

SYSTEM DYNAMICS BASED BALANCED SCORECARD TO SUPPORT DECISION MAKING IN STRATEGY OF PERFORMANCE IMPROVEMENT (A CASE STUDY IN THE UNIVERSITY)

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ABSTRACT

Balanced Scorecard (BSC) is multi-perspective framework used to develop metrics that can support the success of the organization's strategy. However, the relationship between variables of the BSC as a cause and effect is one-way relationship. System Dynamics (SD) at the BSC gives a perspective to look interactions. The magnitude of internal and external challenges faced by the university, it has become problem that could inhibit the achievement of its vision and mission. Using SD based BSC can develop metrics derived from the mental model of the organization to measure its success in connection with the suitability of the organizational strategy.

Key words: *balanced scorecard, system dynamics, and strategy.*

1. INTRODUCTION

In Indonesia, the number of private university is growing rapidly, but the shocking conditions occur where about 30% to 40% of private universities are heading for bankruptcy. This is due to the magnitude of the internal and external challenges faced by universities. Process to develop annual plans and checking mission have become a routine activity for the organization, but to develop metrics for measuring performance and connect with the organization's strategy is still rare.

This research is a case study in Institut Teknologi Indonesia (ITI). In its course as an organization, ITI faced with various problems such as financial deficit and low income received, where both of the problem can make decreasing customer satisfaction and decreasing the number of students who register to university. These conditions will affect the financial problems for the university overall.

Therefore in 2007, there were major changes in organizational structure, vision

and mission statement. After the changes in 2007, there has been neither comprehensive performance measurement nor any instrument that can assess how effective the performance of the ITI as the results of changes. This causes that it is difficult to determine the appropriate strategies used to achieve the vision and mission. While there should be a comprehensive performance measurement, which can be used as a control for the running of the organization to make improvements and to support decision making in strategic planning for the future.

The process of measuring the effectiveness of the performance is really important to do, where it is to ensure the survival of the organization in the face of various problems.

2. THEORETICAL BACKGROUND

Balanced Scorecard (BSC) is not only a performance measurement system, but also the management system to motivate the breakthrough for competitive performance

and most successful when used to drive the process of change (h). BSC is a multi-perspective framework used to develop metrics that can support the success of the organization's strategy and evaluating the past to learn about the future. Moreover, BSC can be determined by performance measurement indicators generated through an understanding of the organization's vision, mission and strategy, which is determined by the dominant logic of organization.

In addition, the BSC has conformity to factor of 7S which is a framework to know interrelationship between strategy of formulation and implementation (as shown in Table 1 (g)).

Table 1. Conformity Relation between 7S Model of Mckinsey and BSC

Relations 7S and BSC	Customer	Finance	Internal Process	Learning and Growth
Structure	x	x	x	x
Strategy	x	x	x	x
System		x	x	x
Staff				x
Culture				x
Skill			x	
Share Value			x	x

The relationship between variables of the BSC as a cause and effect is a one-way relationship (i). So that there can be a tendency indifference to its implementation, which in fact there is the existence of different interactions, in particular the delay between the decision and the key performance indicators. BSC does not firmly separate cause and effect in the context of the time (j). The causal relationship in the real world does not happen simultaneously, because there was a time delay. Therefore, measuring performance of the BSC needs to be approached with a system dynamic (SD), which overcomes the above problems. This is because the system dynamics is fundamentally interdisciplinary and very suitable to support managers to learn and understand complex systems (k).

System Dynamics (SD) to deal the time-dependent behavior of managed systems, and understand interrelationships among variables influence the behavior of the system over time (c, l). SD models are frequently developed and used to represent, analyse, and explain the dynamics of

complex systems. It can provide a common foundation that can be applied wherever we not only in management, but also in environmental change, politics, economic behavior, medicine, engineering, and other fields (e). SD as a method that through qualitative and quantitative models to describe, design, and model robust information feedback structures and control policies through simulation and optimization (c). System dynamics uses a number of different tools to reach its goals and to support decision-making processes, which are both qualitative, such as "causal loop diagrams" (CLDs) and "stock flow diagrams" (SFD) and quantitative (formal models based on a rigorous mathematical language).

3. RESEARCH METHOD

This research study used a system dynamics model based on the BSC, which consists of five stages are as follows:

- I. Development Effectiveness of Scorecard.
 - a. Find perspective and indicators based on literature. At this stage, the perspective and indicator using BSC from previous research as follows: (a, b, d, f, m). This stage produced 4 perspectives and 64 indicators.
 - b. Find perspective and indicators based on questionnaire. The questionnaire was made to determine the suitability of perspectives and indicators to measure the performance of ITI. The questionnaire was given to 30 selected lecturers. This stage produced 4 perspectives and 23 indicators.
 - c. Find perspective and indicators based on interview. The next stage was interviews with the leaders of ITI. Interviews aimed to determine the suitability of the second draft. This stage produced 4 perspectives and 24 indicators.
 - d. Find perspective and indicators based on focus group discussion (FGD). FGD consists of 7 lecturers who understand the BSC.
- II. Replication of the Model. The next stage in the modeling of dynamic systems was

the design the structure of qualitative and quantitative model.

