

Improvement of Information Technology Infrastructure in Higher Education using IT Balanced Scorecard

Clara Hetty Primasari
 Department of Information Systems
 Universitas Atma Jaya Yogyakarta
 Yogyakarta, Indonesia 55281
 clara_hetty@staff.uajy.ac.id

Djoko Budiyanto Setyohadi
 Magister Teknik Informatika
 Universitas Atma Jaya Yogyakarta
 Yogyakarta, Indonesia 55281
 djoko.bdy@gmail.com

Abstract— Today the use of Information Technology (IT) in business is a must since IT is useful to obtain competitive advantage. It can be achieved by alignment of IT and business, which is performed by developing a good IT infrastructure. Higher educational organization is one of business which requires competitive advantage to compete with their competitors. However, there are some problems encountered. These include the lack of a systemic approach to IT implementation, the lack of awareness to use IT, the lack of commitment and the leader's interest to implement IT, the weakness of technical support for IT implementation, poorly targeted staff development, lack of ownership and insufficient funds. Furthermore, an evaluation is need to determine the condition of IT infrastructure problems to deal with issues faced by a higher education organization. Balanced Scorecard is potential framework for analyzing IT infrastructure since it is one of the well-known performance measurements which embrace the important aspect in business. To do performance evaluation in the IT of higher education organization, Balance Scorecard perspective needs to be customized since IT division is more likely to serve internal rather than external parties commonly. The results of this study are expected to give an illustration of the state of IT infrastructure governance of higher education according to four perspectives in IT Balanced Scorecard. Based on this illustration, it can be identified critical recommendation to IT Infrastructure governance in higher education.

Keywords— *Improvement; IT Infrastructure; Governance; IT Balanced Scorecard; Higher Education*

I. INTRODUCTION

Information Technology has been widely used by many parties such as organizations, institutions, companies, educational institutions, and so on to support its business processes. Information and business technologies are closely related, and an institution cannot be a competitive institution if Information Technology and business are not aligned [1]. The alignment between business and Information Technology has proven to have a positive relationship to the performance of an institution [2].

Information Technology occupies a vital position in the process of economic globalization and is a necessity in every developing country [3]. In Education, Information and communication technologies can facilitate education and teaching and learning processes [4]. In the implementation of teaching and learning process, administration, and all academic activities within the university, good IT infrastructure is required. The quality and quantity of infrastructure need to be considered for improvements in productivity and efficiency [5].

In developing countries, generally, there are some problems related to the application of IT infrastructure in higher education. These include the lack of a systemic approach to IT implementation, lack of awareness to use IT, lack of commitment and the leader's interest to implement IT, lack of technical support for IT implementation, poorly targeted staff development, lack of ownership and insufficient funds [6]. An evaluation is needed to find out what specific issues faced by an educational institution in the governance of its IT infrastructure.

There are various frameworks that many previous researchers have found to measure performance, but their effectiveness depends on how qualitative and quantitative perspectives are handled in the relevant context [7]. Kaplan and Norton introduced the Balanced Scorecard as a performance measurement. The purpose of the method is not only limited to make financial evaluation alone but also to measure an important aspect of the business, such as customer satisfaction, internal processes, and the ability to innovate [7]. Martinsons et al. in [8] suggested that the four Balanced Scorecard perspectives need to be modified to fit the IT performance. They argue that a company's IT division usually serves more internal rather than external parties and the project is intended for the benefit of both end users and organizations as a whole.

Based on the above considerations, then selected IT Balanced Scorecard as a framework that used for analysis of IT infrastructure at Higher Education. This research used some Key Performance Indicator (KPI). KPI is the measures used to realize the goals that have been determined. KPIs typically include capability indicators, implementation, and IT resource capabilities [9]. This research resulted in exposure to the state of IT infrastructure in higher education according to the four IT Balanced Scorecard perspectives such as Corporate Contributions, User Orientation, Operational Excellence, and Future Orientation [10]. This was known by the points obtained for each KPI in each IT BSC perspective. By using these points, it could be broken down which KPI that earned good or bad points. These results would be justified by interviews with IT divisions so it could be sorted out several aspects from four IT BSC Perspectives that need to be improved. The main contribution of this research is constructing managerial implication for IT Infrastructure in private higher education based on justification result. Managerial implication contains some recommendations to IT Infrastructure governance for private higher education.

