Jurnal Akuntansi Indonesia, Vol. 14 No. 1 Januari 2025, page 27 - 36

Model Development for Measuring and Analyzing Green Accounting Activities Using Factor Analysis

Lisa Kartikasari[1*], Dian Essa Nugrahini[2]
[1,2]Accounting Study Program, Faculty of Economics, Universitas Islam Sultan Agung, Indonesia
[*)]Corresponding Author, email: lisakartika@unissula.ac.id

ARTICLE INFO

Article history:
Received: 22/01/2025
Revised: 23/01/2025
Accepted: 30 /01/2025

Keywords:
Green accounting activities, environmental, industries, product, information

DOI :
http://dx.doi.org/10.30659/jai.14.1.27 - 36

Abstract
One of Corporate social responsibilities to the environment is by disclosing environmental information as a result of industrial activities or their business. It covers a clear figure of a company to combine cost and environmental benefits in economic decision making reflected in the implementation of green accounting. The purpose of this study is to establish indicators and constructs of green accounting activities by identifying environmental activities grouped into the green support, appraisal, internal failure activities, external failure activities and hidden activities. The population in this research is manufacturing companies in the Central Java province which is administered by purposive sampling technique. It is obtained a sample of 43 companies. Then, the data are analyzed by using factor analysis in order to establish and construct appropriate indicators for green accounting.The findings show that 21 selected indicators with five constructs of green accounting activities. Five constructs with the respective variables as follows: green support activities with six indicators, green appraisal activities with four indicators, green internal failure activities with five indicators, green external failure activities with three indicators and green hidden constructs activities with three indicators.

Abstrak
Salah satu tanggung jawab sosial Perusahaan terhadap lingkungan hidup adalah dengan mengungkapkan informasi lingkungan hidup sebagai akibat dari kegiatan industri atau usaha. Hal ini mencakup gambaran jelas suatu perusahaan dalam menggabungkan biaya dan manfaat lingkungan dalam pengambilan keputusan ekonomi yang tercermin dalam penerapan green accounting. Tujuan dari penelitian ini adalah untuk menetapkan indikator dan konstruksi aktivitas green accounting dengan mengidentifikasi aktivitas lingkungan yang dikelompokkan menjadi aktivitas green support, appraisal, internal failure activities, external failure activities dan hidden activities. Populasi dalam penelitian ini adalah perusahaan manufaktur di provinsi Jawa Tengah yang diambil dengan teknik purposive sampling. Diperoleh sampel sebanyak 43 perusahaan. Kemudian, data tersebut dianalisis dengan menggunakan analisis faktor untuk menetapkan dan menyusun indikator-indikator yang sesuai untuk green accounting. Temuan menunjukkan bahwa 21 indikator terpilih dengan lima konstruk kegiatan green accounting. Lima konstruk dengan masing-masing variabel sebagai berikut: aktivitas green support dengan enam indikator, aktivitas green appraisal dengan empat indikator, internal failure activities dengan lima indikator, external failure dengan tiga indikator, dan hidden activities dengan tiga indikator.

1. INTRODUCTION

Environmental responsibility is a responsibility of all human on this earth. If everyone tries to keep the environment and product and also uses products that are environmentally friendly, they will provide a healthy earth. Likewise the corporate where safeguarding to the environment is very closely due to the corporate operational activities.

One of Corporate social responsibility for the environment is by disclosing environmental information business. The description corporate business in combining environmental costs and benefits in economic decision making is reflected in the application of environmental accounting. Environmental accounting practices have a shared methodological and conceptual framework is a known fact ((Liu et al., 2018). However, some limitations are still relevant in the development of accounting methods and practices (Hosseini & Owlia, 2016) . In particular: The links between local and global levels are often missed; Information flows are often neglected, even if they contribute to shaping the behavior of bio-system at all scales, is usually neglected (Yang, Kong, Xi, Li, & Wang, 2017); (Pretty, 2011); (Nielsen, 2015).

The environmental benefits have been widely felt by companies in various aspects. Raw materials as basic ingredients for making any product all come from the environment. Coolness of the air and physical health become as a result of environmental utilization. Balanced with environmental costs, it should be equal to the benefits obtained from the environment. Environmental costs that should have been incurred by the company have not been done so far. Waste as the output of the business production process has not been reused and has not been managed properly to provide many benefits for the community and environment. Through green accounting, the company will calculate, report, control, and report cost related to the environment.

