more you can acquire. The management of this international reputation relies heavily on the contributions of researchers / lecturers in publishing their scopus-indexed and google scholar-scanned works and dissemination efforts through various academic / academic community communities such as research gate, academia.edu, or linkedIn. The total number of papers published in the academic journals indexed by Elsevier's Scopus database per scholar, and scholarly publications are one of the parameters for universities in the world are ranked. The total number of scientific publications searched results of 1413 (one thousand four hundred and thirteen) faculty members of IPB have google scholar and scopus accounts. The scientific reputation search results are presented in Table 1.

| Indexer        | Number of Lecturers Profile | Ambiguous Account | Account not found |
|----------------|-----------------------------|-------------------|-------------------|
| Scopus         | 714                         | 89                | 665               |
| Google Scholar | 660                         | 36                | 702               |

3.2. Stage of System Development
The above description describes how the condition of the system runs and its relevance to this present research. How the development of the Executive Information Systems through utilizing system development life cycle (SDLC) web-based methods had been carried. The steps of system development are presented as follows:

### 3.2.1. Stage of System Investigation
This stage includes organizational, technical and operational feasibility studies to assess the Executive Information Systems to be developed to support business priorities, reliability, availability of software and supporting hardware, and support of management / human resources that can meet the information needs of executives and deserve to be developed. Feasibility study analysis is presented in Table 2.

| Feasibility Study Organization | Mobility of lecturers and students as well as the scientific reputation of Higher Education |
|-------------------------------|------------------------------------------------------------------------------------------------|
| The feasibility of developing Executive Information Systems for lecturers and students mobility, as well as the scientific reputation of universities based on the criteria, as follows: | |
| 1. The Vision of Higher Learning Institution as stated in the Strategic Plan 2014-2018 is to Become the International Research-Based University, and Prime Mover of Agricultural Mainstreaming. |
| 2. As stated in its Strategic Plan 2014-2018, one of the pillars in it its development strategy is Strengthening Reliability Management System. One of the points is strengthening the integrated Management Information System, through: |
| a. Strengthening data management of the Information Systems covering the relevant institutions and working units. |
| b. Updating the ICT’ needs of working units. |
c. Improving the interoperability and role of working units in updating data and utilizing ICT services and information systems.

3. The main duties and functions of the Directorate of Data Integration and Information Systems are to carry out strategic tasks in the development of Information and Communication Systems and data management databases on information and communication technologies. The task is emphasized in Article 74 which stipulate the development and upgrading of infrastructure resource of institute integrated communication network (hardware, software, netware, and electrical system).

4. IPB vision for 2019-2023 as planned by the newly elected Rector is "To develop IPB to be a research-based and leading-edge university in innovation for nation self-reliance towards techno-socio entrepreneurial university that excels at global level in agriculture, marine, tropical bioscience". One of the main programs of Information Technology and Communication is a Robust ICT System through Integration of information systems for big data management, governance improvements, and managerial capacity.

| Technical phase | The availability and reliability of software, hardware and networks in the development of Executive Mobility of Information Systems and the scientific reputation of IPB determine whether or not it is feasible to develop SIMORI in order to enhance the reputation of IPB towards world-class universities. The technical support tools that IPB currently possesses are:
|                | 1. 300 based controller access point have been distributed for the Department, Faculties, Dormitories, and Auditorium in all the working units.
|                | 2. Secure DNS appliance and Virtual Machine has been provided to anticipate malware and improve access to information.
|                | 3. Adequate Internet connection bandwidth
|                | 4. IP and licensed Topology of Three Layer Hierarchical Model is applied to Public IP usage so that access and search accessibility is easier and faster.
|                | 5. The strong specifications for database servers and are available in sufficient quantities

| Economics      | The analysis of financial data of budget allocation for Information and Communication Technology (ICT) development, which is executed by the Directorate of Data and Information System Integration, for 2015-2018 shows that institutional support for the management of information technology both hardware and software is significant enough. Data on budget allocation received from the Funding Assistance for State Universities Legal Entity (Bantuan Pendanaan Perguruan Tinggi Negeri Badan Hukum BPPTNBP), Community Fund (Dana Masyarakat DM) and Cooperation (Kerjasama KS), are presented as follows:
Figure 3. Budget Allocation for ICT 2013-2018.

Operational

The annual work program of HR strives to improve and strengthen the competence of human resources in Higher Learning Institutions. HRM organizes TEMATIC Training of Computer and Application Field annually. Besides that, there is also Socialization of Functional Appointment of Computer Functional Position for education personnel. Organizing competency-based online training course for learning process that utilizes electronic technology, and to track institutional learner progress.

