

## Do Eco-Efficiency Knowledge Increase Weighting on Environmental Perspective in a Performance Measurement? Experimental Study using Balanced Scorecard

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**Abstract.** Prior research related to performance measurement using the balanced scorecard limited on profit-oriented organizations and has not yet integrated the environmental aspect. This study extends prior studies through environmental aspect integration in a balanced scorecard on the university by an involved internal factor of participants, namely eco-efficiency knowledge. This study investigates the effect of eco-efficiency knowledge on environmental perspective in a balanced scorecard. The study involved participants in responding to the performance measurement of the faculty officials using a balanced scorecard based on a laboratory experiment. Participants of this study consist of 30 undergraduate students majoring in accounting and accounting education, which acts as an internal quality auditor. Data analysis used to test the hypothesis of this study is the analysis of variance. In an evaluation task using a balanced scorecard, we found that an internal quality auditor with high eco-efficiency knowledge placed more emphasis on an environmental perspective than an internal quality auditor with low eco-efficiency knowledge. Further analysis found that participants with non-educational backgrounds more weight on financial indicators than participants with educational background. The conclusion of the assessment of internal quality auditors is a part of the management performance assessment. This study discusses the implications of university strategic management regarding the importance of environmental performance and future research suggestions.

**Keywords:** balanced scorecard, eco-efficiency knowledge, environmental perspective, performance measurement

### 1. Introduction

The Balanced Scorecard (BSC) is one of the most important innovations in strategy management in 20th century (Sayed, 2013). The Balanced Scorecard was developed by Kaplan and Norton, which was part of multidimensional performance measurement (Kaplan and Norton, 1996). BSC contains financial and non-financial measures, including financial, customers, internal business processes, and learning and growth indicators. Concerning management objectives, metrics (scorecards) are developed while data is collected to analyze each of these perspectives (Sayed, 2013). BSC adopted by most organizations generally focuses on profit-oriented businesses. Meanwhile, the implementation of BSC in university is a significant issue.

Some staff and officials at the university reflect a willingness to improve quality, efficiency, and accountability (Taylor and Baines, 2012) and the business world. Therefore, BSC becomes an instrument of such a complex performance measurement translated from its strategy, vision, and mission. The focus of which is determined by different organizational strategies, visions, and missions will have an impact on different performance appraisals.

Besides, the United Nations had declared the "Decade of Education for Sustainability Development" from 2005 to 2014 (UNESCO, 2005). Educational institutions' important role in changing attitudes and behavior related to social and environmental performance is a concern among academics, government, and public. The term environmental education is also often used to emphasize education and promotion of awareness and information on environmental sustainability, such as ecological thinking and behavior (de Andrade Guerra et al., 2018). Environmental sustainability particularly has important relevance for education (Wynder et al., 2013).

Specifically, this research is conducted due to several things. Firstly, the instrument of traditional performance measurement has shifted to a modern way known as Balanced Scorecard (BSC). BSC becomes an instrument of comprehensive performance measurement, including both financial and non-financial measures, including four indicators, namely financial, customer, internal business process, as well as learning and growth indicators. As far as we know from previous research, there is still limited research on similar topics conducted by non-profit organizations, especially universities.

Secondly, the Balanced Scorecard (BSC) research at university mostly only involves four indicators of BSC; however, it has yet to integrate another important aspect, namely environmental management. Therefore, this study has triggered the integration of the performance measurement of a balanced scorecard (BSC) and environmental aspects at the university. Thirdly, performance appraisal experimental research using the BSC approach does not involve internal factors within participants. The factors within participants can give a different contribution to performance measurements. This research involves the eco-efficiency knowledge as a factor within participants that can influence the assessment of one's performance.

Besides, most research is carried out using survey methods and case studies. This study extends previous research, which is conducted by Wynder et al. (2013) by using participants who acted as internal quality auditors representing the university's management by involving participants' internal variables, namely eco-efficiency knowledge. Mainly, this study intends to investigate how the performance appraisal is carried out by internal quality auditors who have different eco-efficiency knowledge through using a performance measurement instrument called sustainability balanced scorecard (SBSC).