The purpose of this study is to build a model of green accounting for manufacturing companies in the province of Central Java by identifying measures of cost quality activities developed by Jeffers (Jeffers, 2008). Active disclosure of green accounting information can help enterprises effectively adjust the allocation of resources promptly, improve production efficiency, reduce the cost of environmental management, and achieve cost reduction and efficiency (Zhao et al, 2025). At the same time, avoiding environmental risks and transparent disclosure of information makes the enterprise internally biased towards environ mentally friendly and resource-saving strategic decisions, reduces operational risks and optimises the internal governance system, thus creating long-term corporate core value and improving financial performance (Zhang et al., 2022). In measuring the quality cost activity, it is divided into two categories. They are green control activities, and green failure activities. Green control activities are activities that are formed to prevent or detect initiatives that do not conform to environmentally friendly measures and can be categorized as green support activities and green appraisal activities. Green failure activities are activities formed by a company or customer to overcome the weakness of environmental protection. Failure activities are categorized into two activities including green internal failure activities and green external failure activities. The difference of this study with Jeffers (2008) is this study focuses on the activity of green accounting while (Jeffers, 2008) focuses on green cost accounting in the research framework. In addition, in this study, each component of measurement emphasized environmental activities. So that the problem of research is in the form of questions is ‘what are the indicators for measuring the components of green accounting activities.

2. THEORETICAL FRAMEWORK

2.1 Green Accounting

Green accounting need to o identify and quantify the environmental impact of the investment project and the cost of annulating this impact (soil remediation, water purification, and other clean-up action), not to mention irreversible damage to the environment and human health (Stanojević, Vranes, & Gökalp, 2010). The environmental costs that have been issued by the company directly provide great benefits for the company and the community. For companies, it will improve the environmental performance and provide greater responsibility for internal or external companies. For the community, a better environment is formed with many companies that are aware of the environment.

The advantages of adopting green accounting are: adopting decisions about financial performance of organizations and green accounting, providing information that is useful for achieving target minimization costs (especially the environment) and negative impacts on the environment, presenting data on costs needed to estimate financial impacts such as initiatives as: preventing pollution , design and green accounting environmental improvements; projections, costs, estimate the life cycle in the environment; circulation of administrative products from the candidate environment; the supply process from an environmental perspective, the product or the manufacturer's obligation, an environment that is centered on the management system, evaluating, testing and reporting the environmental activities performance. Other information sources are routine managerial activities such as product and process design, distribution and control costs, capital budgeting, bidding processes, pricing policies, evaluation performance. The weakness of green accounting is that it does not represent a guarantee for obtaining financial performance or related environment.

Jeffers (2008) suggests that there are two activities related to the measurement of cost quality. First is green control activities consisting of green support activities and green appraisal activities. Second is a green failures activity, consisting of green internal activities and green external activities. Green control activities are activities that are formed to prevent or detect initiatives that do not conform to environmentally friendly measures. This is categorized into two activities; first, green support activities are activities carried out to prevent declining environmental quality of goods or services produced. These activities include of environmental engineering, training programs, recruiting, reporting, supplier evaluation and selection, audits, market research, field trials, prototype inspections, vendor certification and design reviews. Second, green appraisal activities are activities carried out to determine whether goods and services are in accordance with customer needs and environmental protection. These activities include inspection of raw materials, raw materials testing, packaging inspection, supervising appraisal activities, product acceptance, testing equipment, outside endorsements. Green failures activities consist of two categories, namely green internal activities are activities before the failure of delivery of goods (inappropriate shipments, unreliable shipments). These activities include of scrap, rework, downtime, re-inspection, re-testing, design changes, and repairs. In addition to green internal failures activities, there are green external failures activities, namely activities that occur after the delivery of goods to the customer. Recalls, lost sales, return / allowances, warranties, repairs, discounts due to defects, product liability, customer dissatisfaction, lost market share, ill will and complaint adjustments are included in the green external failure activities.