The paper proceeds as follows. In the following section, we first present the Balanced Scorecard application to various institutions such as profit and non-profit or educational institutions. Also Balanced Scorecard that applied to IT Problems called IT Balanced Scorecard. Then, the methodologies used in this research. Following that, result and discussions that consist of result of IT Infrastructure of private university assessment using IT Balanced Scorecard and Report and findings analysis. The next section is Managerial Implication containing recommendations for findings in IT Implementation in private university. The last section is the conclusion of this research.

II. LITERATURE REVIEW

Performance and management measurement is the heart of an organization that wants to be looked transparent, efficient, effective, and successful in its operations [11]. Performance measurement is developed as a means to monitor and maintain organizational controls to ensure that an organization can execute strategies that lead to the achievement of overall goals [12]. One of the tools for performance measurement that is widely used by researchers in the world is the Balanced Scorecard. The Balanced Scorecard developed by Kaplan and Norton allows managers to view business from four essential perspectives [13]. Such perspectives include customer perspective, internal perspective, innovation and learning perspectives, and financial perspective. Combining these four perspectives, the Balanced Scorecard helps managers understand relationships to go beyond traditional notions of functional boundaries and lead to better decision-making and problem solving [13].

Balanced Scorecard is widely applied in companies or institutions that are oriented to profit, but do not rule out applied to non-profit organizations or educational institutions. The University as an educational institution requires appropriate tools and models to ensure the bounded plans and processes and the effectiveness of graduates into the world of work to demonstrate university performance [14]. There are several studies in the implementation of Balanced Scorecard in education such as research conducted by [15] applying Balanced Scorecard for business school and resulted in finding that Balanced Scorecard approach is suitable for high education situation and allow alignment of various sizes with the mission and unique strategy. Hladchenko in [16] compares the application of the Balanced Scorecard to higher education institutions in Austria and Germany and concludes that the Balanced Scorecard provides a systemic view of strategy for institutions. BSC ensures a full complex framework for strategy implementation and control and sets the ground for further learning in institutional strategic management processes by the "plan-do-check-action" scheme. Philbin in [17] conducted a study to identify how university management can be improved by applying performance measurements with the Balanced Scorecard. The university feels the benefits of a scorecard report that provides specific information for institutional research development and teaching capabilities and this has an impact on improvements in the decision-making process. The Balanced Scorecard is also applied in schools in Iran and concluded that the application of BSC compared to other strategic planning models is more effective and efficient for solving the problems of educational organizations [18].

Balanced Scorecard is also applied to IT problems. The IT division within an organization typically provides services for the internal organization, and it makes IT Balanced Scorecard (IT BSC) slightly different from the usual Balanced Scorecard. Grembergen and Bruggen introduced the IT BSC consisting of four perspectives: User Orientation, Operational Excellence, Future Orientation, and Business Contributions.

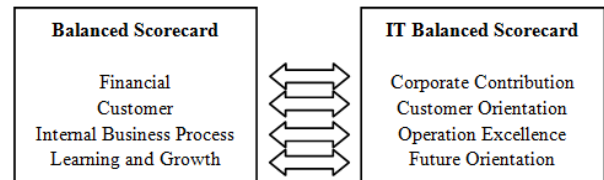


Fig. 1. Comparison of Balanced Scorecard with IT Balanced Scorecard (Grembergen and Bruggen, 1997)

Each perspective in the IT BSC should be translated into metrics and measures that can assess the current situation. This assessment process should be periodically reproduced and coordinated with pre-set objectives. The important thing about IT BSC is that in IT BSC the cause and effect relationship is built and the connection between two types of measurement such as output measurement and performance drivers is clarified [7].

