DESIGN OF DEPARTMENT PERFORMANCE EFFICIENCY MEASUREMENT AT HIGHER EDUCATION WITH INTEGRATION OF BALANCED SCORECARD (BSC) AND DATA ENVELOPMENT ANALYSIS (DEA) APPROACH

Taufiqurrahman[1], Yadrifil[2], T. Yuri M. Zagloel[3]
Department of Industrial Engineering, Faculty of Engineering, University of Indonesia
Kampus Baru UI Depok, 16424, Indonesia
taufiqurrahman_s2tiui@yahoo.com

Abstract

This research discusses the design of department performance efficiency measurement at higher education. Performance measurement is generally a basis for decision making should reflect information such as efficiency, effectiveness and productivity. In this study the set of input and output, grouped by the perspective of the Balanced Scorecard (BSC). By using Data Envelopment Analysis (DEA), the relative efficiency of the department can be known. Totaly there are 5 input and 9 output that become parameters for measuring performance of department in higher education. Based on the BSC perspectives, financial get 2 inputs-2 outputs, internal business process get 1 input-2 output, customer get 1 input-3 output, finally, learning and growth get 1 input-2 output.

Keywords*: Balanced Scorecard, Data Envelopment Analysis, Performance Measurement*

Introduction

Higher education is an organization that creates a complex result of using several resources. Higher education require continuous monitoring and evaluation in order to remain competitive in the educational arena. According to "pasal 20 ayat (2) Undang-Undang Nomor 20 Tahun 2003", the higer education is obliged to provide education, research, and community service. Therefore as part of the higher education, department at higher education do also obliged to implement it, known as "Tridharma Perguruan Tinggi". To be able to competitive and maintain its existence, a higher education should be able to plan and implement appropriate management strategies adapted to vision and mission that has been set. This effort can be performed by measuring the overall performance of higher education so it will know the overall condition of implementation of "Tridharma Perguruan Tinggi" productivity.

Assessment of productivity in the organization is very important. In fact, the main factor productivity include: efficiency and effectiveness. Therefore, in order to assess productivity, organizations must control these two parameters. To measure effectiveness, the Balanced Scorecard (BSC) was introduced as a new performance evaluation method, which is an approach to achieve the strategy. As for measuring the efficiency of the method of Data Envelopment Analysis (DEA) that attempts to maximize efficiency by taking consideration of the input and output. So the factor of productivity (effectiveness and efficiency) can be measured by combining the two models simultaneously [7].

Research Methods

Definition of Performance Measurement

Performance measurement can be interpreted as a process of assessment of progress achieved in order to achieve company targets included an assessment of resource efficiency in products and services, quality of the firm's output and effectiveness of the organization in order to achieve organizational goals [1]. From the definition of some literature, Yuwono et.al (2004, p.23) concludes that performance measurement is the act of measurement conducted on various activities within the value chain that existed at the company. The measurement results then used as feedback that will provide information about the achievements of the implementation of a proposed and the point where companies require adjustments for activity planning and control [13].

Performance measurement is generally a basis for decision making should reflect information such as efficiency, effectiveness and productivity. Efficiency is defined as an effort to achieve as much as possible by using the possibilities available within a relatively short period, without interfere the balance between factors of goals, tools, manpower and time. Effectiveness is a measurement of the level of output achieved based on productivity, clearly seen is the level of the results obtained based on the size of the productivity (in a certain time range). In describing the differences in effectiveness and efficiency as follows [8]:

- Effectiveness is *doing the ''RIGHT'' thing*
- Efficiency is *doing the ''THING'' right*

Department Performance Efficiency Measurement at Higer Education

Department at higer education is the integrated study plan as a guideline for education of academic and/or professionally organized on the basis of a curriculum and is intended to allow students to master the knowledge, skills and attitudes in accordance with curriculum objectives [23]. In practice, Department was in higher education which is the educational unit that organized higher education is an education on the education track at a higher level than secondary education in the treck of school education [22]. Also explained, that higher education is an education after secondary education which includes educational programs diploma, undergraduate, masters, specialist, and doctoral degrees organized by educational institution. Higher education is obliged to provide education, research, and community service [24]. Therefore as part of the higher education, study programs do also obliged to implement it, known as "Tridharma Perguruan Tinggi".

In general, educational institutions are evaluated for academic activities, and administrative and financial activities. In addition, the study programs do also must have internal performance measurement is performed to (1) ensure the ability to meet and/or exceeds national education standards, (2) adjusting the organization's mission and vision statements, and (3) ensure continuous improvement of students, academic personnel and administration. Internal assessment process includes a broad picture of performance criteria such as curriculum development and revision, contribution to the literature, the profile of gender/ethnicity, budget allocation, and development of students and personnel. Therefore, several factors are tangible or intangible in the environment should be considered during the internal review, thus creating a complex problem for the evaluator/decision-makers [12].