- III. Model Validation. At this stage, a number of tests carried out on the model in order to evaluate its validity. The testing of a variety of forms, ranging from checking the consistency of logic, matching the output of the model with data collected in a time series, to perform statistical tests of various parameters used in the simulation. Model validation consists of validating the structure and validation of the performance/ output.
- IV. Sensitivity test. The sensitivity of the model was the model response to a stimulus, the shape of the visible presence of behavioral changes and or performance models. Stimulus was done by giving a particular treatment on a variable or structure of the model. Sensitivity test aimed to build and simulate scenarios to generate proposal strategy.
- V. Proposed strategy. The last step was to know that the policy has a high leverage on the performance of the organization in the coming year. Policy analysis will look at the performance of ITI for the next five years (2015 till 2019). Five-year span was taken in consideration that five-year span is generally used to measure the amount of strategic policy and timescales is proportional to the overall uncertainty of the system or system environment.

4. RESULT AND DISCUSSION

4.1. Qualitative Model

From 5 stages of development scorecard of ITI, obtained 4 perspectives and 19 indicators as follows: (1) Customer Perspective: student satisfaction, organizational capacity, quality of graduates; (2) Financial Perspective: income from tuition fee, grant and donation, other revenues, operating expenses; (3) Internal Business Perspective: the number of students, the adequacy of faculty, facilities and infrastructures, quality of services, recruitment/retirement of lecturers, teamwork; (4) Growth Perspective Learning: competence of lecturers, further education, training, obsolescence, research.

Model of BSC system was a model that described the relationship between the variables of the four BSC perspectives, as a relationship between variables in the measurement of the dynamic performance of the system. Causal Loop Diagram (CLD) was a qualitative model of BSC of ITI system. A simplified and stylized of the qualitative model was shown in Figure 1.

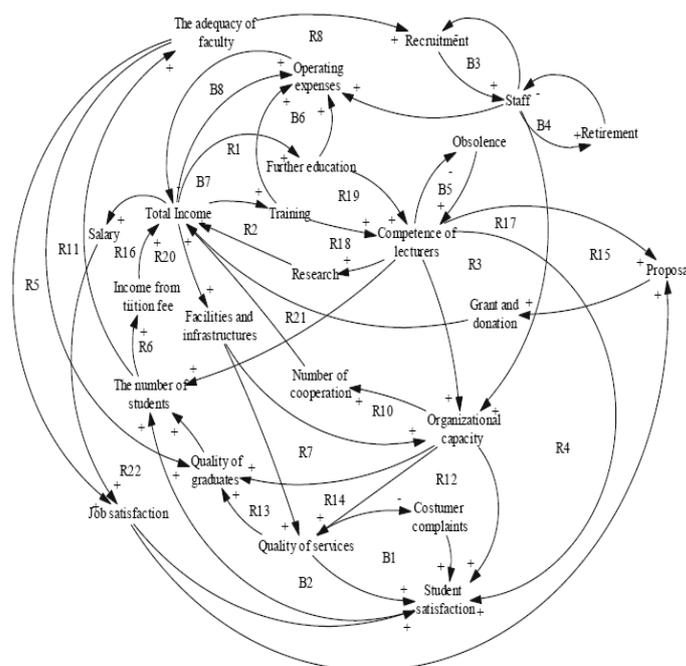


Figure 1. Causal Loop Diagram of ITI

Figure 1 above showed that the performance of the university has a very complex variable relationship. It was found that there were as many as 30 pieces closed loop relationship, consisting of 22 pieces Reinforcing Loop and 4 pieces Balancing Loop.

Because ITI was a non-profit organization, so the customer's perspective was important for institutional perspective. If the customer satisfaction increases, the complaints against the service will decline. This will provide a good internal image so that the number of students entering will increase as well. The increasing number of students entering into the ITI will contribute to increase revenue. Increased revenues will increase funding for training, continuing education, salary and procurement of infrastructure.

Despite the increased activity will reduce revenue of ITI, increased training and further

education will make the faculty members of the institution will improve their competence. Increased competence is necessary to maintain the competence of lecturers not become obsolete. Increased competence of lecturers, in turn will increase the capacity of the organization (albeit with delays), thereby increasing the ability of learning services. Good quality of learning will improve the quality of graduates that have an impact on increasing external image.

Increased external image will increase the number of students into the ITI. The increasing number of incoming students will increase the need for the number of lecturers. It is intended that the actual workload of lecturers in order to serve students in accordance with the available capacity.

