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Sustainable Supplier Selection Using AHP: A Green Purchasing Approach at PT Dapensi Trio Usaha

Riharsono Prastyantoro[1], Agus Purnomo[2], Andri Gunawan[3]
[1]Science and Data Study Program, Universitas Logistik dan Bisnis Internasional (ULBI), Bandung, Indonesia, soniriharsono@ulbi.ac.id
[2]Department of Master Logistics Management, Universitas Logistik dan Bisnis Internasional (ULBI), Bandung, aguspurnomo@ulbi.ac.id
[3]PT. Pos Indonesia (Persero), Bandung, Indonesia, andri_gunawan@stimlog.ac.id

Corresponding Author: soniriharsono@ulbi.ac.id[1]

Abstract: Green purchasing is an important issue in the manufacturing world, where all lines must implement the green concept in order to achieve a green concept that is friendly to the environment. PT Dapensi Trio Usaha in meeting the needs of its customers is faced with problems related to the selection of supplier criteria that have a green category so that it is hoped that later the procurement of goods that containing chemicals can meet the green standards set by ISO 14001. In the procurement process of goods containing chemicals, there are several vendors who have passed the administrative selection and can proceed directly to the tender stage. Among the companies that have met the administrative requirements are PT "A", PT "B", PT "C", PT "D" all of which have ISO 14001 certification from chemical goods providers as one of the main requirements to participate in the tender at PT Dapensi Trio Usaha. This study aims to determine the best supplier with the green purchasing concept using the Analytical Hierarchy Process (AHP) method.

Keywords: Green Purchasing, Green Supply Chain Management, Analytical Hierarchy Process

INTRODUCTION

The industrial business environment, in addition to the government, is currently also starting to encourage the need for environmental friendliness for its supply chain. Some examples can be put forward, including, PT Dapensi Trio Usaha as an affiliated company of PT Pos Indonesia (Persero) hereinafter referred to as PT DTU implementing a green purchase policy that forces its suppliers to have an ISO 14000 certificate as a requirement that must be met by suppliers to establish cooperation with PT DTU. Responding to the above conditions, as part of meeting stakeholder demands and at the same time as part of social responsibility, companies need to develop and manage an environmental management system. An environmental management system is part of an organization's management system that is used to develop and implement environmental policies and also as a guide for organizations in managing their environmental aspects. An environmental management system provides a

mechanism to achieve and demonstrate good environmental performance, through efforts to control the environmental impact of activities, products and services. The system can also be used to anticipate the development of demands and improve environmental performance from consumers, as well as to meet the requirements of environmental regulations from the government.

PT DTU as a business unit of the Pos Indonesia Pension Fund (Dapenpos) as well as an affiliate of PT Pos Indonesia (Persero). Initially, PT DTU was established to support the needs of PT Pos Indonesia. Along with the development and diversity of the Company's business portfolio, PT DTU has worked on the Government, Private and BUMN markets outside PT Pos Indonesia (Persero). PT DTU provides the best service and always provides solutions for mutually beneficial work partners with business concentrations consisting of Business Process Outsourcing (BPO), Cleaning Service, Security Service, Main Agent Pospay, and General Trading.

The General Support Division of PT DTU is tasked with procuring goods for operational needs. One of them is the procurement of goods containing chemicals such as: floor cleaners, wood, steel, and weed killers. In the procurement process, the General Support Division requires *suppliers* who will support the implementation of the procurement process. Among the suppliers registered to assist in the procurement of goods containing chemicals at PT DTU are PT "A", PT "B", PT "C", PT "D". The basic category used in determining suppliers based on the AHP (Analytical Hierarchy Process) method refers to the Green QCADF concept, namely determining suppliers based on the following aspects:

a) Green Quality/GQ (quality owned by the supplier)
b) Green Cost/GC (price offered by the supplier)
c) Green Accuracy/GA (timeliness of delivery and quantity of goods)
d) Green Delivery/GD (fast and appropriate delivery time)
e) Green Flexibility/GF (responsive in solving existing problems)

Among the categories determined by the General Support Division in determining suppliers is the green aspect, where in this aspect the supplier who will be selected must have an ISO 14000 certificate, where this certificate determines whether the supplier is worthy of becoming a partner of PT DTU, which prioritizes the green aspect in procuring goods containing chemicals for production support processes.

Based on the above explanation, this study aims to examine the process of implementing the green purchasing system in the process of purchasing goods that will be carried out by the General Support Division of PT DTU based on the categories contained in the AHP method. So that after knowing the best supplier, the green purchase concept can be implemented in the procurement process.