Balanced Scorecard (BSC)

This approach was first introduced by Kaplan and Norton in the early 1990s. Since then, this concept has been widely used in business as a tool to implement business strategies and has become the focus of many research efforts. BSC combines two indicators of financial performance and non-financial in one report and aims to provide managers with information that more rich and more relevant information about the activities they manage than that provided by financial measures alone. In addition Kaplan and Norton suggested that the number of actions on the balanced scorecard should also be limited in number and grouped into four groups, namely[12]:

- Financial perspective, concentrates on achieving financial success while delivering value for shareholders.
- Internal business process perspective, concentrating on meeting the demands of customers and shareholders by achieving productivity and efficiency in work flow.
- Customer perspective, concentrating on achieving the mission statement and provide value to customers.
- Learning and growth perspective, concentrating on obtaining continuous improvement through innovation and learning goals.

Data Envelopment Analysis (DEA)

Another technique for measuring performance is Data Envelopment Analysis (DEA) that attempts to maximize efficiency by taking consideration of the input and output. DEA is a mathematical programming technique that calculates the relative efficiency of multiple Decision Making Units (DMUs) on the basis of inputs and outputs are observed, which can be expressed by various types of metrics. DEA is very useful in evaluating multi-criteria system and provide system improvement targets as stated in many applications were reported [7]. DEA is a non-parametric approach that compares the same entity, such as DMU, against the best virtual DMU. DEA is usually modeled as a linear programming model (LP) which gives the relative efficiency score for each DMU. The most attractive advantage of DEA is not a parametric approach such as regression analysis (RA), that the DEA optimizes each individual observation and does not require a single function that best fits all the observations [12]. Parametric approach assumes a functional form for the production frontier. Score for the parametric approach is the absolute efficiency for parametric production frontier is a real border. There is always the possibility of error specification of a functional form in the parametric production frontier. Researchers consider it one of the potential weaknesses of the parametric approach. While non-parametric approach, dealing with mathematical programming, rather than functional form. To calculate the efficiency, data points compared with each other. As a result, non-parametric approach to generate the relative efficiency [6].

DMU sample selection should consider the number of DMU itself. In principle the determination of the amount used DMU should

consider a variable number of inputs and outputs are used in order to obtain results sufficiently discriminatory to be able to compare the efficiency of each DMU and also to investigate the production surface of the production function used in the model [2]. To determine the number of DMU should follow the formula as follows [6]:

$$n \geq max\ m \times s, 3(m+s) \quad (1)$$

where:
n = number of DMU ; m = number of input ; s = number of output

In the use of DEA models are known the orientation of the input minimization and output maximization. The model which oriented to the input minimization (outputs oriented) trying to see the extent to which inputs can be reduced while maintaining output levels. Instead the model which oriented to the outputs maximization (input oriented) trying to see the extent to which outputs can be increased while maintaining the level of input. In addition to the selection of the orientation of the model, other things to consider in analyzing the results of DEA are the characteristics of return-to-scale operations that reflect the DMU in a sample. In a homogeneous sample though, some DMU may operate on constant returns scale/CRS or called CCR model, while others may operate on a variables return scale/VRS or called BCC model. CRS means that outputs increases proportionally with the addition of the input or in other words, the scale of operation does not affect the efficiency of the working unit. While the VRS means the output will increase or decrease disproportionately with increasing inputs. That means accordance with the growth of a working units, their efficiency will decrease or increase. CRS has been a common assumption used in the literature until the late 1980's, while the assumption of VRS began to develop after being introduced by Banker et al. (1984) [2].

DEA CCR model is the most basic model of the concept of DEA. With this model a DMU is possible to adopt a set of weights that will maximize its relative efficiency ratio without exceeding the same ratio of other DMU. Equation (2) is a linear program of the CCR model with the assumption of outputs maximization (input oriented). To prevent the elimination of mathematically from an output or an input due to the repetitive calculation of the efficiency, then the weights u and v should not be smaller than a small number of positive non-Archimedian (ε).

$$\begin{aligned} Maks: h_o &= \sum_{r=1}^{s} u_r y_{ro} \\ s.t.: &\sum_{i=1}^{m} v_i x_{io} = 1 \\ &\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0 \\ &u_r ; v_i \geq \varepsilon \end{aligned} \quad (2)$$