III. METHODOLOGY

The institution to be analyzed was one of the private universities in Yogyakarta, Indonesia named Universitas Atma Jaya Yogyakarta (UAJY). UAJY was chosen because it was one of the popular private universities in Indonesia and the IT implementation represent the implementation of IT infrastructure governance in higher education. Research methodologies used in this research shown in Figure 2 and explained as follows:

1) Organization/Institution Analysis

This research began with the analysis of institutions to be studied. This analysis is started by determining the Key Performance Indicator (KPI) for each IT Balanced Scorecard Perspective. The analysis involved identifying the aspects to be measured in each balanced scorecard perspective. Each measured dimension would be used as a KPI.

2) Literature Studies and Determining KPI

To facilitate the determination of KPIs, besides studying the institutions to be analyzed, also by looking for similar research that had been done by previous researchers. KPIs used in this research was determined by comparing previous literature studies related to this study. The KPIs for each of the perspectives were adapted from [19].

3) Data Collection

After determining KPI for each perspective, each KPI was converted in the form of questionnaire question which then distributed by convenience sampling method to 30 respondents consisting of staffs and lectures from various faculties and units in UAJY. Not only with questionnaires, but data collection was also conducted by interviews with IT Head, deputy head of IT User Services Department, several staffs, and lecturers.

4) IT Infrastructure Analysis using IT BSC

The results of the questionnaire were used to build the IT BSC that would be analyzed and combined with the results of interviews to obtain the results of the analysis. IT BSC

was developed using Balanced Scorecard online tool. IT BSC analysis produced IT BSC Report.

5) Report and Finding Analysis

IT BSC Reports were then analyzed and matched the results with findings from the questionnaire results and interviews with IT Head, deputy head of IT User Services Department, several staffs, and lecturers.

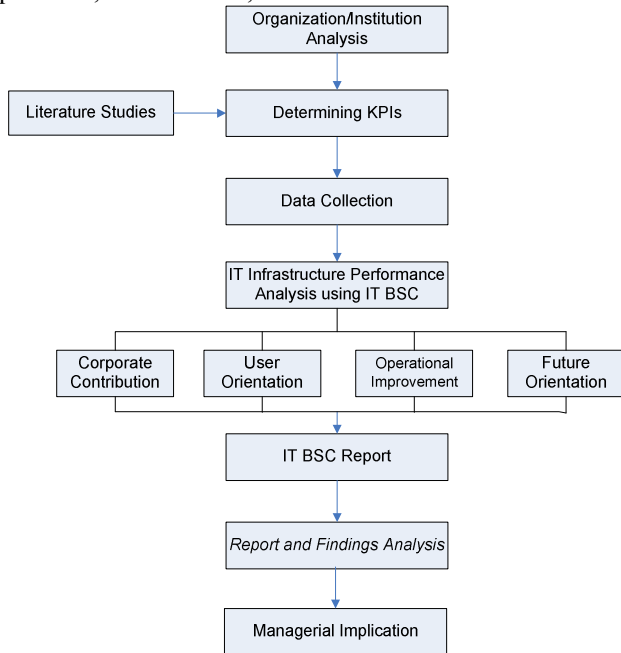


Fig. 2. Research Methodologies

6) Managerial Implication

Analysis of reports and findings is classified which were positive and negative. The positive things found should be kept, while the negative ones must be corrected. These two resulted in suggestions and recommendations for governance of IT infrastructure in the future.