Ideal workload will increase job satisfaction of lecturers. Job satisfaction will improve the quality of service. Job satisfaction needs to be improved in educational institutions, because the role of the lecturer is very important in the learning process. Job satisfaction and improving the competence of lecturers will enhance the ability of faculty, both in making proposals in order to earn income from grants and other sources, as well as in conducting research and community service.

All of this loop was a closed loop and is a positive loop in the system. This positive loop was the key to sustained growth and success in the institution. Therefore, the management needs to identify and manage it properly. Successful strategy goal is to strengthen the positive feedback loop, which at the same time eliminating or managing other negative loop correctly.

4.2. Quantitative Model Structure

Simulation could be done by changing the variables above into the language of system dynamics which were expressed in the level of stock flow diagram (SFD), stock, or state. SFD was a diagram illustrating the relationships between variables that were built CLD ITI.

SFD model in this study consists of four sub-models with four variables. Sub-models and variables consist of: 1) customer perspective sub-model described in the

customer satisfaction variable; 2) financial perspectives sub-model described in income variable; 3) internal process perspective sub-model described in the incoming student variable; 4) growth and learning perspective sub-model described in job satisfaction variable. All variables were influencing variable of ITI performance.

Moreover, the simulation was performed at the steady-state using the data in the period of 2010 to 2012. The data used was derived from data available in ITI, Directorate General of Higher Education, and other sources as well as processed data (model constants was shown in Table 2).

Table 2. Model Constants

Constants	Value	Constants	Value
Personal cost	0.1	Human resources development ratio	0.7
Cost per student	0	Ratio decrease job satisfaction	0.01
Coefficient training	0.05	Absorption ratio of university	0.15
Organizational capacity coefficient	3000	The ratio of grant proposals/ donation	5
Years of service	40	Recruitment ratio	0.8
Research	279.6	The ratio of retirement	0.001
Community services	850	The average value of the grant	50000
Human resources development	4891.9	Infrastructure	5000+746.8
The ratio of staff needs	100		

4.3. Model Validation

Validation of the model consists of structure validation and performance. Structure validation has been done through a framework of thought/ theory at stage 4.1. Validation of the performance model was done by using the Mean Absolute Error (MAE), which was the average deviation value of the actual simulation. Criteria of acceptable deviation limit were between 5-10%, where the deviation of simulation results from actual value was less than 5%. This indicates that the model was consistent with the actual simulation so that qualified and statistically valid, where it could be used for the next stage.

4.4. Scenario of BSC

The scenario was defined as an internally consistent view on that would occur in the future. Once the scenarios have been generated, best strategy can be formulated,

described in two or three scenarios. Formulation of scenario was made based on four main parameters of each perspective that act as factor of ITI performance (was shown in Table 3).

Table 3. Formulation of Scenario

Year	Income (Rp x 1000)	The Number of students (person)	Job Satisfaction	Costumer Satisfaction
2011	17.337.437,5	543	3.21	3.34
2012	17.353.226,5	662	3.28	3.34
2013	20.497.005,7	896	3.34	3.35
2014	32.315.623,2	1007	3.39	3.85
2015	47.622.393,0	1048	3.44	4.08
2016	63.073.655,5	1059	3.49	4.18
2017	76.743.874,6	1060	3.54	4.23
2018	87.379.452,9	1057	3.58	4.25
2019	94.108.142,9	1054	3.62	4.26

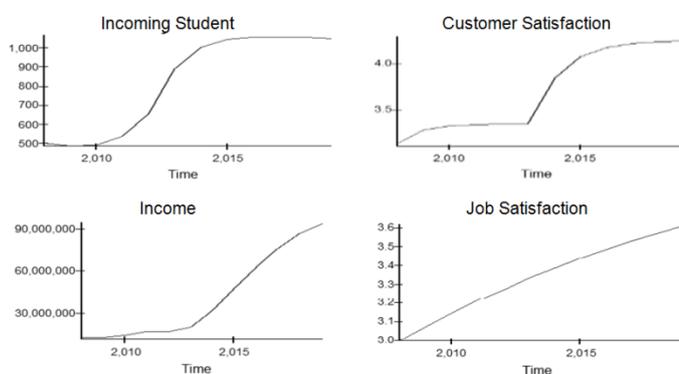


Figure 2. Results of BOT Simulation

From the simulation, it was obtained the structure of the performance measurement model with multiple patterns, namely: 1) the pattern of customer satisfaction and incoming students showed the patterns of goal seeking; 2) the pattern of job satisfaction was exponential form; 3) the pattern of revenue growth was without limits.

The combination of these patterns were basically affected the performance of the ITI. An outline of the scenario showed that the strength of inward looking was a factor that affected the performance. The main factor of inward looking was job satisfaction, where ITI should strived to maintain job satisfaction factors so as not to become balancing in order to increase customer satisfaction and revenue.