This study makes a novel contribution by combining the Analytical Hierarchy Process (AHP) method with the Green QCADF concept in the context of Green Purchasing within the industry. The primary objective is to integrate the five key aspects of green supplier selection (Green Quality, Green Cost, Green Accuracy, Green Delivery, and Green Flexibility) to ascertain suppliers who meet the criteria established by the ISO 14000 standard. This approach not only evaluates conventional selection criteria, but also prioritizes sustainability and environmental responsibility. The innovation of this study is evident in its application of a more specific and comprehensive combination of methodologies in the chemical procurement sector by PT Dapensi Trio Usaha, an affiliate of PT Pos Indonesia. Consequently, this study offers a more comprehensive and adaptable framework for evaluating regulatory requirements and meeting stakeholder expectations in the field of environmental management.

METHOD

Literatur Review

The term purchasing or purchase is synonymous with procurement or procurement of goods. Here is the definition of procurement according to Bodnar, GH, & William, SH (2010), Procurement is the business process of selecting a source, ordering, and acquiring goods or services. This opinion more or less means that procurement of goods is a business process in selecting resources, ordering and acquiring goods or services.

Brown, S. et al (2018) said that in general purchasing can be defined as managing the inputs into the organization's transformation (production process) . This opinion more or less means that purchasing is managing inputs into the organization's production process. The following is the opinion of Galloway, L. et al (2012) regarding the purchasing function is to make materials and parts of the right quality, and quantity available for use by operations at the right time and at the right place. This opinion more or less means that the role of the purchasing function is to procure materials and parts of the right quality and quantity available for use in operations at the right time and in the right place.

The importance of purchasing function management audit can be used to evaluate the organization as a whole or a specific function within the organization, to determine whether the company has achieved maximum cost efficiency from what has been implemented by the function so far. This study makes the purchasing function the target of the audit. The purchasing function is often considered the most important and influential part, it can even be said that most business processes come from purchasing activities. A very fundamental reason to discuss the purchasing function is because in this field waste easily occurs, either because of dysfunctional behavior or because of lack of knowledge in various aspects of purchasing materials, facilities, infrastructure and spare parts needed by the company.

This view according to Julyanthry, J. et al (2020) is easy to understand because in the production process the company requires raw materials. Not many companies control their own raw materials needed to be further processed into finished products, so it can be concluded that there is no form or type of company that is not involved in the purchasing function. The experience of many companies is that the cost of producing a product may reach around fifty percent of the selling price of the product, making the purchasing function a source of waste if not carried out properly and a source of savings that will increase the company's profits if carried out carefully and carefully.

Here are some reasons why purchasing is an important area as put forward by Brown, S. et al (2018), namely:

a) The purchasing function is responsible for managing the company's inputs at the right price, quality and delivery, which includes raw materials, services and sub-assemblies for the organization's needs.
b) The savings achieved through direct purchasing are reflected in the bottom line of the organization. In other words, once a price saving is made, it has a direct impact on the company's cost structure. Thus it is often said that a 1% purchase saving is equivalent to a 10% increase in sales.
c) Purchasing and supply of materials is related to all aspects of management operations.

Experts have conducted many studies on supply chain management. Some associate supply chain with product quality and innovation, some highlight that supply chain can affect company performance and some develop supply chain in an environmentally friendly form. Supply chain management is defined as the integration of procurement activities for materials and services, transformation of semi-finished goods and finished products, and delivery to end customers. All of these activities include purchasing and outsourcing, plus other functions that are important to the relationship between raw material suppliers and distributors.

Porter, ME (2003) introduced a concept of value chain activities known as five primary activities and four supporting activities carried out by each company. The five primary activities referred to are*:* inbound logistics, operations, outbound logistics, marketing & selling,

and after-sales service. While the four supporting activities are: company infrastructure, human resource management, technology development and procurement.

Every company activity in carrying out the production process through the selection of raw materials, then processing them into finished or semi-finished goods and then distributing them to consumers are activities related to supply chain management. In this context, we will discuss how companies carry out supply chain activities while maintaining the sustainability of the surrounding environment, commonly known as green supply chain management .

The concept of green supply chain management/green purchasing is currently a very popular concept in the Southeast Asia region. This concept is a way for organizations to show their sincere commitment to environmental sustainability. Green purchasing in companies focuses on increasing efficiency and synergy between business partners and companies, helping to improve environmental performance, minimize waste and achieve company cost savings.