## **2. Literature Review**

### **Balanced Scorecard**

BSC is a performance measurement system and a strategic control system, which translates the objectives of the company's strategy into a set of reasonable measures and actions that are possible (Tsalis et al., 2015). BSC allows an organization to involve its vision and strategy by providing a new framework that translates the organization's strategy through selected goals and measurements. BSC uses measurement as a new language that describes a critical element of achieving strategy (Kaplan and Norton, 1996).

The balanced scorecard makes measurement a "new language" to explain key elements in achieving a strategy where BSC does not only focus on financial control activities. The BSC has the assumption that the efficient use of investment capital is not the most critical factor for achieving a competitive advantage. However, increasing other factors such as intellectual capital, knowledge creation, or customer orientation becomes important (Figge et al., 2002). It integrates a framework that involves tangible and intangible aspects, cause and effect indicators, and financial and non-financial measures (Kaplan & Norton, 1996).

Some universities have implemented BSC applications. One of them is the Polish university described in the research of Pietrzak et al. (2015). The BSC's ability as a performance measurement tool that can accommodate financial and non-financial aspects provides flexibility for the university to modify BSC. Some universities have modified BSC to suit the needs of today's complex environment. As a performance measurement tool, BSC can integrate and balance all performance indicators in an organization (Kaplan and Norton, 2004).

### **Environmental Performance**

BSC's ability to pay attention to intangible aspects, such as the environment and society, makes many academics call the BSC an appropriate approach to capture environmental issues (Figge et al., 2002; Leon-Soriano et al., 2010; Tsalis et al., 2015). Conceptually, sustainability management with BSC looks to solve organizational contributions to sustainability issues through an integrative way. It means that for organizations that contribute to the development of sustainability, performance must improve beyond three dimensions of sustainability, one of which is the environment (Figge et al., 2002).

Environmental performance refers to managing environmental aspects of the organization (e.g., fuel consumption, water consumption, and environmental impact) (Khalid et al., 2019). Wynder

et al. (2013) state the importance of environmental performance for companies, including organizations needing to provide satisfaction to external stakeholders by operating within social values and boundaries. It relates to the organizational legitimacy of stakeholders.

Legitimacy refers to the degree to which the public or various stakeholders recognize an organization's actions as appropriate and useful (Suchman, 1995). Legitimacy theory focuses on whether the value system of an organization is aligned with society's value system and whether the organization's goals meet social expectations (Chen and Roberts, 2010). Through this legitimacy, organizations can compete more and have more competitive advantages. Acquiring legitimacy is a strategic goal for the organization (Berrone et al., 2017). This view is consistent with increased organizational commitment related to voluntary reporting of social and environmental performance.

Several studies have also investigated the effect of reporting on social and environmental performance on firm value or performance (Duque-Grisales and Aguilera-Caracuel, 2019; Kartadjumena and Rodgers, 2019; Xie et al., 2019). These effects have a positive impact as an organizational competitive advantage so that environmental performance becomes a concern for the organization.

### **Eco-efficiency Knowledge**

Eco-efficiency becomes a consistent tool towards a transition to the development of sustainability (Jassem et al., 2018). Several studies have shown that there is a relationship between SBSC and eco-efficiency to influence decision-makers. Eco-efficiency is a metric for assessing the environmental impact and value of an organization's overall activities (Peças et al., 2018). Furthermore, Eco-efficiency is included in the sustainability assessment method by considering two pillars of sustainability: environmental and economic assessment.

A person's knowledge of environmental education can encourage action to align with the environment (Jensen, 2002). It is in line with previous research, which shows a strong relationship between education and environmental knowledge, attitudes, and actual behavior (Liobikiene and Poškus, 2019; Vicente-Molina et al., 2013; Zsóka et al., 2013). A person with high environmental knowledge has a high commitment to environmental sustainability, which further impacts his behavior.

University officials, in this case, internal quality auditors with high eco-efficiency knowledge, have higher environmental insight related to the benefits of implementing environmental management for organizations that can further improve overall organizational performance. Therefore, internal quality auditors with high eco-efficiency knowledge weigh more on the environmental aspects because the legitimacy of external parties regarding the organization will be high. According to the ideas, the researcher formulates the hypothesis as follows:

Hypothesis: Internal quality auditors who have high eco-efficiency knowledge will place more weight on environmental indicators in their evaluation of performance than internal quality auditors with low eco-efficiency knowledge.