3. RESEARCH METHOD

3.1 Questionnaire design

The questionnaire included common and demographic questions to ascertain appropriate related background information. Common demographic questions include gender, categorical age, and categorical education. The questionnaire uses a Likert scale with a five-point scale from 1 (disagree) to 5 (strongly agree). Further tests covered the reliability of the instrument and Cronbach's values for green activities accounting items were all above 0.81.

3.2 Green accounting activities indicators

Research subject are prerequisite to research that applies content analysis (Gray & Laughlin, 2012). In this study, green activities accounting indicators were taken from the division of green accounting models developed by (Jeffers, 2008). Jeffers (2008) focuses on green cost accounting in the research framework. This study focuses on the activity of green accounting. In addition, in this study, each component of measurement emphasized environmental activities. Of the 39 indicators, each indicator is measured by environmental activities (see appendix 1). There are 39 indicators identified from green activities accounting and 21 indicators that can be further processed using exploratory factor analysis.

Table 1. Green Accounting Activities indicators and Measurement

1	Quality environmental engineering: The company participates in protecting soil, water and air pollution, participating in environmental conservation	21	Downtime: Utilizing downtime that has a good impact on the environment
2	Training programs: Increased employee competencies for environmental issues, training in the implementation of environmental management systems, improvement of employee personal growth and the accuracy of environmentally conscious human resource planning.	22	Re-inspection: Re-inspection of defective products, products not environmental friendly
3	Recruiting: Employee position with environmental field	23	Re-testing: Conduct emission tests, recycle remaining materials
4	Reporting: Internalization environment cost in the financial reporting	24	Design changes: Product design changes because the customer changes the order detail pattern, because it follows changes in consumer tastes, because of the demand for products with special designs, changes in order product size
5	Supplier evaluation and selection: Quality of supplier and supplier produce raw materials eco-friendly	25	Repairs: Improvement of eco-friendly products, product improvement because the product has decreased, recycles the product
6	Audits: Environmental audit, production process audit	26	Recalls: The price of goods is higher than similar products on the market, customers move to buy similar products that are environmental friendly
7	Market research: New product with eco-friendly, to find out the expectations and needs of consumers for environmentally friendly products, there is a change in environmentally friendly packaging design	27	Lost sales: Product expiration, defective products, damaged products

8	Field trials: Active protecting the environment around the company, active following the environmental issues	28	Return/allowances: Reduction of return of goods, checking items before sending to customers
9	Prototype inspection: Examination of hazardous waste content, repair / conservation of damaged land	29	Warranties: Guaranteed products made from environmental friendly raw materials. Guarantees for non-hazardous raw materials
10	Vendor certification: Re-check raw materials from vendors, eco-friendly design requests	30	Discount due to defect: Discounts due to defective products, discounts because the product is damaged
11	Vendor design review: Re-check raw materials from vendors, eco-friendly design requests	31	Product liability: Customers receive different orders, there is an increase in the price of ordered goods, an additional fee when ordering goods
12	Inspection of raw materials: Ensuring product quality in accordance with environmental standards, specified product characteristics, separation of environmental eco-friendly products and non eco-friendly products	32	Customer dissatisfaction: The entry of the same product on the market but more environmentally friendly, the company's products are not environmental friendly
13	Testing of raw materials: Ensuring raw materials in accordance with environmental standards, ensuring environmental friendly raw materials	33	Lost market share: Because the product is dangerous for the environment, there are products from competitors that are environmental
14	Packaging inspection: Request for packaging that does not damage the environment, packaging recycled, packaging does not contain harmful chemicals	34	friendly
15	Supervising appraisal activities: Companies participate in environmental campains, the Company actively participates with the community in managing the environment	35	Complaint adjustment Regulatory and health: Environmental health programs, natural product processing, compliance with
16	Product acceptance: Maintenance of waste management equipment	36	environmental regulations Safety and environmental management systems : Integrating environmental accounting, adhering to environmental policies, adopting environmental changes, guaranteeing health and safety at the company
17	Testing equipment: Checking equipment in companies with materials that do not endanger the environment, the use of environmental friendly equipment	37	Changing attitude of customers: Prevention of marketing non-environmental friendly products, products with hazardous ingredients
18	Outside Endorsment: Environmental campaigns in the community, clean environmental revitalization programs, waste treatment facilities	3.8	Changing attitude of employees: Active participation of employees in the prevention of damage to the company's environment
19	Scrap: Removing scrap products from hazardous material waste, removing scrap products from toxic waste	39	Advertising/image issues: Carbon emission reduction, environmental education for people and children, ecosystem vitality
20	Rework: Waste from factory waste must be recycled, reuse of defective products		