Green purchasing involves companies, suppliers and distributors in environmental conservation programs. In carrying out the production process, companies are expected to be able to carry out clean production programs, environmental design, pollution reduction, proper waste management, waste recycling and the application of environmentally friendly technology. Of course, all of these things can be realized with the help of suppliers and distributors as business partners of the company.

The strategy of managing environmentally friendly raw materials is known as green purchasing. Green purchasing can address issues such as reducing waste generated, substituting environmental materials through sourcing raw materials, and minimizing hazardous raw material waste. Involvement and support from suppliers are essential to achieving these goals. Min, H., & Choi, SB (2020) identified that high costs of environmental programs, uneconomical recycling, and uneconomical reuse are the three most important barriers and obstacles to green purchasing.

Suppliers are involved in the form of providing environmentally friendly raw materials, distribution, providing environmentally friendly tools and technology, and creating their own environmental programs. Suppliers as providers of raw materials for the company play a fairly important role in the success of the company in producing quality goods and meeting environmentally friendly aspects.

Waste management in the form of recycling and reuse greatly helps companies in making cost savings and competitiveness. For example, the use of packaging whether it is made of glass, metal, paper or plastic, contributes greatly to the flow of solid waste. According to Rao, P. et al (2009) stated that recycling and reuse are key strategies adopted by several companies in Southeast Asia that actively participate in packaging reduction programs.

Data Collecting and Processing

In data collection there are several things that are done, namely:

a) Identification of data and problems in the company related to green purchasing issues..
b) Collecting data from respondents who are competent in the field of green purchasing and the procurement process of goods containing chemicals .
c) The compilation of the problem hierarchy begins with identifying the problem elements related to selecting the best supplier based on the green purchasing concept, which consists of:
    1. Level 0, The target or objective of compiling the problem hierarchy is to determine the best supplier based on the green purchasing concept that has the best performance, namely the highest priority weight.

2. Level 1, are the criteria that are the conditions used to achieve the objectives of the problem hierarchy. The criteria for selecting the best supplier based on the green purchasing concept are as follows:
   - Green Quality GQ
   - Green Cost GC
   - Green Accuracy GA
   - Green Delivery GD
   - Green Flexibility GF
3. Level 2, is a sub-criteria which is an explanation of the criteria. The following are the sub-criteria of the above criteria:
   - Green Materials GM
   - Certification ISO 14001 CI
   - Competitive Price CP
   - Price Discount PD
   - Right on Time RoT
   - Right on Number RoN
   - Green Vehicle GV
   - Green Pollution GP
   - Quick Response QR
   - Responsibilities RS
4. Level 3, alternative is the determination of the highest criteria, namely the highest priority weight of the best suppliers based on the green purchasing concept chosen by PT DTU. Suppliers who participated in the procurement auction for goods containing chemicals at PT DTU are as follows:
   - PT "A"
   - PT "B"
   - PT "C"
   - PT "D"

   This series of indicators will be the main input in assessing the implementation of the green purchasing concept at PT DTU. With a percentage weight for each criterion based on the success of the green purchasing concept .

d) Data processing based on respondent data using the AHP method as a tool used to solve problems in companies related to green purchasing issues.

RESULT AND DISCUSCION

After processing the raw data from respondents, the following results were obtained:

Table 1. Priority Weights on Criteria

No	Criteria	Weight	Percentage
1	Green Quality	0.3153	31.53%
2	Green Cost	0.1820	18.20 %
3	Green Accuracy	0.1821	18.21 %
4	Green Delivery	0.1552	1 5 , 52 %
5	Green Flexibility	0.1654	1 6 , 54 %
Amount			**100%**

Source: analysis results

By looking at the table above, it can be concluded that PT DTU in determining suppliers who have green criteria for procuring goods containing chemicals prioritizes Green Quality (GQ) with a percentage of 31.53 %, because goods containing chemicals are in the urgent category, materials that the procurement process requires fast time and high accuracy. That the

criteria Green Accuracy (GA) is in 2nd place with a percentage weight of 18.21 %, then in third place is Green Cost (GC) which has a percentage of 18.20 %. And in 4th place is the Green Flexibility (GF) criterion which has a percentage weight of 1.6.54 %. Then in last place is Green Delivery (GD) which has a percentage weight of 1.5.52 % .