But for the future, it was no longer sufficient determinant. Therefore, ITI should pay attention to the elements of outward looking in order to have a more effective performance. The reason was that in the long run, the inward-looking element was no longer become dominant of positive

feedback. External factors that mainly affect ITI performance were customer satisfaction (customer perspective) and incoming students (internal process perspective).

4.5. Sensitivity Test

Sensitivity test was done to see the extent of the response models built if the stimulation was done by making intervention to the variable or enter a specific value to a variable or relationships between variables. This test was performed by add the value of each of these variables by 10%. The result of sensitivity test to several variables was shown in Table 4.

Table 4. Sensitivity Test of Model

Base case	Costumer satisfaction	The number of students	Job satisfaction	Income	Average
Optimum customer satisfaction	10.07	21.52	0	22.53	13.53
Human resources development ratio	0.04	18.41	0	20.31	9.69
Organizational capacity coefficient	0.06	35.66	0	1.31	9.26
Staff	0.03	13.76	0	17.87	7.91
Competence of lecturers	0.03	15.7	0	15.08	7.7
Tuition Fee	0.04	21.56	0	8.73	7.58
The ratio of staff needs	0.03	27.43	0	2.06	7.38
Facilities and infrastructures	0.01	8.8	0	19.73	7.14
The ratio of grant proposals	0.04	21.55	0	0.74	5.58
The average value of the grant	0.04	21.55	0	0.74	
Research	0.04	21.52	0.06	0.26	5.47
Other revenue	0.04	21.56	0	0.26	5.46
Community services	0.04	21.52	0.22	0.03	5.45
Personnel cost	0.04	21.56	0	0.01	5.4
The result of the provision of training	0.04	21.47	0	0.01	5.38
Effect of customer satisfaction	1.49	4.61	0	6.68	3.2

Table 4 above shows some of the following:

- Learning and growth perspective was the perspective that has influence the highest element to the ITI performance. Therefore, it was important for the institution to identify various activities in order to improve the competency of human resources, either through training or other education, so that the competence of lecturers can be improved.
- Customer satisfaction variables were the most sensitive to the performance of the system and become leading indicator for other aspects, so that it was placed on the top of BSC.
- Internal process perspective was the most sensitive perspective to changes in each element. It suggested that business

operations supported the future performance of the institution. Therefore, in order to improve performance in the future, it is important for the institution to identify critical processes. It could support the institution to achieve the goals of customers and stakeholders.

- d. Financial perspective was less sensitive to the learning and growth perspective. This was due to the increased income derived from student payments, grants/ other sources have not been used to enhance the growth aspect of organizational learning.

4.6. Proposed Strategies

Result from the sensitivity test of the model was obtained the proposal of ITI strategy for the next five years, as shown below.

Table 5. Proposed Strategies

Strategy	Best Practices
To increase the quality of human resources	<ul style="list-style-type: none"> - Increase training activities and seminars - Increase the budget for training and seminars - Increase further education
To improve business operations so that can improve of service	<ul style="list-style-type: none"> - Conduct technological innovation - Improve service time - Renovate laboratories, buildings, parking lot, cafeteria - Improve hygiene and comfort - Building cooperation and trust working culture
To increase the effectiveness of the promotion	<ul style="list-style-type: none"> - Use name of Habibie as brand equity - Change design of web according to brand equity and update web content regularly - Diversify the means of promotion - Cooperate with local governments, companies, alumni and senior high school

5. CONCLUSION

Model for performance measurement at the College (ITI) was used 4 perspectives and 19 indicators. From the model was obtained that in period of 2010 to 2012, so far was effective as driven by business operations, markets and financial. But the learning and growth perspective (especially human resources) seemed to only be a secondary variable. The implication was that the assessment of performance against intangible assets was not yet considered as an important emphasis.

From the performance measurement of ITI in the period of 2010 to 2012 was obtained that ITI performance put an emphasis on reinforcing elements, while the performance of the ITI in the next five years should give emphasis on balancing element. This is because the system of performance measurement period has begun steady (stagnant).

The results of this study showed, that the characteristics of education business in order to be performed is mainly on branding university. Human factor has not been an important factor in order to improve the competitiveness of the institution, but rather to meet the requirements of the institutional recognition as an educational organization.

Proposed strategies to improve the performance of ITI for the next five years are primarily to improve human resources, business operations and market through the increase of the resource advantages. This is in line with model of resources based view (RBV), which uses the based resources approach for its competitive advantage. According to the RBV, it is more feasible to exploit external opportunities by using existing resources. Organization will obtain its competitive advantages by having, controlling, and making use of its resources. Therefore, the strategy of ITI for the next years is based on the advantage of resources (for examples of some proposed strategies as listed in Table 5).

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