3.3 Population and Sample

The population of this study is a financial manager in a manufacturing company in the province of Central Java. A total of 100 questionnaires were sent to the financial managers of large manufacturing companies in the province of Central Java. Finance manager is chosen because it is responsible for the costs incurred by environmental activities. Questionnaires returned as many as 43 questionnaires.

4. RESEARCH RESULTS AND DISCUSSION

4.1. Exploratory factor analysis and principal component analysis

Exploratory Factor Analysis (EFA) one of the analysis is in fact sequential and linear, involving many options (William, 2010). The various steps required in the classical EFA executing are all subject to a certain degree of arbitration and information on ad hoc judgments (Conti, Frühwirth-Schnatter, & James J. Heckman, 2014). This study proposes as many as 39 indicators of green accounting activities. The exploratory factor analysis process tries to find the relationship between new variables or form factors that are mutually independent each other so that one or several sets of latent variables or factors that are less than the number of initial variables that are free or uncorrelated can be made. So among factors that are formed do not correlate each other. The first step is to do an exploratory analysis for each group so that it is produced the indicators that can represent the group. The exploratory analysis was carried out by looking at Kaiser-Meyer analysis sampling adequacy value of 0.5 and minimum image value of 0.5 and the results of 21 indicators were obtained.

Table 2. Green accounting activities indicators adopted for research model

Green Accounting Activities Indicators			
1	Quality environmental engineering	21	Re-inspection
2	Training programs	22	Re-testing
3	Recruiting	23	Design changes
4	Reporting	24	Repairs
5	Supplier evaluation and selection	25	Recalls
6	Audits	26	Lost sales
7	Market research	27	Return/allowances
8	Field trials	28	Warranties
9	Vendor certification	29	Discounts due to defects
10	Vendor design review	30	Product liability
11	Inspection of raw materials	31	Customer dissatisfaction
12	Testing of raw materials	32	Lost market share
13	Packaging inspection	33	Complaint adjustments
14	Supervising appraisal activities	34	Regulatory and health
15	Product acceptance	35	Safety and environmental management
16	Testing equipment	36	systems
17	Outside endorsements	37	changing attitudes of customers
18	Scrap	38	Changing attitude employees
19	Rework	39	Advertising/image issues
20	Downtime		

4.2. Kaiser-Mayer-Olkin (KMO) measure of sampling adequacy

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Barlett's test of sphericity for the extraction factors can be used (Chan, Chan, Chan, & Lam, 2012). Kaiser-Meyer-Olkin and Bartlett's step analysis results show the following results:

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.765
Bartlett's Test of Sphericity	Approx. Chi-Square	118.652
	Df	55
	Sig.	.000

The results of the analysis of table 3 show that the KMO-MSA value is 0.765 so that it is greater than 0.50 and the value of Bartiett`s Test of Sphericity Approx. Chi Square is 118.665 with a significant level of less than 0.05. Therefore, factor analysis can be continued with the selected indicators.

4.3. Initial extraction of the components and rotation to a final solution

Factor component value can also be interpreted as the correlation between the factors formed with the components. The rotated component matrix with principal component analysis extraction method uses the selected varimax method. The result is that there are 5 components with each factor component value of the existing variable. If the component value factor ≥ 0.5 means that the dimension or sub-variable of the measurement of the factor is a member of the factor that is formed. Conversely, if the component value factor ≤ 0.5 means that the measurement sub-variable dimension is not a member of that factor. As seen in table 3, members of the factors formed for component 1 include of 1, 7, 9, 11, 36 and 37 sub variable. So that based on the results of the analysis of matrix components that have been rotated, it will produce a clear component division.