IV. RESULT AND DISCUSSION

A. Results of Assessment with IT Balance Scorecard

Table 1 shows IT Balanced Scorecard report that was generated from questionnaire result. We can see value from each perspective and KPIs. Perspective value ranged from 1-100%, while KPIs from 1-5. The higher the value, the higher or better the value for the perspective or the related KPI. From the report in table 1, it can be seen that the perspective that obtains the best or most significant result is the corporate contribution and the smallest or the worst is the future orientation

KPI with the most significant value is the Business Value of IT Unit, and the lowest is the skill of IT employees. This report will be adjusted to the existing findings and analyzed the cause with information from the interview. It is done to obtain suggestions for improvement and what needs to be maintained and improved for better performance in the future.

TABLE I. IT BALANCED SCORECARD REPORT

Indicator	Desc	Value	Target
Perspective Corporate Contributions		70,00%	
IT Cost Control	KP-1	3,73	5
IT and Business Goals	KP-2	3,6	5
Business Value of IT Function	KP-3	4,17	5
Effectiveness of IT Unit	KP-4	3,7	5
Total performance in group		70,00%	

Perspective User Orientation		66,04%	
Product quality	OP-1	3,67	5
User Contribution	OP-2	3,53	5
User Satisfaction	OP-3	3,5	5
User Interaction with IT Unit	OP-4	3,87	5
Total performance in group		66,04%	
Perspective Operational Improvement		67,29%	
Effectiveness of app development	PO-1	3,47	5
System Maintenance Intensity	PO-2	3,7	5
Effectiveness of Service Functions	PO-3	3,87	5
Repair Accuracy	PO-4	3,73	5
Total performance in group		67,29%	
Perspective Future Orientation		59,58%	
Training Budget for IT personnel	OM-1	3,33	5
IT Personnel Expertise	OM-2	3,30	5
The budget for IT R&D	OM-3	3,33	5
IT Product Innovation	OM-4	3,57	5
Total performance in group		59,58%	
Total performance in IT Scorecard		66%	

B. Report and Findings Analysis

The results of IT BSC report were then justified by interviews with some related parties such as the head and deputy head of IT Division as well as some staff and lecturers in UAJY.

1) Corporate Contribution

For Corporate Contributions perspective, there are some KPIs such as IT Cost Control, IT and Business Goals, Business Value of IT Function and effectiveness in IT Unit.

Corporate contributions are embodied in IT Division's strategic plan. There are four focused Strategic Plan of IT Division, including:

1. Improve supporting facilities of Technology-Based Learning Activities. The indicator has not established yet but what is done now is optimizing the use of Learning Management System (Moodle), then improving the WIFI coverage, so that the learning process more convenient.
2. Improve integrated university administration services. This action is done through the internal systems of UAJY such as SIKEU, SISPRAS, SPKP, and others. The indicator of success is that all built systems can be used maximally.
3. Increase infrastructure such as internet reinforcement, building connections, and server capabilities.
4. IT Human Resource Development which performed regularly by training and certification.

IT cost control has been done through the UAJY Financial Information System called Sistem Informasi Keuangan (SIKEU). Based on [20], an effective Cost control system should comply with cost control framework that consists of three criteria:

- a. Systematic and detail Work Breakdown Structure (WBS)
WBS used for cost control must follow a systematic structure. Activities should be partitioned into easy-to-manage elements so that budgets and expenses can be easily controlled. Besides, WBS must also be broken down into various depth levels. The depth level can be made into three levels.
- b. Proper Cost Code
The cost code used in a system must be flexible, following the WBS and accounting code. The cost structure code should have the ability to tackle the

things that increase in the future. Besides the cost code must also be adjusted with the WBS and accounting code.

c. **Employ Earned Value Concept**

Earned value is the performance measurement to report the status of a project regarding both cost and time on a given date. By employing the earned value concept, cost status at given progress can be identified. By identifying the cost status, management can obtain information about the total actual expenditure of each item under the predefined budget.

Based on observations and interviews with SIKEU users, SIKEU has met the three criteria of cost control framework above. However, the users still complain caused by the bug of the system, such as:

- a. Error in system navigation links so the user should re-login to continue their process,
- b. Bug regarding deleting data since when the user wants to delete one data all of the data are deleted
- c. the input process is difficult to be performed caused the data should be inputted one by one.