Table 2. Priority Weights for Sub-criteria

No	Sub Criteria	Weight	Percentage
1	Green Material	0.1792	17.92%
2	ISO 140001 Certification	0.1361	13.61%
3	Competitive Price	0.0786	7.86%
4	Price Discount	0.1035	10.35%
5	On time	0.0555	5.55%
6	Exact Amount	0.1266	12.66%
7	Green Vehicle	0.0568	5.68%
8	Green Pollution	0.0984	9.84%
9	Quick response	0.0714	7.14%
10	Responsibility	0.0940	9.40%
Amount			**100%**

Source: analysis results

PT DTU in determining the best supplier that is in accordance with the green purchasing concept, the first thing that is assessed is in terms of green material (GM) which has a percentage weight of 17.92 %, with the reason that to achieve the green purchasing concept, the material sent by the supplier must be truly green. And in second place is in terms of ISO 140001 Certification which has a priority weight value of 13.61%. In third place in determining the best supplier is the criterion in terms of Right Amount (RoN) with a weight of 12.66%. In fourth place is the price discount (PD) criterion with a weight of 10.35%. Then in fifth place is the green pollution (GP) criterion which has a weight of 9.84%. In sixth place is the responsibility criterion (RS) with a weight of 9.40%. In seventh place is the supplier assessment in terms of competitive price (CP) with a weight of 7.86%. In eighth place is the responsiveness criterion (QR) which has a weight of 7.14%. Then in ninth place PT DTU in determining suppliers is assessed in terms of green vehicle (GV) which has a weight of 5.68%. In last place is the On-time (RoT) criterion which has a weight of 5.55% .

After data processing is carried out with the support of data that has been collected by the author during the research using the AHP method as a problem-solving method, the priority order of the best suppliers that prioritize the green purchasing concept can be known starting from the first process with the largest weight, to the last priority with the lowest weight. The order of the best suppliers is as follows:

Table 3. Priority Weights on Alternatives

No	Alternative	Weight	Percentage
1	PT. “A”	0.2859	28.59%
2	PT. “B”	0.2591	25.91%
3	PT. “C”	0.2424	24.24%
4	PT. “D”	0.2569	25.69%
Amount			**100%**

Source: analysis results

Based on the weighting results, the supplier which has the highest priority weight of 0.2859 or a percentage of 28.59 % is PT . "A". Then in second place is PT. "B" with a weight of 0.2591 and if expressed as a percentage it becomes 25.91%. In third place is PT. "C" which has a weight of 0.2569 and if expressed as a percentage it is 25.69%. And in last place is PT.

"C" which has a percentage of 24.24% and PT. "C" must improve its performance in order to compete with other companies.

Consistency tests are conducted on paired matrices and on hierarchical structures. A paired comparison matrix assessment result can be said to be consistent if the CR value is less than 0.1 (CR <0.1). Likewise for consistency testing if the CRH value is less than 0.1. Consistency is very important to obtain accurate results from the research results conducted. Therefore, each answer given by the respondent must be tested for consistency. So that the results of the research can be accurate and can be used as a proposal for solving problems in the company.

The consistency value is obtained by comparing the consistency index with the random index value for the appropriate comparison matrix order. From the previous calculation, namely the consistency test for each pairwise comparison matrix and the value obtained from the test for each matrix is not less than 0.1 or in a percentage of 10%. So if each matrix has a value of less than 0.1 then the answer from each respondent is consistent.

Table 4. Results of calculating the ratio against the Criteria

No	Criteria	CR
1	*Green Quality* (GQ)	0.0000
2	*Green Cost* (GC)	0.0000
3	*Green Accuracy* (GA)	0.0000
4	*Green Delivery* (GD)	0.0000
5	*Green Flexibility* (GF)	0.0000

Source: analysis results

Table 5. Consistency Ratio Against *Sub*- Criteria

No	Sub Criteria	CR
1	Cheap	0.5682
2	Discount	0.4318
3	Friendly	0.4316
4	*Responsiveness*	0.5684
5	Clean	0.3048
6	Well maintained	0.6952
7	Effective	0.3659
8	Flexible	0.6341
9	On time	0.4317
10	Exact Amount	0.5683

Source: analysis results

A problem hierarchy can be said to be consistent if the CRH calculation is less than 0.1 or in percentage 10% and is stated as consistent. From the previous calculation, the CRH calculation from the comparison of the hierarchy structure level has a value of less than 0.1 or in percentage is 10%. The consistency of the hierarchy ratio for level 0 to level 1 is 0.0490, while for level 1 to level 2 the results are as follows:

