Recommendation of Cloud Computing Use for the Academic Data Storage in University in Lampung Province, Indonesia

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Abstract— A number of benefits originate from the implementation of cloud computing. Cloud computing has been extensively implemented in organizations like companies and universities. However, in Indonesia cloud computing is not widely approved by universities yet. This condition can be caused by lack of trust of the universities in the risk of cloud computing implementation. This paper is intended to analyze the risk of current data management of academic data in university, as a baseline to create recommendation of cloud computing use in university. The result of the analysis is risk leveling of academic data of cloud computing implementation in Higher Education. The process used is COBIT 5 Framework. The result of this study is expected to help the IT staffs to manage academic data in universities more effectively. Eventually, it is able to give effects on the increase of service quality.

Keywords— IT Governance; risk leveling,,; cloud computing; higher education

I. INTRODUCTION

A number of benefits derive from the application of cloud computing, such as saving costs, improving efficiency, increasing agility, flexibility and scalability. Adoption of cloud computing in university has a positive impact on educational institutions in the provision of learning facilities and support for the administrative management of the IT staffs [7].

Based on statistical data obtained in the study in a university environment, it was found that by using cloud computing 40% of the cost can be reduced, use of resources, support and collaborative learning co-operative can be improved efficiently and learning time can be increased from 25% to 50% [9]. Furthermore, cloud-based administrative can help IT staff to reduce risk and make standardized process.

The data volume in universities seems undeniable to ever increase, both academic data and other supporting data. The increase of data volume and access intensity requires the availability of adequate infrastructures. With the limitation of available resources in the universities it can affect the data academic management to become ineffective. One of the solutions is by including cloud computing implementation in academic data in universities. Those data are sensitive, interactive and collaborative, particularly those related with academic process [7].

This paper is intended to analyze the current management of academic data in some of univesities in Bandar Lampung, Indonesia., as a baseline to create recommendation of cloud computing use. Storing the data in cloud is basically similar to outsourcing. There must be risks in outsourcing. Meanwhile, academic data is sensitive even though its level is different. This study results in a priority recommendation to academic data that will be stored in cloud. The priority level is determined by the criteria of benefits and risks of cloud computing implementation. The criteria are : availability, privacy, performance, security, reliability and scalability [7]. This analysis will minimize the risks of academic data of cloud computing at the university.

The rest of this paper is organized as follows. Section I is introduction that describes the background and the aim of the research. Section II is related work that gives supporting theories to conduct the research. Section III describes the stages to analyze the academic data risk. Section IV is the results and discussion about risk of data academic implementation cloud at universities. Finally, Section V is conclusion.

II. RELATED WORK

One of IT resources importantly managed in the organization is data. In universities, academic data are very crucial since they are directly involved in the core process on the universities. Academic data include the students' registration data, academic operational and the alumni data.

One method to make the data management in a university effective is by using cloud computing [2]. Management of cloud computing technology will involve a third party. Involving a third party would pose a risk related to the control of resources [4]. Therefore, it needs to do risk leveling of academic data to be allocated in the cloud computing implementation.

The main risks of the use of cloud computing in academic data are security and privacy of data [3]. Furthermore, data availability becomes the key risk factor in academic data management. In this case, the data availability has to be completed when needed.

The process of risk analysis will be conducted using the COBIT 5 framework. The risk management is one of the processes of COBIT 5, which is a process (manage risk), and managed data [5]. Steps done to manage risk are: data collection, risk analysis, maintaining a risk profile maintenance, and risk articulation [6]. Business processes at the university consist of core and support processes. In this paper, the analysis is the core process of the university. Core processes include activities: new admissions, academic and operational, graduates process [13].

III. RESEARCH METHOD

The risk analysis of academic data will be conducted in the following stages: data collection, risk analysis, maintaining and risk profile maintenance.

A. Data Collection

Analysis performed on academic data at the university. The current academic data is being stored in the server. In this circumstance, the cloud users are still limited, especially for email and classroom in assistance of google apps.

The data collected from three private universities with accreditation for each program of study. The instrument used in this study is an interview with BAAK (administration and academic division) and computer center division (PUSKOM). Interview is done to find out academic data group or category. Academic data that is analyzed focuses on academic data including the student registration data, the operational and the alumni of academic data. Each has sub-processes; each process will be associated with the specified data. The measurement will be done using *likert* scale (score 1-5).

In addition, observation was also conducted on the management of security for data protection, privacy management, scalability, reliability and availability system when overload transaction.