For IT Investment, it has been in line with existing budget in SIKEU, but it has never been held a calculation about benefits and profits of IT implementation in UAJY. The obstacle of the investment is that the technology used by IT Division is still relatively new, so it feels quite expensive. Beside that, the budget for the technology is limited, and the investment process is long enough.

2) *User Orientation*

For User Orientation perspective there are some KPIs such as Product Quality, User Contribution, User Satisfaction, and User Interaction with IT Division.

To gain user satisfaction, IT Division always strives to make quality products. Products produced by IT Division are tailored to the needs of users. Applications that have been made include:

- a. for staff and lecturers: SIKEU (finance information systems (IS)), SIMKA (personnel IS), SPKP (employee performance appraisal IS) in which there is a presence system with a fingerprint, and ATMAREWARDS (rewards for the use of e-learning sites).
- b. for students: SIATMA (academic IS), SIKMA (student IS), and ATMAREWARDS
- c. for external and alumni: PMB Online (admission IS), and SIMPONI (alumni portal IS).

From the user side, users feel helped by the SIKEU, fingerprint Presence Systems, and other applications created by IT Division. This condition is proven since there are only 10% of respondents who feel that the application produced by IT Division has not suitable with their needs.

When the application is developed, users are involved to ensure the quality of the systems. The user involvement embraces to various management level, from staff up to managerial level. During the development process, users are always included in each stage of application development so that the quality of the application is maintained and the resulting application can be defined as user preferences. Before the application developed, interviews were done to the user about the expected specifications and functions of the system. After that, the application is developed until completed. Subsequently, it is tested to the user to get feedback. Improvements are always made based on user's

feedback until the user feels that the system is ready and fit by their wishes.

Constraint related to the user is that some users are reluctant to switch to the new system because they are comfortable with the old system. The problem about new technology is although new technology mainly succeeded in delivering managers' desired sense to the change process, generating engagement and spirit, it did so while provoking a sense of frustration and anxiety with the technology itself [21]. This condition happens at SIMKA. Users still feel comfortable to use old system although the old system used has not been integrated with other systems that exist in the university, and its functions are not complete compared to the system that has been developed by IT Division.

In addition to system development, user interaction with IT Division occurs in handling customer complaints. 97% of respondents feel that users can quickly obtain answers from complaints or questions in the use of existing systems, through helpdesk (ksi.uajy.ac.id/helpdesk) with a response speed within 24 hours assisted by student staff team.

3) *Operational Improvement*

For Operational Improvement perspective, there are some KPIs such as Effectiveness of application development, Systems maintenance facility, Effectiveness of service function, and Repair Accuracy. Based on the questionnaires, only 10% of users were dissatisfied with the system developed by IT Division. This situation proves that system development has been effective, but still needs some evaluation about what makes users dissatisfied. According to Helpdesk, 97% of users are satisfied with the complaint response or IT Helpdesk. To improve the quality of service to the user, IT Division uses helpdesk information system based on a ticket system. Any User Repair / Request Advice will be provided with a unique ticket number that can be used to monitor progress and follow-up provided online. IT Division delivers complete archives and history of all User Repair / Suggestions. Submitted forms on hours and days of work will be responded to promptly on the hours of the working day, while forms submitted outside of these hours will be handled at the earliest on the next business day. IT Helpdesk guarantees maximum problem resolution within 48 hours or 2 days from the time of the complaint. Not only fast, but improvements made by the IT team are also accurate and effective according to the problems experienced by users. For complaints that related to other units, IT Division will give it to another unit. Complaints are also documented in regular reports per month.

Maintenance that has been done tends to improve if there is something problematic. Maintenance is done based on the unit request. Examples of maintenance were done when the server down, then identified the cause because it turns out quite a lot of users. The solution was to replace or add the server. If there was damage to the goods and must be replaced or add new, it was not the responsibility of IT Division, but the procurement part.