## **3. Research Methods**

### **Participant**

This research is experimental laboratory research. The experiments in this study used a between subject design. The independent variable of this study is eco-efficiency knowledge. There are two cells, and each subject gives to assess the performance of three different cases. The research subjects were randomly assigned.

The subjects in this study were students from the Department of Accounting and Accounting Education, Faculty of Economics, Universitas Negeri Semarang. The subject was chosen as a proxy for the university's internal quality auditor because students in the department were expected to be able to make judgments and decisions in managing management in higher education. Sampling in this study used purposive sampling with a judgment sampling type. The sample criteria of this study were students from the Accounting and Accounting Education majors who had or were taking management accounting courses or had studied BSC material. The number of subjects used in this study was thirty participants. Each subject was given a case, and information about the performance of three different faculties then make a performance assessment.

### Assignment

Participants were asked to take on the role of an internal quality auditor at the university and evaluate the three faculties' performance based on the size presented in the BSC format (Table 1). This research instrument was developed by Lipe & Salterio (2000) and subsequently used by other studies (Kaplan & Wisner, 2009; Libby et al., 2012; Wong-On-Wing et al., 2007; Wynder et al., 2013). We modified the research instruments to the university situation. Each faculty's target is the same, and every six months, an evaluation is carried out.

**Table 1.** Balanced Scorecard 3 Faculties

Measure	Target for the six months	Faculty A		Faculty B		Faculty C	
		Actual	% better (or worse) than target	Actual	% better (or worse) than target	Actual	% better (or worse) than target
Financial perspective							
% increase in tuition revenue	12%	10	-16.67	15.2	26.67	13	8.33
% reduction in operating expenses	8%	6.5	-18.75	10	25	9.5	18.75
% increase in community service	15%	12.5	-16.67	18	20	15.5	3.33
% increase in research fund	10%	11.5	15	8	-20	11	10
Custimer perspective							
Student satisfaction rating	90	94.5	5	83	-7.78	89	-1.11
Graduates going for further study within one year	79	79	0	72	8.86	78	1.27
Student retention	85%	86	1.18	79	-7.06	88	3.53
Faculty image growth	35%	30	-14.29	43	22.86	37	5.71
Internal process perspective							
Learning facility utilization percentage	80%	77	-3.75	90	12.5	83	3.75
Student to lecture ration	30	36	-20	27	10	33	-10
Research and library quality	75%	73	-2.67	69	-8	76	1.33
Innovative learning methodology utilization	10	12	20	8	-20	11	10
Learning and growth perspective							
Hours of training (staff and lecture)	70hours	79.5	13.57	55	-21.43	66	-5.71
Staff and lecture satisfaction survey	80	95.5	19.38	66	-17.5	82	2.5
Institutional involvement in finding research grand	25	24	-4	26	4	26	4
staff and lecture competency retention and recuitment	10%	7.5	25	12	-20	9	10
Environmental perspective							
Toxic air emissions	1000 ppm	1010	-1	995	0.5	1200	-20
Toxic water emissions	500 ppm	490	2	495	1	550	-10
Energy efficiency	50 tonnes	51	-2	52.5	-5	55	-10
Disposing of untreated waste	20 litres	18.5	7.5	18	10	26	-30

According to the scorecard used in research, performance is the same averaged by each measure. The performance of the two faculties (Faculty A and Faculty B) is equally good. Faculty A, by the practice of organizational strategy, invests in training and developing teaching staff, education personnel, and all academicians. In general, it can be inferred that Faculty A has good performance on lead indicators and an organizational strategy with the hope that financial performance will achieve excellence in the future.

In contrast, Faculty B achieved good targets in all financial indicators (lag indicator), except for reducing operating costs. In this case, investments relating to training and development for teaching staff, education staff, and the whole academic community have not been given much attention. At the same time, this result indicates that student satisfaction is declining. It can be concluded that the financial performance of Faculty B exceeds the target. Yet, the lead performance is not achieved well, so that way, superior financial performance may not last for the long term.

The environmental performance of Faculty A and Faculty B does not figure out such significant issues in the comparison between two faculties. Therefore, the importance of placing poor

environmental performance is measured through differences by evaluating the result of Faculty C compared to Faculty A and Faculty B. As the result shows that Faculty C has positive performance on all four BSC indicators. An important issue at Faculty C is that environmental performance lasted significantly below the target (70% worse than the target). The poor environmental performance can affect reputation and liability and be related to government regulations. Consequently, it will affect on reducing future financial performance.

