Evaluation of the Use of Cloud Storage on Academic Website Using SWOT Analysis and Balanced Score Card

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Abstract—Data security and data leakage is an important issue in a dangerous technology in Cloud Storage systems on Cloud Computing. Academic website also faced problems like data leakage and system hacked for certain purposes. To achieve an appropriate level of data security standard on the Cloud Storage for academic website, the strengths and weaknesses in data security of Cloud Storage on academic website was evaluated using SWOT analysis. The analysis is based on four layers that exist in the cloud storage structure, namely access Cloud Storage. This is important since in recent years, many incident took place on attacks layer, application layer interfaces, management layer, and storage layer. The study also evaluates the performance of cloud storage by measuring the academic website using IT Balanced Scorecard which based on four perspectives of IT Balanced Scorecard. This study focuses only on Cloud Storage website of Academic Information System (AIS) UIN Jakarta, since many hacking incident on student accounts while there is no evaluation results on the website AIS Cloud usage.

Keywords: Cloud Computing, Cloud Storage, data security

I. INTRODUCTION

Cloud storage technology makes full use of the existing different storage devices in the system to provide users with data storage, data retrieval, data backup and other functions through application software ran by a user terminal. In recent years, attacks and data leakage in cloud storage system within Cloud Computing seemed to be increased [1].

In previous research,[1], use risk analysis to the 4 layers in Cloud Storage technology. The result showed that the technology developed very fast, and cloud storage security technology is facing unprecedented challenge. However, cloud storage security is not just a technical issue. It also involves standardization, management, laws and regulations and other problems. [2], analyze safety hazards of Cloud Computing. In this analysis discussed traditional and approved security solutions and procedure evaluation parameters. It was discussed also the procedure for evaluating parameter are determined. Those will be provided as one packaged solution. [3] get the result that in multi-layer cloud network, any device can augment its resources by taking off his duties to the public cloud, private cloud, or even the user's device. However, it is difficult to handle access control on data stored in different clouds that offer variety of access control.

This research is focused on the cloud storage system UIN Jakarta Academic Information System (AIS) UIN Jakarta, since many hacking incident on student accounts while there is no evaluation results on the website AIS Cloud usage.

II. LITERATURE STUDY

A. Cloud Storage

Cloud Storage operates through a Web-based API that is implemented remotely through interaction with the infrastructure of in-house cloud storage client applications for input / output (I / O) and read / write operations (R / W) [4]. Standard Cloud Storage can help to overcome the problems of accessibility, security and portability issues and the costs associated with growing data sets [5].

The advantage of Cloud Storage in the academic field are to minimize investment costs in academic
infrastructure, to enable the development and implementation of applications quickly that is increasing productivity in the academic field, and to facilitate the integration of the academic system services with various devices [5].

B. Four Layer Cloud Storage

The structure of cloud storage system consists of four layers:

- **Access layer**
  - Personal space service, Carrier space rental
  - Enterprise or SMB to achieve data backup, data archiving, centralized storage, remote sharing
  - Video surveillance, centralized storage of IPTV and other systems, large capacity online storage site

- **Application Interface layer**
  - Network access (WAN or internet) / user authentication / rights management
  - Public API interface/application software/web server

- **Management layer**
  - Cluster system, distributed file system, grid computing
  - Content distribution, p2p, deduplication, data compression
  - Data encryption, data backup

- **Storage layer**
  - Storage virtualization, storage centralized management Status monitoring, maintenance upgrades
  - Storage devices

Figure 1. Layer in Cloud Storage [1].

- **Storage layer**
  - Storage layer is the most basic part of cloud storage. The storage device can be in Fiber Channel FC storage devices. This could also be an IP storage device such as NAS and iSCSI, or direct-attached storage (DAS) devices such as SCSI or SAS.

- **Management layer**
  - Management layer implements collaboration between multiple storage devices in cloud storage through clusters, distributed file systems, and grid computing technology. This enable multiple storage devices provide the same services and to have bigger and better data access performance.

- **Application interface layer**
  - Application interface layer is the most flexible part of cloud storage. In the actual type of business, different cloud storage operators can develop a different application service interface, and providing a wide range of services.

- **Access layer**
  - Each authorized user can access the cloud storage system through a standard public application interface and enjoy the cloud storage service. The types and methods of access provided by cloud storage are the results from different operating unit.