4) *Future Orientation*

For Future Orientation perspective, there are some KPIs such as Training Budget for IT Personnel, IT Personnel Perspective, Budget for Research and IT Development, and IT Product Innovation. IT Personnel Expertise is good because IT personnel followed rigorous selection before they accepted to work and they always get training

routinely. The conducted training for IT Personnel is done sufficiently as it is targeted and as it is required. Training budget is affordable by the provided budget at SIKEU.

IT Division's staff are spread in every faculty and library to help and support IT in every unit in UAJY. What remains an obstacle is the lack of staff.

Innovation and development are always pursued by IT Division, and its budget comes from the research budget of LPPM (Research unit in UAJY). The innovation of IT products still exists and begins with informal research using the latest technologies.

From justification above, can be sorted out several aspects from four IT BSC Perspectives that need to be improved to form recommendation to management. Aspects that need to be improved such as calculation about benefits and profits of IT implementation, users' complaints about system's bugs., users that comfortable with old systems so that they do not want to use new systems, the use of new technology that considered expensive, and the lack of IT staff. Beside drawbacks above, there are some aspects that have done well such as good IT cost control, consistency to use new technology, consistency to make sure product's quality, and effective and fast user complaints handling.

In the next section, managerial implication is constructed based on the above drawbacks and what have been done well in IT Implementation in UAJY. Managerial implication contributes recommendations to management for highlighted aspects explained before.

V. MANAGERIAL IMPLICATION

From the findings for each of the perspectives, then it is known things need to be improved and maintained in the implementation of UAJY's IT infrastructure governance. Things that need to be maintained include:

1) *IT Cost Control*

IT cost control has been done very well using SIKEU. All expenses for IT division and even all units in UAJY have been registered and used by the budget listed on SIKEU. Good cost control will make the effectiveness of budgetary usage thereby reducing the possibility of wasted costs that should be allocated to more productive things. Some recommendation for cost control system (SIKEU) are:

- a. Evaluate the use of SIKEU regularly either by spreading questionnaires or by interviewing some random users.
- b. Perform technical improvements by user's complaints
- c. The addition of automatic data input feature with import excel or csv file so that user can enter some data at once with the provided format.

2) *The use of new technology*

IT Division always tries to use new technology in every developed product. Recommendation for this usage are:

- a. Before using new technology, it must be ensured in advance that the technology can truly support and contribute more value on the built services, so the technology used can be beneficial and not just a waste of money.
- b. The use of new technology should be accompanied by regular training of staff related to the new technology to be used.

3) *Quality products*

IT Division always strive to create quality IT products and services. Recommendations of product quality include

- a. Retaining user involvement in every phase of information system development. User involvement is critical to maintaining the quality of a product especially when the product has been launched and used by users in general.
- b. Always make improvements according to user input. Feedback from users during product creation will minimize the possibility of complaints and changes as well as add functionality when the product is launched.

4) *Effective and fast user complaints handling*

Besides the good things that need to be maintained above, there are some things that should be taken into consideration, i.e.:

1) *The indicator has not established for strategic plan especially Improving supporting facilities of Technology-Based Learning Activities.*

Some recommendations are:

- a. Should be created an indicator of success for the strategic plan of the improvement of technology-based learning support facilities to spur and become the motivation to achieve the target.
- b. Indicator created can be used to facilitate evaluation because the evaluation points have been identified. This indicator can make management know things that are lacking and need to be improved or upgraded from a strategic plan.

2) *Calculation of the benefits and profits of IT implementation in UAJY has never been done.*

Some recommendations are:

- a. Benefit and profit calculations should be created to measure the success of IT implementation. The results of the calculations can be used to determine the achievement in the short, medium, or long term.
- b. Calculation result could be used to determine the steps and strategies to be taken whether it is in line with the goals and vision and mission of IT Division.