Every linear programming problem, have other linear programming model which are closely related with the above primal model, called the dual. To formulate the dual problem, is used the variable θ as a variable which is the dual equality constraints who is the result of the normalization of the total weight of the inputs. The variable λ is the dual variable which is the inequality constraints of the primal. Equation (3) used to find the optimal outputs (outputs maximization) with a minimum input-oriented (input oriented).

$$\begin{aligned} Min: &\ \theta_m \\ s.t.: &\sum_{n=1}^{N} \lambda_n y_{jn} \geq y_{jm} \\ &\sum_{n=1}^{N} \lambda_n x_{in} \leq \theta_m x_{im} \\ &\lambda_n \geq 0 \\ &\theta_m \text{ (bebas) tidak terbatas} \end{aligned} \quad (3)$$

Previous studies that use DEA in higher education among others Vessal, Ahmad (2007) which uses the output oriented BCC model to calculate the efficiency of several universities in the U.S. [21]. Martin, Emilio (2003) use the input oriented BCC model to calculate the efficiency of the department at the University of Zaragoza [14]. Sitompul, Carles (2004) evaluated the performance of existing majors at one university by using the input-oriented CCR model [20]. Bobe, Belete (2009), evaluating the efficiency of faculty in universities located in regional Victoria, Australia by using the input-oriented CCR model [5]. Baysal, et al (2010), calculate the efficiency performance of 47 universities in Turkey by using the BCC output oriented model [4]. Nazarko, Joanicjusz (2010) compared the efficiency of 19 engineering university in Poland by using the CCR output oriented model [16]. Paul Lau Ngee Kiong, et al, comparing the efficiency of high school in Malaysia using the output-oriented BCC model [18]. Fathi, et al, counting efficiency of 22 branch of Islamic Azad University in the 5 region using the input-oriented CCR model and BCC output oriented [9].

According to Amin (2010), the concept of Super-Efficiency is an extension DEA model was first proposed by Andersen & Petersen (1993). This concept is supported by the simplicity and benefits. By using this concept, it is possible to rank each DMU, even an efficient DMU. In the DEA-CCR model and DEA-BCC model, an efficient DMU rated the same that has achieved the highest efficiency with a value of 1 or 100%. The idea of super-efficiency concept is to let the DMU were observed over than 1 or 100%. In calculations the concept of Super-Efficiency applied to a DEA-CCR mathematical model of Primal and Dual. This is achieved by eliminating the restrictions of a series of constraints related to DMU will be counted the Super-Efficiencies.

Intergration of BSC-DEA

In the integration model of BSC-DEA, inputs and outputs are grouped according to the BSC perspectives. The proposed model is based on the DEA, which quantifies the concept of the BSC approach. The facts related to the advantages and disadvantages of the BSC and DEA, among others [3]:

- DEA has input and output, but the BSC has received a multi-perspective evaluation.
- In the DEA technique, there is no view of the future, but BSC focuses on display in the future based on the financial perspective is the result of past performance and the three perspectives of growth and learning, internal processes and customers.
- DEA technique does not apply the strategy of the organization while using the BSC method for decision-making strategy of the organization.
- More difficult to analyze each index involved in the BSC while the DEA to analyze the results more easily.

According to Cooper (1999), the integration of BSC-DEA model to try to achieve [17]:

- Achieving strategic objectives (purpose of effectiveness)
- Optimise use of resources to produce the desired output (purpose of efficiencies)
- The balance between different aspects of the organization (purpose of balance)
- Get the causal relationships in perspective

There are four main reasons that indicate the need for integration of BSC-DEA method, that is [17]:

- One of the challenges in the BSC is a performance measure should have a base or benchmark. Assessment is impossible without a foundation or benchmark. Because DEA is based on the relative comparison of the DMU being evaluated against each other. By combining the BSC by the DEA can known the important challenges of the BSC, was the need to establish a baseline and reference (Eilat et al, 2008).
- BSC has no mathematical model or weighting schemes. Therefore, it is difficult to make comparisons within and between organizations. DEA efficiencies frontier can be used to calculate efficiencies DMU. Slack can be used as an organizational inefficiencies in the BSC.
- BSC confronts managers with very complex optimization problems because the BSC has the complexity and inter-related indicators. This complexity also increases a number of variable magnitude.
- Lack of a common scale of measurement lead to more complexity. Fortunately, the DEA can help us to face the complexity of this kind. (Rickards, 2007)

Eilat & Golani (2008) studied the BSC to the DEA model through the constraints of balance. DEA technique is different from traditional weight restrictions that limit the flexibility of heavy weights that are considered essential and inherent in the action. They apply their methods to the hierarchical structure of the balance sheet. Furthermore, Changsu-Chao et al (2005) have applied DEA to the BSC to measure performance efficiency hotels in Taiwan and Vietnam [17].