Table 4. Rotated Component Matrix

	Component				
	1	2	3	4	5
Varb2	.191	.291	.208	.096	.653
Varb5	.228	.122	.016	.736	.290
Varb7	.838	.299	.052	-.026	.073
Varb8	-.186	-.269	-.090	-.336	.621
Varb9	.640	.028	.335	.481	.216
Varb11	-.772	.110	-.280	-.197	.265
Varb16	.124	.536	.283	.343	.053
Varb17	.112	.856	-.031	.093	-.270
Varb18	.078	.372	.779	-.020	.117
Varb20	.339	-.630	.115	.248	.489
Varb22	.045	.378	.723	.170	.376
Varb23	.149	.520	.038	.317	.205
Varb24	.250	.421	.703	.109	.036
Varb25	.177	.267	.649	-.264	.172
Varb26	.299	.063	.552	.330	.-.301
Varb34	.352	.174	-.089	-.729	.189
Varb35	-.351	.260	.430	.633	.274
Varb37	.690	.389	.199	.441	.045
Varb36	.505	-.322	.257	.293	-.240
Varb38	.490	.150	.370	.145	.782

4.4. Interpreting the rotated solution and naming the components

Based on the results of the analysis of the matrix components that have been rotated, it results in the division of components. In this study, five components are shown in table 5.

Table 5. The constructs formed and indicators

The constructs formed	Indicators	
First component – Green support activities	1	Quality environmental engineering
	7	Market research
	9	Prototype inspections
	11	Vendor design review
	36	Regulatory and health
	37	Safety and environmental management System
Second component – Green appraisal activities	16	Product acceptance
	17	Testing Equipment
	20	Rework
	23	Re-testing
Third component – Green internal failure activities	22	Re-inspection
	24	Design change
	25	Repairs
	18	Outside endorsements
	26	Recalls
	34	Lost market share
Forth component – Green external failure activities	35	Complaint adjustments
	5	Supplier evaluation and selection
	Changing attitude of customers	
	2	Training programs
Fifth component – Green hidden activities	8	Field trials

The matrix component analysis shows that the green accounting indicators that have been designed in this study provide indicators of the five constructs formed.

4.5. Calculation of component scores matrics

In the explanation of the Matrix Score Component Coefficient, it emphasizes the form of the relationship model or the equation between the factors and the constituent variables. It should be understood that in factor analysis, all the dimensions or indicators of the factor or item have been transformed into standard data or Z data (Z data has an average = 0, variance = 1, and data without units or relative). The factor values for each sample is called the factor score (SF) and each factor score is the new data that composes a new variable from the compiler indicator or dimension or item. Below is the general form of the formula to compute scores on the first component extracted (created) in a principal component analysis:

$$C1 = b11\ (X1) + b12\ (X2) + \ldots + b1p\ (Xp)$$

where C1 is the participant's score on principal component 1 (the first component extracted); b1p the coefficient (or weight) for observed variable p, as used in creating principal component 1; Xp the participant's score on observed variable p.

The Component of Matrix Score or factor weight in this study is as follows:

C1 = 0,838Varb7 + 0,640Varb9 - 0,772Varb11 + 0,505Varb36 + 0,690Varb37

C2 = 0,536Varb16 + 0,856Varb17 - 0,630Varb20 + 0,520Varb23

C3 = 0,779Varb18 + 0,723Varb22 + 0,703Varb24 + 0,649Varb25 + 0,552Varb26

C4 = 0,736Varb5 - 0,729Varb34 + 0,633Varb35

C5 = 0,653Varb2 - 0,621Varb8 + 0,782Varb38

5. CONCLUSION

The increase of demand for environmentally friendly goods and services will increase along with environmental awareness in all industry sectors and society. Therefore, the importance of identifying green accounting activities become a necessity for all industries. In this study, it had been identified 39 indicators of green accounting activities developed by (Jeffers, 2008). It used factor analysis as many as 21 selected indicators with five constructs of green accounting activities. The first is green support activities with six indicators, they are Quality environmental engineering, Market research, Prototype inspections, Vendor design review, Regulatory and health and Safety and environmental management system. The second is green appraisal activities with four indicators such as product acceptance, testing equipment, rework and re-testing. The third is green internal failure activities with five indicators, namely re-inspection, design change, repairs, outside endorsements and recalls. The fourth is green external failure activities with three indicators namely lost market share, complaint adjustments, supplier evaluation, and selection. The last is green hidden constructs activities with three indicators, such as the changing attitude of customers, training programs, and field trials. Identification of indicators and measurements of green accounting activities can improve managerial planning, control, and decision making. The limitations of this study are the low collectability of questionnaires.