3) *The technology used by IT Division is still relatively new, so it feels quite expensive.*

In the use of new technology, the most important thing is to ensure maximal perceived benefits. Some recommendations are:

- a. Before deciding the use expensive technology, consideration should be given to the advantages and disadvantages of using the technology. Should be considered if the price of the implementation of the technology is high but the benefits are good for institutional progress,
- b. Making price comparisons from some suppliers of the technology to be used. Choose a supplier or vendor that provides the best price and warranty.
- c. Should be given understanding to other parties authorized for monitoring/controlling the budget to understand that the implementation of the new technology will indeed contribute and bring positive impact to the institutional progress.

4) *Some users are reluctant to switch to the new system because they are comfortable with the old system.*

The key to successful application utilization apart from product quality is also found in the successful socialization of its use. Recommendation to this aspect is:

- a. To convince and encourage every user such as staff, lecturers, and students is required exemplary and influence from the leader. Leaders must be able to give a strong influence so that all parties under it are also encouraged to use information systems developed by the IT division.

5) *Lack of IT staff.*

Related to the lack of staff at IT Division, there are several recommendations:

- a. It is expected to ensure the number of staff by the needs of IT Division both with proper division of tasks so that there is no overlap, or with recruitment.
- b. For recruitment can be done by requesting the HR Division to be able to prioritize hiring for IT staff so that they can immediately obtain staff without reducing the process of recruitment itself.

The above recommendations were made in accordance with what is need to be improved (drawbacks) and what is need to be maintained (good things) known from points obtained for each KPI in each IT BSC perspective justified with interview result. Recommendations were constructed in detail and adjusted with highlighted drawbacks and positive things found in IT BSC result. Recommendations would be managerial implication for IT Infrastructure governance in private higher education.

It is required awareness from various parties to the implementation of IT in UAJY. Not only the IT division alone improves itself, but must also be accompanied from the awareness of other related units and which used systems from the IT division.

VI. CONCLUSION

The governance of IT infrastructure in UAJY has been analyzed using IT Balanced Scorecard. This research resulted in several points obtained for each KPI in each IT BSC perspective. From these points could be broken down which KPI is good and bad. Next process was justifying and analyzing each KPI result with interview with IT Division. From the results of the analysis found some things that need to be maintained and upgraded from IT Infrastructure governance in UAJY. The overall result of IT Balanced Scorecard for IT governance in UAJY is good with 66% value. Some things that need to be maintained and improved based on the result of Balanced Score Card analysis, such as IT Cost Control, The use of new technology, Quality products, User engagement in app development, and effective and fast user complaint handlings. Other than that, things to note such as Indicator has not established for strategic plan especially Improving supporting facilities of Technology-Based Learning Activities; Calculation of the benefits and profits of IT implementation in UAJY has never been done; Technology used by IT Division is still relatively new, so it feels quite expensive; and some users are reluctant to switch to the new system because they are comfortable with the old system.

ACKNOWLEDGMENT

This research was supported by Lembaga Penelitian dan

Pengabdian Masyarakat (LPPM) Universitas Atma Jaya Yogyakarta.