Table 6. Consistency Ratio Against Criteria

No	Criteria	CRH
1	*Green Quality* (GQ)	0.0785
2	*Green Cost* (GC)	0.1000
3	*Green Accuracy* (GA)	0.0000
4	*Green Delivery* (GD)	0.0441
5	*Green Flexibility* (GF)	0.0497

Source: analysis results

Based on the results of the previous calculations, it shows that the hierarchical structure that has been created is consistent, because the hierarchy consistency ratio is less than 0.1 or if expressed as a percentage is 10%. Therefore, the information provided during the pairwise comparison process is quite accurate by having a value of i for all pairwise comparison matrices and a consistent hierarchy structure, then the process of determining the criteria for suppliers of goods containing chemicals by prioritizing the concept of green purchasing, priority can be carried out and it is hoped that it can provide maximum results for the company.

PT DTU in determining suppliers has policies in implementing the procurement process, among the important things are those related to the completeness of the administration that must be owned by the supplier before the auction process continues to the next stage, among the documents that must be fulfilled as administrative requirements are as follows:

A. Company Business License
B. Company Registration Certificate
C. Taxpayer Identification Number
D. Construction Services Business License as a requirement for construction services tenders
E. Bank Reference Letter
F. Proof of tax payments for the last 3 months and annual tax
G. Certificates that support participation in tenders, in this case procurement of goods containing chemicals. So the certificate that must be owned is the ISO14001 Certificate from the manufacturer that produces goods containing chemicals .

From the requirements of point G above, it shows that PT DTU has great concern for environmental sustainability which is included as a requirement to become a vendor. Thus, PT DTU has developed and implemented Green Purchasing in the procurement process of raw materials related to environmental sustainability.

CONCLUCION

From the results of research conducted by the author on the analysis of determining goods cointaing chemicals suppliers by prioritizing the green purchasing concept in the General Support Division PT DTU uses the AHP method, so the author can conclude that:

A. PT DTU in determining the best supplier that is in accordance with the green purchasing concept , the first thing that is assessed is in terms of green material (GM) which has a percentage weight of 17.92 %, with the reason that to achieve the green purchasing concept, the material sent by the supplier must be truly green. And in second place is in terms of ISO 140001 Certification which has a priority weight value of 13.61%. In third place in determining the best supplier is the criterion in terms of Right Amount (RoN) with a weight of 12.66%. In fourth place is the price discount (PD) criterion with a weight of 10.35%. Then in fifth place is the green pollution (GP) criterion which has a weight of 9.84%. In sixth place is the responsibility criterion (RS) with a weight of 9.40%. In seventh place is the supplier assessment in terms of competitive price (CP) with a weight of 7.86%. In eighth place is the responsiveness criterion (QR) which has a weight of 7.14%. Then in ninth place PT DTU in determining suppliers is assessed in terms of green vehicle (GV) which has a weight of 5.68%. In last place is the On-time (RoT) criterion which has a weight of 5.55%.
B. Based on the weighting results, the supplier which has the highest priority weight of 0.2859 or a percentage of 28.59 % is PT . "A". Then in second place is PT. "B" with a weight of 0.2591 and if expressed as a percentage it becomes 25.91%. In third place is PT. "C" which has a weight of 0.2569 and if expressed as a percentage it is 25.69%. And in last place is PT. "C" which has a percentage of 24.24% and PT. "C" must improve its performance in order to compete with other companies.

C. PT DTU's policy of referring to green purchasing in determining supplier selection is not only for the procurement of goods containing chemicals only, but also for other raw materials related to environmental impacts that require green in all lines, especially raw materials that will be used by PT DTU, with reference to the ISO 14000 concept.

This study possesses limitations due to its confined focus on PT Dapensi Trio Usaha and the specific realm of chemical procurement, consequently reducing the generalizability of the obtained results. The application of the AHP method herein heavily hinges upon subjective judgment, thereby potentially introducing bias into the findings. Furthermore, the study exclusively addresses the Green QCADF and ISO 14000 aspects, disregarding external variables such as broader government regulations.

Subsequent studies should endeavour to broaden the scope of investigation by encompassing other industries and non-chemical materials. Employing alternative methodologies like TOPSIS or VIKOR has the potential to mitigate subjective bias. Moreover, incorporating more stringent international regulations and environmental standards would enhance the comprehensiveness of the analysis.

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