B. Analyzing Risks

In the COBIT framework, risk management covers several elements, which are : organizational risk, social risk, and technical risk. One elemen of Technical risk is application risk [6]. Application Risk analysis is done by defining influential risk factors. Then, the analysis is done based on the indicators measurement include: availability, privacy, performance, security, reliability and scalability Measurements were made in the process of managing data storage, data maintenance, and data backup.

The data analysis will be based on the importance level and performance process and associated with academic data management. The performance level is indicated using scores on *likert* scale. It is obtained the average score of current condition on element availability, manageability, privacy, performance, security, reliability and scalability. The scoring is done by using likert scale with the range of score 1-5. Through current condition mapping, it can be applied on academic data in cloud computing.

C. Maintaining a risk profile

Maintaining and transforming risk profile of academic data, Management of academic data are grouped into Data storage, maintenance of data, while the data are grouped by type into: Data Students Admission, Academic Plan Data, Re-Registration Data, Learning Data, and Evaluation Data, Academic leave Data, and Final Graduation Exam Data. In each section the data is analyzed using the same indicator. The risk indicators used are Availability, Manageability, Security, Performance, Reliability, Scalability and Privacy.

IV. RESULT AND DISCUSSION

The measurements were taken at three universities in Bandar Lampung, Lampung Province, Indonesia. Based on the measurement results it is obtained the following results:

A. Current Maturity Level

Current maturity level describe the condition of the data management performance running today

Table 1 below shows the condition of the current maturity level of the data processing at the universities.

Table 1. Current Maturity Level

ACADEMIC DATA	UNIV. 1	UNIV. 2	UNIV. 3
Students Admission Data	4.1	4.6	3.9
Academic Plan Data	4	4.7	3.9
Registration Data	3.9	4.7	4
Learning Data	4.2	4.6	4
Evaluation Data	4.3	4.9	4
Academic leave Data	3.7	4.6	3.7
Final Exam Data	3.6	4.9	3.4
Graduation Data	3.5	4.5	3.3

The academic data is divided into 8 parts, from student admission to graduation data. The figures in each cell describe the average value of current maturity level (average) for availability, manageability, privacy, performance, security, reliability and salability in every part.
The highest maturity level is on the evaluation data and the lowest maturity level is on the graduation data. The evaluation data includes the data of students' scores, consisting assignment score elements, mid-semester test, final semester test, presence, final score, semester sore list and transcript.

B. Importance Maturity Level

The importance level indicates resources for the benefit of the university process. Table 2 below shows the importance

level of data Equations processing at the universities based on the management's point of view.

Table 2.Importance level

ACADEMIC DATA	UNIV. 1	UNIV. 2	UNIV. 3
Students Admission Data	3.7	4	4.1
Academic Plan Data	3.7	3.9	3.9
Registration Data	3.7	3.9	4
Learning Data	3.8	3.9	4
Evaluation Data	4.9	5	4.8
Academic leave Data	3.4	3.5	3.3
Final Exam Data	4	4.1	4.3
Graduation Data	2.9	3.1	2.8

The scores in the above table show that the highest importance level is on the evaluation data that is 5 and the lowest importance level is on the graduation level that is 2.8.

C. Current Maturity Level of Data Management

Table 3 shows the condition of current maturity level of data management at the universities. Data management is classified into 3 parts: data storage, data maintenance, and data backup. In each part, it consists of several indicators.

Table 3, Current Maturity Level of Data Management

DATA MANAGE-MENT	DESCRIPTION	UNIVERSITY		
		1	2	3
Data Storage	Compliance with the capacity of data storage media	3	4	3
	Frequency server down	3	4	3
Data Mainte-nance	Compliance with the implementation of maintenance procedures	5	4	3
	Security ensures data is performing well	5	4	4
	Ensuring Data Privacy conformance level	4	4	5
	Data integrity of the processes of academic	5	5	3
	Ensure conformity usability of data	3	5	4
	Compliance with the data protection of sensitive data	5	5	4
	Ensure data availability	5	5	5
	Ensure data reliability	5	5	5
Data Backup	Backup the data refers to standard procedures	5	5	3
	Backup the data periodically	5	5	4

The scores in the table above shows maturity level of data storage is mostly at level 3. The score indicates that one of problem of data management is in compliance with the capacity of data storage media and Frequency server down.

D. Importance Level of Data Management

Table 4 shows that the importance level of data management at the universities is based on the management's point of view.