Research that addresses the integration of BSC-DEA for higher education is Woun Jong-Youn, Kwangtae Park (2009) produces four models of development for university reform in Korea by using the BSC analyzed DEA [11]. In addition Kongar, Pallis, & Sobh (2010) compared the performance of each department in the School of Engineering at the University of Bridgeport by making four independent DEA models proposed in accordance with the perspective of the BSC approach. A simple schematic of the model proposed by can be seen in Figure 1 and Figure 2 [12].

Results and Discussion

In this study, the object to be used as a DMU is a under-graduated program department (strata 1/S1) at one of the university in Jakarta. The next stage is to determine the input and output variables that customized to the type of the DMU. In the integrated BSC-DEA model, the inputs and outputs are chosen must take into consideration four major perspectives BSC. The selection model of this research adapted Kongar, et al (2010) [12] by

making some adjustments to the conditions of the university and the data obtained related department (DMU) is concerned. Table 1 is a variable input and output used in this study.

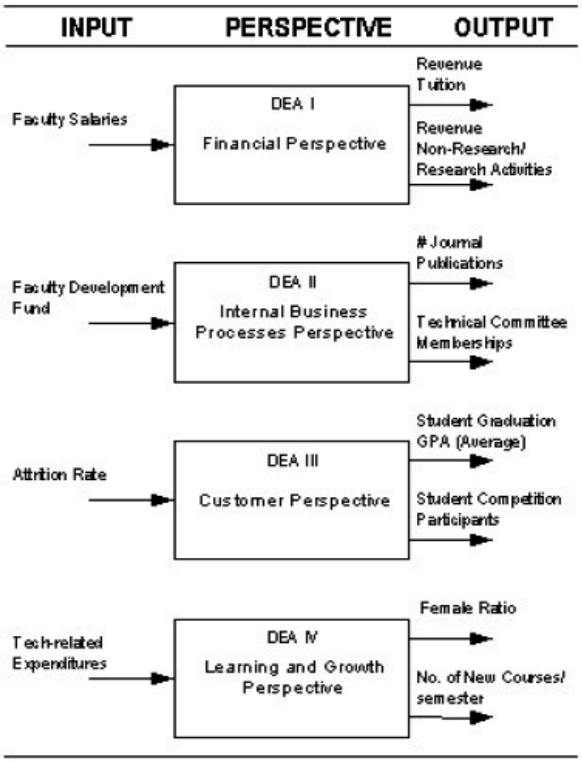

Figure 1. Simple Scheme Proposed Model (Set a) [12]

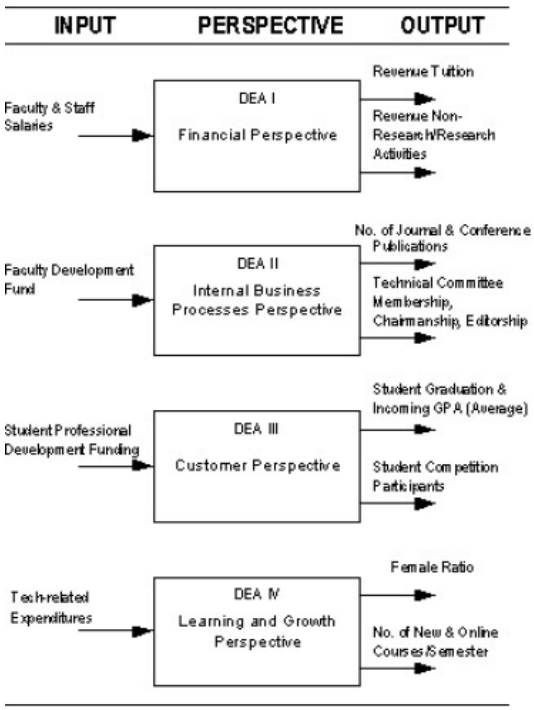

Figure 2. Simple Scheme Proposed Model (Set b) [12]

Table 1
Inputs-Outputs Variable of Integrated BSC-DEA Model

Perspective Code	Inputs	Outputs
F	• Cost of employee • # employee	• Revenue from the students • Revenue form other sources
I	• Cost of operational	• # of research • # of community service
C	• % retention	• # current student • # graduated • Student graduation GPA (IPK)
L	• Cost of development and maintenance	• PPDP • ILBD