C. IT Balanced Scored Card

Balanced Score Card (BSC) is the effective tools of performance management. It uses measurable indicators for assessing organization’s implementation and strategic targets [6]. The BSC develops the four views index. They are learning and growth, internal processes, customers, and finances. BSC goal is balancing the financial target as a result of past performance, and three other indices (future display index) [7].

| **How do users view the IT department?** | **How does management view the IT department?** |
|------------------------------------------|-----------------------------------------------|
| **Mission**                              | **Mission**                                   |
| To be the preferred supplier of information systems | To obtain a reasonable business contribution from IT investment |
| **Objectives**                           | **Objectives**                                |
| Preferred supplier of applications       | Control of IT expenses                        |
| Preferred supplier of operations vs proposes of best solution from whatever source | Business value of IT projects                   |
| Partnership with users                   | Provision of new business capabilities         |
| **User satisfaction**                    |                                               |
| **OPERATION**                            | **CONTRIBUTION**                              |
| EXCELLENCE                               |                                               |
| How effective and efficient are the IT processes? | How well is IT positioned to meet future needs? |
| **Mission**                              | **Mission**                                   |
| To deliver effective and efficient IT applications and services | To develop opportunities to answer future challenges |
| **Objectives**                           | **Objectives**                                |
| Efficient and effective developments     | Training and education of IT staff             |
| Efficient and effective operations       | Expertise of IT staff                         |
| **FUTURE**                               | **ORIENTATION**                               |
| **OPERATION**                            | **CONTRIBUTION**                              |
| How well is IT positioned to meet future needs? | Research into emerging technologies |

IT Balanced Scorecard: the outcome of measures and performance drivers [8]. IT Balanced Scorecard to provide a comprehensive and structured presentation and review. It will allow related managers to monitor the strategy of IT implementation based on the value of each IT perspective [9].

D. SWOT Analysis

SWOT is an abbreviation for Strength (Strength), Weakness (Weakness), Opportunity (Opportunity), and Threat (Threat) which is a strategic factor specific to a particular company [10].
SWOT analysis is used to determine the position currently experienced by the company, and to determine the strategic directions can be taken by company using a SWOT Analysis Diagram. SWOT can also be used to produce a number of possible alternative strategies. The TOWS matrix (TOWS is just another way of saying SWOT) describes how the external opportunities and threats faced by a particular company can be matched with the company's internal strengths and weaknesses that can produce four possible alternative sets of strategies.

Table2. SWOT matrix [12]

| INTERNAL FACTORS (IFAS) | Strengths (S) List 5-10 internal strengths here | Weaknesses (W) List 5-10 internal weaknesses here |
|-------------------------|------------------------------------------------|-----------------------------------------------|
| EXTERNAL FACTORS (EFAS) |                                           |                                              |
| Opportunities (O) List 5-10 external opportunities here | SO Strategies Generate strategies here that use strengths to take advantage of opportunities | SO Strategies Generate strategies here that take advantage of opportunities by overcoming weaknesses |
| Threats (T) List 5-10 external threats here | ST Strategies Generate strategies here that use strengths to avoid threats | WT Strategies Generate strategies here that minimize weaknesses and avoid threats |

E. Academic Information System

Academic information is very important information for students. Some academic information has a certain deadline, therefore, it must be delivered to the student as soon as possible [13]. Web Services technology offers convenience of bridging information resources no matter what technology used by each source [14]. Academic information systems can clarify the academic path of students during their studies and increasing integrity and transparency by providing equal information to all stakeholders. This also adds convenience by allowing access from anywhere through web [15]. In the Academic Web, electronic resources from this organization are very informative and can be used as sources of new media for science and contribute to promote scientific knowledge [16].

III. METHOD

Method used in this study can be explained as follows:

1) Literature Study

At this stage, the study was done on literature related to cloud storage, risk analysis, performance measurement, Balanced Scorecard and IT Balanced Scorecard. From the literature, it is expected to learn the description of risk analysis in the cloud storage and performance measurement of academic website using IT Balanced Scorecard

2) Data collection

Methods used for data collection was interview. Interview was conducted to the Pustipanda UIN Jakarta. The interviews is about cloud storage, cloud storage risks on the web academic, advantages and disadvantages of cloud storage academic web and how to cope if the risk occurs in the cloud storage academic web.