REFERENCES

- [1] L. Aversano, C. Grasso, and M. Tortorella, "Managing the alignment between business processes and software systems," *Inf. Softw. Technol.*, vol. 72, pp. 171–188, 2016.
- [2] S. Charoensuk, W. Wongsurawat, and D. B. Khang, "Business-IT Alignment: A practical research approach," *J. High Technol. Manag. Res.*, vol. 25, no. 2, pp. 132–147, 2014.
- [3] S. Mitić, M. Nikolić, J. Jankov, J. Vukonjanski, and E. Terek, "The impact of information technologies on communication satisfaction and organizational learning in companies in Serbia," *Comput. Human Behav.*, vol. 76, pp. 87–101, 2017.
- [4] F. Hamidi, M. Meshkat, M. Rezaee, and M. Jafari, "Information technology in education," in *Procedia Computer Science*, 2011, vol. 3, pp. 369–373.
- [5] A. Mitra, C. Sharma, and M.-A. Véganzonès-Varoudakis, "Infrastructure, information & communication technology and firms' productive performance of the Indian manufacturing," *J. Policy Model.*, vol. 38, no. 2, pp. 353–371, 2016.
- [6] C. Sife, A.S.;Lwoga, E.T; Sanga, "New technologies for teaching and learning: Challenges for higher learning institutions in developing countries," *Int. J. Educ. Dev. using ICT*, vol. 3, no. 2, 2007.
- [7] W. Van Grembergen, R. Saull, and S. De Haes, "Linking the IT Balanced Scorecard to the Business Objectives at a Major Canadian Financial group," *J. Inf. Technol. Case Appl. Res.*, vol. 5, no. 1, pp. 23–50, 2003.
- [8] J. Keyes, *Implementing the it balanced scorecard, aligning it with corporate strategy*. 2005.
- [9] ISACA, "CoBIT 4.1," *IT Gov. Inst.*, pp. 1–29, 2007.
- [10] W. Van Grembergen and S. De Haes, "Measuring and Improving IT Governance Through the Balanced Scorecard," *Inf. Syst. Control J.*, vol. 2, no. 1, pp. 34–42, 2005.
- [11] S. Hamid, Y. M. Leen, and S. H. Pei, "Measuring the performance and excellence of academicians through the e-Balanced Scorecard (e-BSC)," in *Information Management in the Modern Organizations: Trends and Solutions - Proceedings of the 9th International Business Information Management Association Conference*, 2008, vol. 1–2, pp. 713–717.
- [12] A. Zangouinezhad and A. Moshabaki, "Measuring university performance using a knowledge- based balanced scorecard," *Int. J. Product. Perform. Manag.*, vol. 60, no. 8, pp. 824–843, 2011.
- [13] R. S. Kaplan and D. P. Norton, "The balanced scorecard: Measures That drive performance," *Harvard Business Review*, vol. 83, no. 7–8, 2005.
- [14] M. Fooladvand, M. H. Yarmohammadian, and S. Shahtalebi, "The Application Strategic Planning and Balance Scorecard Modelling in Enhance of Higher Education," *Procedia - Soc. Behav. Sci.*, vol. 186, pp. 950–954, 2015.
- [15] C. Papenhausen and W. Einstein, "Implementing the Balanced Scorecard at a college of business," *Meas. Bus. Excell.*, vol. 10, no. 3, pp. 15–22, 2006.
- [16] M. Hladchenko, "Balanced Scorecard – a strategic management system of the higher education institution," *Int. J. Educ. Manag.*, vol. 29, no. 2, pp. 167–176, 2015.
- [17] S. P. Philbin, "Design and implementation of the Balanced Scorecard at a university institute," *Meas. Bus. Excell.*, vol. 15, no. 3, pp. 34–45, 2011.
- [18] H. Tohidi, A. Jafari, and A. A. Afshar, "Using balanced scorecard in educational organizations," in *Procedia - Social and Behavioral Sciences*, 2010, vol. 2, no. 2, pp. 5544–5548.
- [19] R. Alit and F. P. Aditiyawan, "Pengukuran Kinerja Organisasi Teknologi Informasi Menggunakan It Balanced Scorecard (Studi Kasus : Universitas Pembangunan Nasional ' Veteran ' Jawa Timur)," *SCAN - J. Teknol. Inf. DAN Komun.*, vol. XI, no. 3, 2016.
- [20] C. Charoenngam and E. Sriprasert, "Assessment of Cost Control System: A Case Study of Thai Construction Organizations," *Eng. Constr. Archit. Manag.*, vol. 8, no. 5/6, pp. 368–380, 2001.
- [21] N.-S. Reynolds, "Making sense of new technology during organisational change," *New Technol. Work Employ.*, vol. 30, no. 2, pp. 145–157, 2015.