REFERENCES

Agatha E. Jeffers (2008). Development of framework To measure the financial and managerial implications of green accounting in U.S corporations, Review of business research, Vol 8 No 6

Amaechi Patrick Egbunike and Godsday Edesiri Okoro. (2018) Does Green Accounting Matter to The Profitability of Firms? A Canonical Assessment. Economics Horizon. 20(1) pp 15-23

Aronson, Thomas (1998) Welfare measurement, green accounting and distortionary taxes. Journal of Public Economics 70 (1998) 273–295

Baltelmus, Peter. (1999). Green accounting for a sustainable economy Policy use and analysis of environmental accounts in the Philippines. Ecological Economics 29 155-170

Bebbington, J., Russell, S., Thomson, I., (2017). Accounting and sustainable development: reflections and propositions. Critical. Perspective of Accounting. 48. pp 21-34.

Brett Williams, Andrys Onsman, Ted Brown (2010). Exploratory factor analysis: A five-step guide for novices. Journal of Emergency Primary Health Care. Vol. 8, Issue 3

Charles H. Cho., Dennis M. Patten. (2013). Green Accounting: Reflections from a CSR and Environmental Disclosure Perspective. Critical Perspective on Accounting. 24. pp 443-447

Gabriella Conti, Sylvia Frühwirth-Schnatter, James J. Heckmanc, Rémi Piateke. (2014) Bayesian exploratory factor analysis. Journal of Econometrics. 183 pp 31–57

Gengyuan Liu, Hans Schnitzer, Xinan Yin, Walter Pengue, Enrico Benetto, Donald Huisingh, Yutao Wang, Marco Casazza. (2018). Environmental accounting: In between raw data and information use for management practices. Journal of Cleaner Production 197

Joseph H.L. Chan, Daniel W.M. Chan, Patrick T.I. Lam (2012). Risk mitigation strategies for guaranteed maximum price and target cost contracts in construction: A factor analysis approach. Journal of Facilities Management Vol. 10 No. 1. pp. 6-25

Maryam Hosseini, Mohammad Saleh Owlia. (2016). Designing a model for measuring and analyzing the relational capital using factor analysis: Case study, Ansar bank. Journal of

Intellectual Capital, Vol. 17 Issue: 4, pp.734-757
Matthew Egan, Dale Tweedie, (2018). A green accountant is difficult to find: Can accountants contribute to sustainability management initiatives?. Accounting, Auditing & Accountability Journal
M. Stanojevic, S. Vranesa , I. Gkalp. (2010). Green accounting for greener energy. Renewable and Sustainable Energy Reviews. 14. pp. 2473–2491
Nielsen, S.N., (2016). Second order cybernetics and semiotics in ecological systems where complexity really begins. Ecological. Modelling. 319, 119-129.
Pretty, J., (2011). Interdisciplinary progress in approaches to address social-ecological and ecocultural systems. Environmental. Conservation. 38 (2), 127e139.
Rob Gray, Richard Laughlin, (2012). It was 20 years ago today: Sgt Pepper, Accounting, Auditing & Accountability Journal, green accounting and the Blue Meanies. Accounting, Auditing & Accountability Journal, Vol. 25 Issue: 2, pp.228-255
Yang, L., Kong, F.L., Xi, M., Li, Y., Wang, S. (2017). Environmental economic value calculation and sustainability assessment for constructed rapid infiltration
system based on emergy analysis. Journal Cleaner Production. 167. pp 582-588.
Zhao, R., Mou, Y., & Yu, X. (2025). Analysis of the moderating effects of environmental regulations on green accounting information disclosure and financial performance of heavily polluting enterprises. Finance Research Letters, 72, 106493.
Zhao, R., Mou, Y., & Yu, X. (2025). Analysis of the moderating effects of environmental regulations on green accounting information disclosure and financial performance of heavily polluting enterprises. Finance Research Letters, 72, 106493.