3) Data processing

The result of interviews with Pustipanda was compared to IT perspective Balanced Scorecard. The result constitute the basis for formulating key performance indicator (KPI) of cloud storage academic website. Then create SWOT matrix to learn the internal strengths and weaknesses of cloud storage academic website. The KPI and target that was set are mapped into four perspective of IT BSC which are contributions from organizations, user orientation, operational improvement, and future contributions.

Later each KPI was measured. Actual condition value is obtained from the following calculation: each answer on scale 1-5 is multiplied by its weight. Each result for all answer is added up. Then the total value is divided by the number of respondents. Then the total value multiplied by 20% (20% because of the scale there are 5, then 100%: 5). To calculate the weighted results using the formulation of strategic objectives as follows: 1) weight = weight value comes from the academic website management, 2) the result of interest = (result size / 100) x weight, 3) the results of the average size = result of achievement of data processing from each perspective of IT Balanced Scorecard, 4) total is the percentage of each perspective.

- Data analysis and determination of the level of performance

The measurement results are then analyzed so it can be determined which aspects are less supportive to the achievement of the strategic plan so that corrective action can be taken. Its
measurement results is in the form of scorecard that contains values to each IT perspective BSC which will determine the level of academic web performance.

A. SWOT Analysis 4 Layers Cloud Storage

Cloud storage for academic website has an advantage to be accessed from anywhere. There are some network factors need to be considered, namely 1) problem compilation related to connection of internet service provider (ISP), 2) user accessing the academic systems is increasing, 3) storage space crash the systems. Cloud storage in academic systems contain four layers. Namely, storage layer, management layer, application layer, and interface of access layer. The following is SWOT analysis for academic systems of four layers cloud storage.

| Strengths (S) | Weakness (W) | Opportunity (O) | Threats (T) |
|---------------|--------------|-----------------|-------------|
| - Cloud Academic System Storage can be accessed anywhere. | - Can occur hang when visiting crowded and space is full of uncontrolled storage. | - Rejuvenation device -mirroring and routines perform data backup internet bandwidth | - Server down can occur if a visit to the bustling academic system |
| - Already using SSL in anticipation | - Using the SSL -Separate database server, application, streaming database -Network aspect: install a firewall | - create multiple virtual storage space | - Using java in operation |

Table 3. SWOT Matrix Academic Cloud Storage System

B. Data processing

The composition of KPI was started by studying the perspective of IT BSC. The perspective was aligned with strategic goal of academic information systems so that the KPI for academic information systems is displayed in Table 4.

| BSC IT Perspective | Key Performance Indicator |
|---------------------|---------------------------|
| Achieve organizational contribution that is the business value of information technology and the effectiveness from the application information systems | Improving the effectiveness of academic administrative services |
| Providing information systems on-demand to achieve user satisfaction | - Operator system of satisfaction - Increase the system operator competency |
| Providing maximum IT products and services for effective and efficient information systems | Improving the quality of information systems |
| Answering the challenges of the future by educating and training the IT staff as well a research on the development of IT | Increase IT staff expertise |

Table 4. Key Performance Indicator

IV. RESULTS AND DISCUSSION

The information system object for the research is a web-based academic information system. The function of this system is to provide data sources and academic administration that covers institution data, student data, lecturer’s data, scholarship data, lecture scheduling, academic transcripts, study plan cards, study results cards, summary data, and academic transaction report for students.

Security on the academic system is good enough because the system utilize Secure Storage Layer (SSL), encrypting visitors so that it is difficult to be hacked. Programming language uses the Java language, the Linux operating system and the Tomcat service. Some anticipation if there hacked data, namely by using SSL, separating the database server, application server and streaming database server.

Figure 3. Research Method
Then for the KPI that had been set, targets are determined specifically for each KPI. KPIs and targets were reassembled into their respective IT perspective Balanced Scorecard as shown in Table 5. KPI targets derived from the translation of each IT Balanced Scorecard perspective so that it comes into several sizes. Next step is determining the final value of the balanced scorecard prior to calculation of IT balanced scorecard.