#### Definition of Variable Operations

The dependent variable of this study is performance measurement. Participants were asked to evaluate each faculty leader on a 10-point-scale, which be measured by assessment standards as follows; there was not enough improvement (0) to extraordinary (exceeded expectations, superior leadership) (10). The independent variable of this study is eco-efficiency knowledge, which is measured using Ravi's measurement (2015).

#### Data analysis

Data analysis used to test the hypothesis of this study is the analysis of variance (ANOVA). This study uses the application of SPSS version 21 to test hypotheses.

### 4. Result and Discussion

#### Results

Participants consist of two groups, which are internal quality auditors who have high and low eco-efficiency knowledge. The following are descriptive statistics of performance measurements of each faculty.

**Table 2.** Descriptive statistical of performance measurement

	Eco-Efficiency Knowledge		Total (n = 30)
	High (n = 15)	Low (n = 15)	
Performance Measurement of faculty A	5.333 (2.058)	4.933 (1.533)	<b>5.133 (1.795)</b>
Performance Measurement of faculty B	6.266 (1.791)	6.800 (1.146)	<b>6.533 (1.502)</b>
Performance Measurement of faculty C	5.733 (1.751)	6.933 (1.334)	<b>6.333 (1.647)</b>

Table 2 shows descriptive statistics for each experiment group with regards to performance measurements. Of 30 participants, the performance measurement average of Faculty A was 5.133, Faculty B was 6.533, and Faculty C was 6.333. In connection with the main objectives of hypothesis testing, the focus is mainly on the performance measurement of Faculty C. Internal quality Auditor that has higher eco-efficiency knowledge provides lower performance measurement (5.733) than internal quality auditors who have low eco-efficiency knowledge (6.933).

The assumption test result of ANOVA for the hypothesis of this research suggests that the significance value of Levene's Test for Performance Measurement of faculty C is 0.645. It means that the dependent variable's variance value at various levels of the independent variable is relatively different. Therefore, the assumption of homogeneity has been fulfilled. Furthermore, the test is conducted normality assumption by using P-Plot. Test result normality indicates that the distributed residual value is normal.

This research hypothesis focuses on environmental performance as a special lead performance indicator. Faculty C performed well on traditional measures found in the BSC, but very poorly on environmental performance. Therefore, a lower evaluation recognizes the strategic significance of poor environmental performance. This research hypothesis examines the effect of eco-efficiency knowledge on performance measurements. This study tests whether internal quality auditors who have high eco-efficiency knowledge provide more weight on environmental performance than internal quality auditors who have low eco-efficiency knowledge.

**Table 3.** One-way ANOVA test results

Source	Df	Mean Square	F	Sig.
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Between Groups	1	10800	4.456	0.044 **
Within Groups	28	2.424		
Total	29			

Description: \* \* \* = significant at 1% level; \* \* = significant at 5% level

Based on table 3 using one-way ANOVA, the difference average in the performance measurement of faculty C showed significant results ( $F = 4.456$ ;  $p < 0.044$ ) so that this research hypothesis was supported.

#### Additional Analysis

Furthermore, this study tested the impact of different participants' educational background.

**Table 4.** Descriptive statistics of educational background

	Education Background		Total (n = 30)
	Education (n = 20)	Non-education (n = 10)	
Performance measurement of faculty A	4.900 (1.744)	5.600 (1.897)	<b>5.133 (1.795)</b>
Performance measurement of faculty B	6.100 (1.209)	7.400 (1.712)	<b>6.533 (1.502)</b>
Performance measurement of faculty C	6.450 (1.234)	6.100 (2.330)	<b>6.333 (1.647)</b>

Table 4 displays descriptive statistics for each faculty performance measurement based on a different educational background. Participants with educational background provide a lower measurement (higher) for faculty A and B (Faculty C) performance versus participants with a non-educational background.