In the financial perspective (the perspective code: F), input variable set consists of: Costs of employee are the funds spent to pay the salaries of permanent employees (lecturer and staff administration) for any department that are accumulated during one semester and #Employee is the number of employees remains good lecturers and administrative staff to the department. While the output variables specified in this perspective consists of: revenue from the students, which funds received by a course of tuition students every semester and revenue form other sources, the funds received by the program of study beyond tuition, such as research activities and community service performed by employees each semester form the department, cooperative activities carried out by the department, the funding activities of the course by the Foundation, etc.. For the input variables in the internal business process perspective (the perspective of the code: I) is: cost of operational, which is the amount spent for the smooth functioning of department, such as: lecturer salaries, office stationery, the cost of research and community service, etc.. While the output for this perspective consists of: #of research, is the amount of research done in the name of the department and recorded in the Institute for Research and Community Service (LPPM), and #of community service, is the number of community service

performed on behalf of the department and recorded in the Institution Research and Community Service (LPPM). Variable Input in the customer's perspective (perspective code: C) as follows: %retention, the ratio of the number of current (active) students with students enrolled in units of percent. While the outputs set out in this perspective consists of: #current students, is the number of students registering to attend classes, #of graduates is the number of students who have been declared completed follow the study in accordance with applicable regulations, and Student Graduation GPA (IPK), the average grade point of graduates. Input selected in the learning and growth perspective (perspective code: L), is the costs of development and maintenance, which funds expended improvement and maintenance of resources owned by a department, such as: the cost of further studies, the cost of training/seminars, lab maintenance costs/office equipment, etc.. While output in this perspective consists of: PPDP, the average percentage use of learning support is a survey of the class population to determine the extent to which teachers use in class mulimedia facilities and the availability of lecture materials, as well as ILBD, which is an average index of background form lecturer who is the calculation of educational backgrounds and ranks held by the department. From the 14 department (DMU), is selected only 13 DMU is used, because there is one of the DMU doesn't have value on the output variables ie: #Graduated and Student Graduation GPA (IPK). In addition to the calculations used input oriented CCR model which assumes the input-oriented or output maximization and constant returns scale (CRS/CCR model). It is based on consideration of the university who prefer the increased output. Results of output maximization may be recommended to increase output as well as the reduction of inputs at the same time. Because some variables are financial data who very limited permit its use, therefore the period of data used is the data evaluation of department during the Academic Year (T.A) Ganjil 2009/2010 (2009-1) to Genap 2009/2010 (2009-2). Based on equation (1) minimum number of DMU for each perspective can be calculated, the results are presented in Table 2.

Table 2
Minimum Number of DMU

Perspective Code	Number of Inputs	Number of Outputs	Minimum DMU
F	2	2	12
I	1	2	9
C	1	3	12
L	1	2	9

From these results, it can be concluded that the number of DMU set to be included in the calculation, amounting to 13 DMU has met the requirements because if seen from each perspective in Table 2, the minimum number of DMU of the largest is 12 DMU.

From the results of the optimization of integrated BSC-DEA model for each department (DMU) with the help of Efficiency Measurement System version 1.3 software, can be obtained the following results:

- The relative efficiency of each department (DMU) based on the perspective of the BSC as shown in Table 3 for T.A 2009-1 and Table 4 for T.A 2009-2.
- The weighting for each criteria based on the perspective of the BSC, which aims to identify which variable to be the largest contributors in each DMU (departments). The weights can be determined from the model results are completed with the help of EMS software version 1.3 using the values listed in the column marked with {W}. Weighting value is the value of the variable you are looking for the solution to the DEA primal model.
- The intensity and the benchmark for an inefficient department based on the BSC perspectives. This value is the value of the variable resulting from the dual model.
- The value of slack for inefficient study programs based on the BSC perspectives. Describing the amount of output must be increased and/or the number of inputs that have to be reduced by an inefficient DMU to be classified as an efficient DMU. Slack values can be determined from the results of the optimization model solved with the help of EMS software version 1.3 by looking at the fields marked with {S}.

While with the BSC-DEA Super Efficiency model can be created rank is based on the DMU efficiency value. The results of the BSC-DEA Super Efficiency model is similar to the results of the BSC-DEA model, the difference lies only in the DMU that has a efficiency value of 100% in DEA-BSC model will change the value if it is done processing efficiency by BSC-DEA Super Efficiency model, whereas the relative efficiencies value for DMU of less than 100% will remain the same. Super-efficiency value and ranking of the DMU can be seen in Table 5 for T.A 2009-1 and Table 6 for T.A 2009-2.