### Table 5. Target KPI

| BSC IT Perspective | KPI                                          | Target (%) |
|---------------------|----------------------------------------------|------------|
| Contributions       | Improving the effectiveness of academic     | 80         |
| Organization        | administrative services                      |            |
| User Orientation    | -Operator system of satisfaction              | 75         |
|                     | -increase the system operator competency     | 80         |
| Operational         | System Quality Improvement                   | 78         |
| Improvement         |                                              |            |
| Future Orientation  | Increase IT staff expertise                   | 75         |

Total of 15 questionnaires were sent out, and returned as much as 15 questionnaires, a total of 15 questionnaires were answered. Table 7 is a recapitulation of the calculation data processing for each IT perspective Balanced Scorecard.

### Table 6. Value End Performance Balanced Scorecard

| Value (Score)% | Scale | Category  |
|----------------|-------|-----------|
| 73-85          | 5     | Excellent |
| 59-72          | 4     | Best      |
| 45-58          | 3     | Good      |
| 31-44          | 2     | Bad       |
| 17-30          | 1     | Very Bad  |

### Table 7. Results of Data Processing Perspective User Orientation

| Strategic Goals                              | Strategic size | Strategic target | Actual conditions | Achieve ment |
|----------------------------------------------|----------------|------------------|-------------------|--------------|
| BANK Officer appearance                     | 75%            | 73%              | 74%               |              |
| Officer control in matters                  | 80%            | 68%              | 74%               |              |
| Speed of response officers                  | 80%            | 67%              | 74%               |              |
| seriousness and patience officer            | 80%            | 67%              | 74%               |              |
| alacrity of officer solve problems.         | 80%            | 68%              | 74%               |              |
| The credibility of the officer.             | 75%            | 60%              | 68%               |              |
| Hear any complaints properly.               | 75%            | 68%              | 72%               |              |
| Friendly and courteous attitude of the officers. | 75%    | 75%              | 75%               |              |
| An understanding of the user's problem.     | 75%            | 69%              | 75%               |              |
| Total                                       |                |                  |                   | 731%         |
| Average                                     |                |                  |                   | 73%          |

### Table 8. Results of Data Processing Perspective Contributions Organization

| Strategic Goals                              | Strategic size | Strategic target | Actual conditions | Achieve ment |
|----------------------------------------------|----------------|------------------|-------------------|--------------|
| Achieve organizational contribution that is the business value of information technology and the effectiveness from the application information systems | The procedure for applying clear | 80%              | 72%              | 76%          |
| Supplies adequate physical                    |                |                  |                   |              |
| Services via telephone.                       |                |                  |                   |              |
| Certainty of time.                            |                |                  |                   |              |
| Total                                        |                |                  |                   | 291%         |
| Average                                      |                |                  |                   | 73%          |
Furthermore, the weighting of the strategic objectives for each perspective of the IT Balanced Scorecard were determined. The weights are set based on observations during the study in PUSTIPANDA which was then approved by the management. Weights are determined to find the results of interest of each outcome measure. The weights are obtained under the agreement and approval of the parties. Furthermore, target fulfilment level results at each IT perspective Balanced Scorecard will be determined (Table 12) as well as the results of performance measurement of academic website.

Table 10. Results of Data Processing Perspective

| Future Orientation     | Strategic Goals                                      | Actual conditions | Achievement |
|------------------------|------------------------------------------------------|-------------------|-------------|
| Answering the challenges of the future by educating and training the IT staff as well a research on the development of IT | timeliness and accurate information | 75% | 74% |
| The information is presented in accordance with the needs and activities. | | 75% | 74% |
| Timely delivery of information. | | 75% | 68% |
| Total                  |                                                     |                   | 216%        |
| Average                |                                                     |                   | 72%         |

C. Analysis of Data

The results of data processing of 15 respondents in the four perspectives of the IT balanced scored card showed that on user orientation, the contribution of organizational and operational excellence have 73% which is in the position of 'Very Good'. However to the perspective of the future orientation, the value is 72% so it is in a position “Good”. In addition, when viewed from the weighting of the strategic objectives, the four perspectives has a score of 54-58% so that only occupy the position of “Good enough”. The position is obtained from the value of final performance on the method of Balanced Scored Card

V. CONCLUSIONS

The measurement results was obtained from the four IT balanced scored card perspectives on the AIS UIN Jakarta academic web. The perspective of User Orientation gets 54.75%, Organizational Contributions get 58.4%, Operational Perfection gets 56.94% and Future Orientation gets 54% with each category at “Good” level

The perspective results from the four perspectives of the IT Balanced Score Card for academic web in average is 56.02% where the score is at the level of “Good enough”.

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