The Analysis of tangible and intangible benefits

- Reducing the cost of information processing by reducing the printing cost and distribution, as they can be displayed online that choice will impact the website's success in nearly every area, included search engine optimization (SEO) and social media marketing (SMM). The total number of scientific publications displayed in the official website facilitates the tracking of information and improve the institution's position in the university rankings in the world.
- Describing the information needs of researchers / lecturers in the academic community as well as information on the subject range of research categorized in the QS University Ranking into factors that can support the need for system development. By leveraging existing platforms and components in the development of other existing information systems, the SIE is feasible to be developed.
- Improvement of the availability information and analysis required to support the lecturer and student mobility activities. Criteria for the needed information are, their country origin, home university, time of arrival and their return, visa identity, purposes their inbound / outbound visits, country distribution, their length of stay, purpose of activity (credit earning, internship , apprenticeship), purposes grouping mobility, accommodation while they do their international programs (in campus / off campus), email (for information dissemination), gender, and type of accommodation.
- Human resources who manage such system does not require special qualifications because SIE is developed to provide easy access of information for leaders / executives.
- The convenience for policy makers in their decision making process, as the information needed are displayed in graphics and tables. Those forms are very useful for displaying the relationship between quantities quickly and in an accessible form. Online display improves the institutional’s image to the world.

3.2.2. Stage of System Analysis. This is the stage where the system analysis process is occurred. This stage describes the functional requirements of the system with object approach using UML (Unified Modeling Language) that include context diagrams, use case diagrams, activity diagrams, class diagrams and sequence diagrams [11].
Figure 4. Context diagram

Figure 5. Use case diagram
3.2.3. Stage of System Design. System design determines how the system will meet the objectives of information system development. System Design focuses on how to accomplish the objective of the system. This stage mainly focuses on: 1). Database design in database integration for lecturer and student mobility data with sqlserver platform, while for scientific reputation data using mysql platform. 2) User interface design is divided into three parts. The first part contains information on graph analysis which is accessible by all stakeholders of higher learning institutions. The interface is displayed in tabular menu which consists of Lecturer Mobility, Student Mobility, Scopus Index and Google Scholar Index. The second part is the login interface by entering the username and password the user has added by the admin. The third part of the system is the dashboard, which displays all the information required based on feasibility analysis and information needs. 3). Process design, is the activity of determining the workflow, equipment needs, and implementation requirements for a particular process. In general analysis of system design was based on the institutional's current business processes. This web-based information systems webpages also have unique addresses URL to help people locate them. The web page displays the required information by executing the site address associated with the web server called query string [4].

3.2.4. Stage of System Implementation. The stage of system implementation is a process of transforming the system design into an application or software system. It is the implementation of the development of SIE web with PHP micro frameworks, and codeIgniter approach. CodeIgniter is a powerful PHP framework that can help users greatly speed up the development of web applications. The developed EIS with codeIgniter, SIMORI, can be accessed at address: the following address: ehttp://simori.ipb.ac.id, and is presented in figure 8.
4. Conclusion
The formulation of managerial implications will be utilized as the basis of strategic recommendation for executives in Higher Education. With reference to the present research recommendations were formulated for higher education management:

1. The program of research and cooperation activities are still very few, so it is necessary to develop multi-institutional research consortium to establish networks with both national and international universities and research institutions to maintain and improve the scientific reputation of universities.
2. The most presented information on inbound lecturers are their main activities in delivering general lectures, therefore inviting foreign professors for research collaboration in the campus will generate new spirit to develop a global reputation to increase its World Reputation Rankings.
3. The total number of foreign students (inbound) from various countries for the most activities, the summer courses, show that the hospitality program for international students is an important program to increase the interest of international students. Such program is very beneficial in creating the international atmosphere as well as increasing the reputation of Higher Learning Institution toward World Class University.
4. Based on total number of scientific publications searched results, only 50% out 1413 (one thousand four hundred and thirteen) faculty members of IPB have google scholar and scopus accounts. Therefore, it is advisable for other faculty members to increase their profile accounts in various social media, and actively publish their scientific articles of their research programs through various scientific publishers.
5. Critical success factors of Executive Information Systems development for education management is data management [5]. The role of the Internal Verifier to manage data for success implementation of Executive Information Systems is really required. The Directorate of Cooperation and International Program will be responsible to verify the mobility of lecturers data. While for scientific reputation, as it slightly differs for its data management, therefore it is necessary to analyze the interoperability between executive information systems with the
scientific lecturers' management system to get the most advance and up-dated data on the scientific publications.

6. The challenge to manage critical organizational data is growing, and universities are embracing data governance (DG) strategies to protect the integrity of their valuable enterprise assets. According to [3] MongoDB expressions to control document structure can be taken as optional data governance. The flexibility of a dynamic schema in MongoDB can now easily be paired with data governance controls over an entire collection of the universities. Mobility data management and scientific reputation by accessing data through a data warehouse in accordance with the integrated database architecture according was developed according to [15]. Data warehousing has been an important part of the data architecture and IT infrastructure of many organizations and institutions. While big data and analytics do have their place, data warehousing stands out as a practical, proven practice for analyzing structured business data in order to support data-driven decision making. The sql command executed to access the data warehouse real will be faster, the number of records processed less and the join process is reduced.

**Suggestion**

To make attractive presentation of the information accessible in the SIMORI, further research program is really required. The application software to synchronize data extracted from external servers such as scopus and google scholar need to be developed. The proposed developed system will display all titles published by lecturers and students of IPB. It is expected that the systems will cover the most titles cited, as well as the metadata of those publications indexed and displayed in the Executive Information System. Of course, it requires skillful EIS team who are skillful to communicate and improved user attitude towards EIS to influence EIS implementation. Good EIS team communication skills and a positive user attitude towards EIS are essential to promote scientific reputation of Bogor Agricultural University, to increase its ranks in World University Rankings.

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