Table 3
Efficiency Value of BSC-DEA Model for T.A 2009-1

DMU	Perspective Code	
	F	I
11	50,627765%	32,625075%
12	61,328099%	22,744604%
21	37,233090%	69,849736%
22	100,000000%	98,798609%
24	46,329541%	100,000000%
25	78,780452%	57,832860%
31	54,743116%	32,961322%
32	84,898172%	65,995506%
41	53,597826%	21,433105%
51	100,000000%	20,252972%
71	53,129546%	44,694689%
81	76,344084%	19,467234%
83	100,000000%	21,768237%
DMU	**Perspective Code**	
	C	**L**
11	92,266525%	45,450979%
12	92,266525%	39,585741%
21	25,102203%	70,160788%
22	42,849730%	81,124083%
24	94,689265%	100,000000%
25	25,102203%	73,877510%
31	100,000000%	45,506190%
32	100,000000%	72,869407%
41	55,346615%	34,891789%
51	67,847504%	18,190620%
71	41,529580%	53,906295%
81	56,050659%	35,812730%
83	56,050659%	70,991150%

Table 4
Efficiency Value of BSC-DEA Model for T.A 2009-2

DMU	Perspective Code	
	F	I
11	41,712247%	38,655702%
12	58,139227%	19,726968%
21	33,256943%	57,381717%
22	100,000000%	43,118384%
24	28,906110%	100,000000%
25	73,106749%	51,015187%
31	64,751473%	19,723406%
32	83,706195%	49,686892%
41	55,839072%	26,214051%
51	100,000000%	16,481277%
71	49,443432%	33,065762%
81	69,342988%	20,482765%
83	100,000000%	11,719942%
DMU	**Perspective Code**	
	C	**L**
11	82,229870%	51,674312%
12	82,229870%	43,837158%
21	46,450468%	76,250156%
22	37,656532%	85,320506%
24	100,000000%	100,000000%
25	25,598641%	70,333396%
31	100,000000%	43,502685%
32	100,000000%	81,442899%
41	47,711025%	35,770452%
51	64,757510%	21,043478%
71	42,652531%	56,284712%
81	52,174073%	39,208775%
83	52,174073%	82,123944%

Table 5
Efficiency Value and Rank of DMU for T.A 2009-1

DMU	*Financial*		*Internal Business Process*	
	Score	**Rank**	**Score**	**Rank**
11	50,627765%	11	32,625075%	8
12	61,328099%	7	22,744604%	9
21	37,233090%	13	69,849736%	3
22	109,682008%	3	98,798609%	2
24	46,329541%	12	252,542446%	1
25	78,780452%	5	57,832860%	5
31	54,743116%	8	32,961322%	7
32	84,898172%	4	65,995506%	4
41	53,597826%	9	21,433105%	11
51	157,989736%	1	20,252972%	12
71	53,129546%	10	44,694689%	6
81	76,344084%	6	19,467234%	13
83	128,761033%	2	21,768237%	10
DMU	***Customer***		***Learning and Growth***	
	Score	**Rank**	**Score**	**Rank**
11	92,266525%	4	45,450979%	9
12	92,266525%	5	39,585741%	10
21	29,321772%	13	70,160788%	6
22	43,877284%	10	81,124083%	2
24	114,486399%	2	123,279222%	1
25	29,713082%	12	73,877510%	3
31	99,999996%	3	45,506190%	8
32	203,393840%	1	72,869407%	4
41	55,346614%	9	34,891789%	12
51	67,847510%	6	18,190620%	13
71	41,529580%	11	53,906295%	7
81	56,050659%	8	35,812730%	11
83	56,050659%	7	70,991150%	5

Table 6
Efficiency Value and Rank of DMU for T.A 2009-2

DMU	*Financial*		*Internal Business Process*	
	Score	**Rank**	**Score**	**Rank**
11	41,712247%	11	38,655702%	6
12	58,139227%	8	19,726968%	10
21	33,256943%	12	57,381717%	2
22	124,351882%	2	43,118384%	5
24	28,906110%	13	217,625066%	1
25	73,106749%	5	51,015187%	3
31	64,751473%	7	19,723406%	11
32	83,706195%	4	49,686892%	4
41	55,839072%	9	26,214051%	8
51	172,014758%	1	16,481277%	12
71	49,443432%	10	33,065762%	7
81	69,342988%	6	20,482765%	9
83	116,832769%	3	11,719942%	13

DMU	*Customer*		*Learning and Growth*	
	Score	**Rank**	**Score**	**Rank**
11	82,229877%	5	51,674312%	8
12	82,229872%	4	43,837158%	9
21	46,568194%	10	76,250156%	5
22	43,232643%	11	85,320506%	2
24	107,170252%	2	136,348321%	1
25	25,598642%	13	70,333396%	6
31	104,733727%	3	43,502685%	10
32	155,166321%	1	81,442899%	4
41	47,711025%	9	35,770452%	12
51	64,757512%	6	21,043478%	13
71	42,652534%	12	56,284712%	7
81	52,174073%	8	39,208775%	11
83	52,174073%	7	82,123944%	3