Table 4. Importance Level of Data Management

DATA MANA-GEMENT	DESCRIPTION	UNIVERSITY		
		1	2	3
Data Storage	Compliance with the capacity of data storage media	5	5	4
	Frequency server down	5	4	4
Data Maintenance	Compliance with the implementation of maintenance procedures	4	4	4
	Security ensures data is performing well	5	4	5
	Ensuring Data Privacy conformance level	3	5	3
	Data integrity of the processes of academic	5	5	4
	Ensure conformity usability of data	4	5	4
	Ensure conformity usability of data	4	5	4
	Compliance with the data protection of sensitive data	5	5	4
	Ensure data availability	5	5	5
	Ensure data reliability	5	5	5
Data Backup	Backup the data refers to standard procedures	5	5	4
	Backup the data periodically	5	5	4

The scores in the table above shows that the most of level is at level 5. This indicates there is a view that the whole process has the highest level of importance.

E. Expected Maturity Level of Data Management

Table 5 shows expected data management at the universities based on the management's point of view.

Table 5. Expected Data Management

REQUIREMENT ANALYSIS	UNIVERSITY		
	1	2	3
The need for enhanced system performance	4	4	4
The need to use cloud computing for data storage in the academic data	3	3	4
The need to use cloud computing for backup data storage in the academic data	4	4	5
The need for applications that can improve service performance with more efficient	5	5	5

The scores in the table above show that most of the expected level is at level 4 and 5. The needs of performance improvement at level 4, needs for cloud computing usage in managing academic data mostly at level 4 for data storage, while backup data storage is at level 4 and 5. Then need for improvement to the application is at level 5.

F. Importance level VS Current Maturity Level of Data Management of University 1

Fig. 1 below shows the comparative between importance level and current maturity level of university 1.
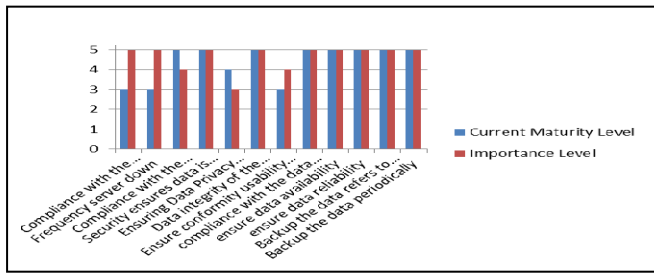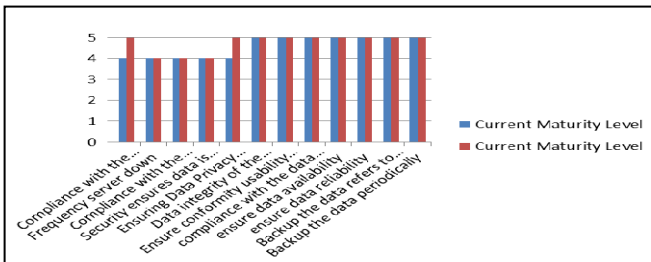
Fig. 1. Importance level VS Current Maturity Level of Data Management of University 1

The above graphic shows most indicators are at importance lavel 5. Current maturity level reached is varied. The indicator with the highest value of interest with lowest maturity level is complience with the capacity of data storage media and frequency server down.

G. Importance level VS Current Maturity Level of Data Management of University 2

Fig. 2 below shows the comparative between importance level and current maturity level of university 2.

Fig.2. Importance level VS Current Maturity Level of Data Management of University 2

The above graphic shows that most indicators are at importance level 5, while current maturity level reached is at level 4 and 5. The indicator with lowest current maturity level is Compliance with the capacity of data storage media.

H. Importance Level VS Current Maturity Level of Data Management of University 3

Fig. 3 below shows the comparative between importance level and current maturity level of university 3.
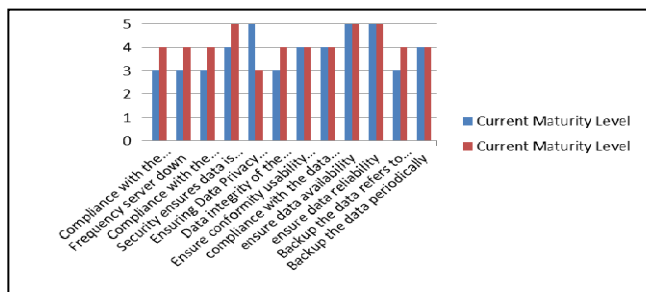

Fig. 3. Importance level VS Current Maturity Level of Data Management of University 3.