**Table 5.** Educational background testing results

Source	Df	Mean Square	F	Sig.
Between Groups				
Performance measurement of faculty A	1	3,267	1,014	0.323
Performance measurement of faculty B	1	11,267	5,820	0.023 **
Performance measurement of faculty C	1	0817	0294	0.592
Within Groups				
Performance measurement of faculty A	28	3,221		
Performance measurement of faculty B	28	1,936		
Performance measurement of faculty C	28	2,780		
Total	29			

Description: \* \* \* = significant at 1% level; \* \* = significant at 5% level

Interestingly, the different educational backgrounds of participants only had an impact on the performance measurement of Faculty B. Testing using MANOVA in table 4 shows that the difference in the average performance evaluation of Faculty B leaders showed significant results ( $F = 5.820$ ;  $p < 0.023$ ). Faculty B achieved good targets in almost all financial indicators (lag indicator). However, indicators of learning and growth are not so considered. It shows that participants with non-educational educational backgrounds focus more on financial indicators than participants with educational backgrounds.

#### Discussion

This research hypothesis investigates the effect of eco-efficiency knowledge on performance measurements. The test results using one-way ANOVA supported the hypothesis. Expends previous research, the research can provide evidence that there is a difference in performance measurement of internal quality auditors who have different eco-efficiency knowledge. Internal quality auditors who

have high eco-efficiency knowledge will further leak performance measurements by emphasizing the environmental perspective instead of internal quality auditors who have low eco-efficiency knowledge. The findings of this study support the research of Zsóka et al. (2013), Vicente-Molina et al. (2013), and Liobikiene&Poskus (2019).

The internal quality auditor with high eco-efficiency knowledge has more insight into understanding environmental issues, organizational role in preserving the environment, and the impact of environmental damage than internal quality auditor with low eco-efficiency knowledge. The Important role of organizations in maintaining this environment is closely related to the legitimacy of the organization. This result confirms the legitimacy theory (Berrone et al., 2017; Suchman, 1995). Organizations that have a high level of attention to environmental issues have a great image on the stakeholders. The strategy encourages organizations to focus more on environmental issues so that they become indicators in performance measurements. The internal quality auditor with high eco-efficiency knowledge considers environmental performance an important indicator in addition to the financial indicators. Through such strategies, internal quality auditors have confidence that the organization will achieve success. Environmental indicators as a lead indicator can drive improvements to other indicators up to achieving high financial performance.

These findings imply that the weight of one's performance measurement does not always emphasize learning and growth indicators. However, the current era has encouraged organizations to develop a sustainability balanced scorecard where there are other relevant indicators, namely environmental indicators. Internal quality auditors with high eco-efficiency knowledge weigh the primary measurement of environmental performance. The strategy is indeed not directly related to economic or financial aspects. However, the benefits will be felt in the future, and the benefits obtained are likely to exceed costs incurred if they do not consider environmental issues.

## 5. Conclusion

This research aims to investigate the effect of eco-efficiency knowledge on performance measurement using a balanced scorecard approach. Based on the analysis, the research can draw some conclusions. First, eco-efficiency knowledge increases the performance measurement weights on the environmental indicators. This test is significant at a level of 5%. Internal quality auditor with high eco-efficiency knowledge further undergoes performance assessments on higher environmental indicators than Internal quality auditor with low eco-efficiency knowledge. The internal quality auditor with high eco-efficiency knowledge has environmental insight and has the confidence that by investing in environmental issues will drive future financial performance. Secondly, participants with non-educational backgrounds more weight on financial indicators than participants with educational background. This test is significant at a level of 5%.

The conclusion of the assessment of internal quality auditors is a part of the management performance assessment. Reputations of leaders become worse when performance measurement provided by the internal quality auditor is low. Performance at the faculty level is expected to encourage university performance. Through excellent performance at the faculty, level be it from an environmental perspective, human resource development, internal business process, customers, and the financial perspective will drive performance at the university level.

There are some limitations to this research. Firstly, on this experimental approach, participants were asked to respond based on the faculty level performance scenario through a balanced scorecard approach previously also used to measure performance measurement (Wynder et al., 2013). Although this approach's strength provides the ability for researchers to manipulate variables, this approach is not capable of incorporating all relevant information on the real world. Secondly, this study does not consider the subject control with regards to the subject's understanding relating to the balanced scorecard.

Due to the still limited research involving the topic of performance measurement in universities involving environmental perspectives by using a balanced scorecard, then research with similar topics needs to be improved. Here are some suggestions that can be given for further research. Further research can conduct true-experimental research by considering the subject's understanding with regards to the balanced scorecard. Besides, further research can be done by adding variables order and framing to measure performance measurement.

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