From Tables 3 and 4, it can be concluded that each DMU is possible to have higher relatively efficiency values in one perspective, but lower in other perspectives. It can be used as the basis for improvement targets. Based on these tables can be made analysis of the strategies of each perspective, namely:

- Financial perspective, it is known that the average DMU efficiency has a value of less than optimal performance. From the slack of the input variable, this means wasteful by the DMU, but due to the orientation of the inputs used in this model is to maximize the output by the number of fixed inputs then that strategy can be made to the financial perspective of increasing the amount of revenue from other sources.
- Internal business process perspective, it is known that the average DMU efficiency has a value of less than optimal performance. For this perspective there is no slack in the input variable value, so it can be said there is no wastage by DMU in this perspective. Of the slack value, the priority strategies that can be done to the internal business process perspective of increasing the number of community service, because the average DMU has the largest slack value on this variable, although there is DMU which has a value of slack in the amount of research but the average value is relatively small.
- Customer perspective, it is known that the average DMU efficiency has a value of less than optimal performance. For this perspective there is no slack in the input variable value is the percentage of retention, so it can be said there is no wastage by DMU in this perspective. Strategies that can be done to the customer's perspective of increasing the number of current (active) students and the number of graduates, because the average DMU in this variable has the largest slack value, although there is a DMU which has a slack value on an average studen graduates GPA (IPK) but the average value is relatively small .
- Learning and growth perspective, it is known that the average DMU efficiency has a value of less than optimal performance. For this perspective there is no slack in the input variable value, so it can be said there is no wastage by DMU in this perspective. So that strategies can be made for learning and growth perspective of improving the value of the output variables consisting of the average PPDP and the average ILBD.

Conclusion

From the results of the design, produced five input variables and 9 output variables that will be the parameters in the measurement of the efficiency performance of the department, with details:

- Financial perspective consists of 2 inputs (costs of employees and the number of employees), and 2 outputs (revenue from student and revenue from other sources).
- Internal business process perspective consists of 1 input (cost of operational) and 2 outputs (number of research and the number of community service).
- Customer perspective consists of 1 input (percentage of retention) and 3 outputs (number

of current/active students, number of graduates and the average of student graduation GPA/IPK).

- Learning and growth perspective consists of 1 input (cost of development and maintenance) and 2 outputs (average PPDP and average ILBD).

From the applications of the design with the BSC-DEA model, is produced the relative efficiency value for each DMU (department) in each period in accordance with the BSC perspectives, and it is possible that DMU (department) that efficient, different in each perspective, such as:

- For the financial perspective: DMU22, DMU51, and DMU83 classified as an efficient DMU in T.A 2009-1 and 2009-2.
- For the internal business process perspective: only DMU24 classified as an efficient DMU in T.A 2009-1 and 2009-2.
- For the customer perspective: DMU31, and DMU32 classified as an efficient DMU in T.A 2009-1, whereas in T.A 2009-2 which is classified as an efficient DMU is the DMU 24, DMU 31 and DMU 32.
- For learning and growth perspective: only DMU24 has relative efficiency value of 100% in T.A 2009-1 and 2009-2.

From BSC- DEA Super-Efficiency model, the value can be determined the most efficient DMU and the first ranked according to each perspective, among others:

- DMU51 for the financial perspective in T.A 2009-1 and 2009-2.
- DMU24 for internal business process perspective and learning and growth perspective in T.A 2009-1 and 2009-2.
- DMU32 to perspective customers in T.A 2009-1 and 2009-2.

This study has several limitationsis the use of assumptions for determining returns to scale and subjective judgments the orientation of the model selection and the selection of input-output variables. Therefore, the use of statistical techniques is recommended for the next studies that established model has a strong base.

References

Abduh, Mukhamad. "Perancangan Balanced Scorecard Pada Instalasi Manajemen Informasi Kesehatan RS Persahabatan". Tesis. Program Studi Teknik Industri, Fakultas Teknik Universitas Indonesia. 2007

Achirulloh, Rachmad. "Evaluasi Kinerja Pemasok Dengan Mengkombinasikan Metode *Data Envelopment Analysis* (DEA) Dan Metode Pembobotan Nilai Yang Digunakan Pada PT. BMC". Departemen Teknik Industri, Fakultas Teknik, Universitas Indonesia. 2006

Aryanezhad, M B, et al. "A BSC-DEA Approach to Measure the Relative Efficiency of Service Industry: A Case Study of Banking Sector". International Journal of Industrial Engineering Computations, 1 (2010)