The above graphic shows that indicators are at importance level 4 and 5, while current maturity level reached is varied. The indicator with the lowest value of current maturity level is compliance with the capacity of data storage media, Frequency server down and Compliance with the implementation of maintenance procedures.

I. Expected Maturity Level of Data Management

Fig.4 below shows the expected maturity level of data management of performance system at universities.
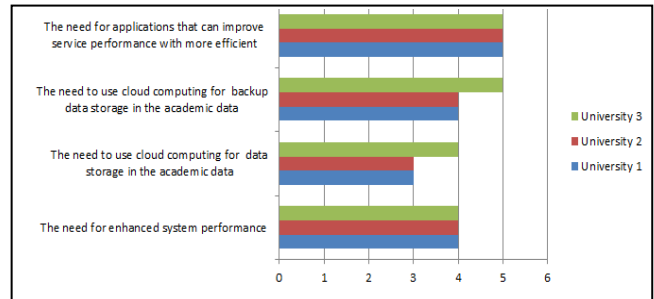

Fig.4. Expected Maturity Level of Data Management.

The above graphic shows that most indicators are at importance level 4 and 5. All universities need improvement of system performance. The universities needs application that can efficiently improve performance of service , and needs of the use of cloud computing for backup data storage. This indicates that the management have a high expectation against the performance of data academic management at the university.

Based on the table it is compliance with the capacity of data storage media and Frequency server down becomes a problem at the three universities. Generally, server down takes place in the activities of the registration (KRS on line) and score Entry. Server down is caused with the data volume increase at the specific range of time, so it needs a very high performance. Although educational online services are not as critical as other services such as those related to e-health, but they must be available anytime [12].

The problem with limitation of IT infrastructure, the down server intensity at the university causes poor service quality. Problem that linked with infrastructure limitation can be minimized by using cloud computing as media storage. This can be done by using *infrastructure as a Service* (Iaas) as one of the fasilities of cloud computing. Mell [10] who stated that cloud computing services are categorized into three main types : *infrastructure as a Service* (IaaS), *Platform as a Service* (PaaS), *Software as a Service* (SaaS). IaaS provides the consumer with processing, storage, networking and other computing resources on demand [7]. User can manage their resource on hardware allocation base on needs such as size of memory, size of hardisk and size of processor. The advantage may directly affected those who involve in managing the university. The advantages such as better quality of media in teaching and learning process, more

effecient resources and easier maintenance application and infrastructure.

Based on that case and data condition at the universities, it can be recommended to make use of cloud computing as data storage media. Cloud computing is an alternative solution. Data on data in Table 3 about current maturity level and table 4 about importance level from data management show the significance of the data storage, the data maintenance and backup data. Implementation of Cloud computing facilitates extensive data storage with simple resource infrastructure. This is in line with point from A.Gonzales [7] who stated that cloud computing manage resource in simple way and reduce maintenance efforts.

The implementation of Cloud Computing allows minimizing the cost of infrastructure procurement. Meanwhile, the academic data is sensitive, so it needs an analysis on data storage treatment in cloud. The recommendation is done from the data consisting of low importance. It is assumed that the data has low access frequency. Based on importance level of data management (table 2), do the sequences of recommendation are graduation data, academic leave data, academic plan data, registration data, learning data, students admission data, final exam data and evaluation data.

It is hoped that it can improve service performance more efficiently (fig. 9), as discussed by Emeakaroha, "Cost reductions and quality of service are are impacted by cloud computing implementation [14], and Sultan said, " adopted cloud computing not only to rationalize the management of IT resources, but also to make the education process more efficient [8].

Besides cost efficiency cloud computing implementation will help to minimize operation time, reduced installation and maintenance effort, then IT staff can focus on core task [7].

The adoption of cloud computing at the university include: Email, E-learning systems, learning Management, Library system, university website or portal, file backup and storage, online collaboration, student record system, file sharing, office productivity suite, ERP system, project management system and virtual lab environment. The service covers the most widely used is Email and E-Learning systems. Survey conducted in this study also produces the same thing.

V. CONCLUSION

This paper provides recomendations about priority level of academic data storage in cloud computing based on its level of risk. To minimize the risks, the storage is prioritized for the data that have low level of interest. The sequence of priorities is graduation data, academic leave data, academic plan data, registration data, learning data, students admission data, final exam data and evaluation data. It is used as an effort to fulfill the needs for the compliance with the capacity of data storage media with low level of controlled risks and Frequency server down anticipation. Therefore, the use of cloud computing becomes an alternative in obtaining the increase of service consistency at universities.

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