Baysal, Mehmet Emin. Toklu, Bilal. "An Efficiency Analysis in Higher Education System in Turkey. Performance Management and Measurement with Data Envelopment Analysis: Proceedings of the 8th International Conference of DEA. July 2010, Olayan School of Business, American University of Beirut, Lebanon. 2010

Bobe, Belete. (2009). "Evaluating The Efficiencies of University Faculties: Adjusted Data Envelopment Analysis". Paper for Accounting and Finance Association of Australia and New Zealand (AFAANZ) 2009 Conference. Adelaide, Australia. 5 – 7 July 2009

Cooper, William W. et al. "Data Envelopment Analysis, A Comprehensive Text with Models, Applications, References and DEA-Solver Software". Second Edition. Springer Science+Business Media, LLC. 2007

Ebnerasoul, Seyyed Asghar et al. "Performance Evaluation of Organizations: An Integrated Data Envelopment Analysis and Balanced Scorecard Approach". International Journal of Business and Management. Vol. 4, No. 4, April 2009

Ekawati, Ratna. "Penerapan AHP/DEA Pada Penilaian Kinerja Pemasok PT. X". Program Studi Teknik Industri, Fakultas Teknik Universitas Indonesia. 2006

Fathi, Bahram et al. "The Measuring of the efficiency of Islamic Azad University in Iran Using Data Envelopment Analysis (DEA)", (Case study: Azad University Branches in region five)

Golany, Boaz et al. "Constructing and Evaluating Balanced Portfolios of R&D Projects with Interactions: A DEA Based Methodology". European Journal of Operational Research. 172 (2006) 1018–1039. 2006

Jong-Woun Youn, Kwangtae Park. "University Development Models and Efficiency Analysis". Journal of Service Science 1:9-30. 2009

Kongar, Elif et al. "Non-parametric Approach for Evaluating the Performance of Engineering Schools". Int. J. Engng Ed. Vol. 26, No. 5, pp. 1210–1219. 2010

Luthfi, Teuku Haekal. "Usulan Perancangan Strategi Perusahaan Dengan Metode *Balance Scorecard* Pada PT. Diva Mitra Bogatama". Skripsi. Program Studi Teknik Industri, Fakultas Teknik, Universitas Al-Azhar, Indonesia 2008

Martin, Emilio. "An Application of the Data Envelopment Analysis Methodology in the Performance Assesment of the Zaragoza" University Departments. Documento de Trabajo. 2003

Najafi, E et al. "Efficiency and Effectiviencess Rating of Organization with Combined DEA and BSC". Applied Mathematical Sciences. Vol. 3, 2009, No. 26, 1249 – 1264. 2009

Nazarko, Joanicjusz. "DEA Method in Efficiency Assessment of Public Higher Education Istitutions". Performance Management and Measurement with Data Envelopment Analysis: Proceedings of the 8th International Conference of DEA. July 2010. Olayan school of Business, American University of Beirut, Lebanon. 2010

Niknazar, Pooria. (2011). "Evaluating the use of BSC-DEA Method in Measuring Organization‟ s Efficiency". Högskolan I Borås, Institutionen För Data-Och Affärsvetenskap

Paul Lau Ngee Kiong, et al. "Data Envelopment Analysis (DEA): Efficiency as an Indicator of Schools' Performance"

Purwantoro, R Nugroho. "Penerapan Data Envelopment Analysis (DEA) dalam Kasus Pemilihan Produk Inkjet Personal Printer". Usahawan. No. 10. Th. XXXII. 2003

Sitompul, Carles. "Analisis Efisiensi dengan Bantuan Sistem Pendukung Keputusan (SPK)". Seminar Nasional Aplikasi Teknologi Informasi 2004. Yogyakarta, 19 Juni 2004

Vessal, Ahmad. "Evaluating the Performance of Universities Using Data Envelopment Analysis". California Journal of Operations Management. Volume 5, No 1, pp 27-32. February. 2007

Peraturan Pemerintah Republik Indonesia Nomor 60 Tahun 1999 Tentang Pendidikan Tinggi

Keputusan Menteri Pendidikan Nasional Republik Indonesia Nomor 232/U/2000 Tentang Pedoman Penyusunan Kurikulum Pendidikan Tinggi Dan Penilaian Hasil Belajar Mahasiswa

Undang-Undang Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional

Mengukur Efisiensi Organisasi dengan DEA (Data Envelopment Analysis). Jurnal Ekonofisika. 18 Sep. 2008

http://rachmadr.web.ugm.ac.id/in/?p=29