

# Risk Analysis of Green Purchase Management: A Case Study of a Mattress and Bedding Manufacturer

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## Abstract

This study aimed to identify the risk factors and management strategies in green purchasing specific to a mattress and bedding manufacturer. The study employed various tools, including questionnaires, focus group discussions, and statistical analysis of risk assessment surveys. The findings revealed that environmental policy, pricing, and vendors posed a moderate level of risk, while product characteristics and unethical practices posed a high level of risk. Based on these identified risks, the study recommends the utilization of the 4T risk management framework, which involves treating, accepting, transferring, and avoiding risks. The implications of this study are significant as it provides guidance to the company in developing effective risk management plans for green purchasing. Additionally, it contributes to the broader discourse on sustainable procurement.

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**Keywords:** Purchasing, Green Purchasing, Risk Management, Green Supply Chain Management

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## Introduction

In recent years, the issue and impact of environmental problems have played a significant role in the supply chain system (Transchel & Pagell, 2010; Qu & Oyler, 2018) due to the global trend of reducing ecological matters. These can see through

the development of green supply chain management, which emphasizes continuous improvement and development of processes. The focus is on materials that can become waste, wasted energy use, and resource depletion.

In the process of purchase, it is considered the starting point of the supply chain, a



critical step in controlling the cost and quality of products, and an action with a high risk of corruption; as Ware (2007) pointed out that the purchase process is a perennial source of corruption. In addition, an organization's purchasing department is also a unit that efficiently drives the green supply chain, as the purchase process must comply with operational standards, including the selection of suppliers and the consideration of raw materials. It has a responsibility towards the environment and stakeholders. By creating collaboration between the buying organization and the supplier and promoting the use of clean production principles, organizations must prioritize the purchase process and receive support from management to promote environmentally-friendly organizational practices (Chidchob & Planthong, 2018)

The case study company is a mattress and bedding manufacturer that offers two main types of products: finished goods and make-to-order products. In terms of raw material procurement, the company categorizes its purchasing into two types: direct materials and indirect materials. These materials, throughout their lifecycle, have significant environmental impacts. However, the company's supplier selection criteria solely focus on quality, price, delivery, and service, without considering environmental factors. As mentioned above, environmental issues will become increasingly important in business responsibility in the future (Matthews, 2021; Aguilar, 2021), and this issue has significant attention in the case study company. Consequently, the authors of this research are convinced of the necessity to investigate the risk factors and management practices associated with purchasing for environmental

sustainability within the case study company. Thus, the objective of this study is to provide guidance to the case study company in formulating an appropriate risk management strategy for sustainable purchasing, which can be employed in the future.

### **The objectives of this study are**

1. To identify the risk factors in the green purchasing of a case study company.
2. To propose strategies for effectively managing green purchasing in a case study company.

## **Literature review**

### **The concept of environmental purchasing**

Green purchasing is a process or a procedure for the purchase or the selection of raw materials from suppliers, including collaborating with v agents or partner companies to source environmentally friendly raw materials to replace those that may be hazardous to the environment (Yen & Yen, 2012). It involves sourcing raw materials that can reduce waste generated during production and stimulate the production of green products that encourage manufacturers to pay attention to the environmental impact of their products. Additionally, The article by Bai & Sarkis (2021) examines the relationship between environmental responsibility and financial performance. The results show a positive relationship between environmental responsibility and financial performance, suggesting that



firms that adopt environmentally responsible practices can achieve better financial results. Finally, the article highlights the potential benefits of green supply chain practices for companies in the industry.

The triple bottom line approach, rooted in sustainability theory, provides a valuable framework for integrating environmental, social, and economic considerations into green purchasing practices. As highlighted by Elkington (1998), the triple bottom line expands the traditional focus solely on financial performance and encourages organizations to evaluate their impact in three dimensions: planet, people, and profit. In the context of green purchasing, this approach encourages businesses to consider not only the economic feasibility of procurement decisions but also the environmental sustainability and social responsibility aspects. By incorporating ecological criteria into supplier selection, product design, and consumption patterns, organizations can contribute to a more sustainable future while ensuring long-term profitability and societal well-being. The triple bottom line approach provides a holistic framework for organizations to align their green purchasing practices with their sustainability goals and to foster positive outcomes for the environment, society, and the economy.

### **The concept of risk**

Risk refers to any uncertain event or action that, if it occurs, will negatively impact the objectives or goals of an organization or reduce the likelihood of achieving the objectives and goals of a

plan/project in pursuit of its mission and vision. Risks are classified into three types: 1) Hazard, which is a risk that poses a danger or threat; 2) Uncertainty, which is a risk that is uncertain or unpredictable; and 3) Opportunity, which is a risk that presents an opportunity for gain or benefit. (Suwannasarn, 2009; Kongswakiat, Pipitnawwarat, & Sumethiprasit, 2013)

### **The risk management framework based on COSO guidelines**

1) Risk management identifies, analyses, assesses, monitors, and controls activities, tasks, and processes risks. Its purpose is to minimize the impact of potential hazards on an organization and to ensure that the organization prepares to respond to any threats that do occur (King Mongkut's Institute of Technology Ladkrabang, 2019)

2) Event identification is a process used in risk management to identify all possible events that could impact an organization. These include both internal and external factors that may cause risks. By identifying events that could occur, an organization can then take steps to prepare for and mitigate those risks.

3) Risk assessment is a process used to evaluate the likelihood and potential impact of identified risks. It usually does in two dimensions: the probability that a change will occur and its effect if it does appear. An organization can prioritize its efforts to address the most critical risks by assessing risks.



4) Risk response is the process of deciding how to respond to identified risks. This process involves evaluating the potential impact of the risk and determining whether the organization is willing to accept that level of risk or whether it needs to take action to mitigate the risk. There are four main types of risk response: avoidance, reduction, sharing, and acceptance.

5) Control activities are policies and procedures to prevent or detect risks. They design to ensure that an organization's policies follow and that risks are identified and addressed promptly. Control activities may include physical security measures, automated controls, and management review procedures.

6) Information and Communication: Risk management data must be identified, recorded, and stored in a format and timeframe that enables relevant personnel to perform their responsibilities.

7) Monitoring: Risk management within an organization must involve tracking and assessing the performance of each component of the risk management process as specified within the designated timeframes. (Cross, 2021; Neumann, 2020; King Mongkut's Institute of Technology Ladkrabang, 2019)

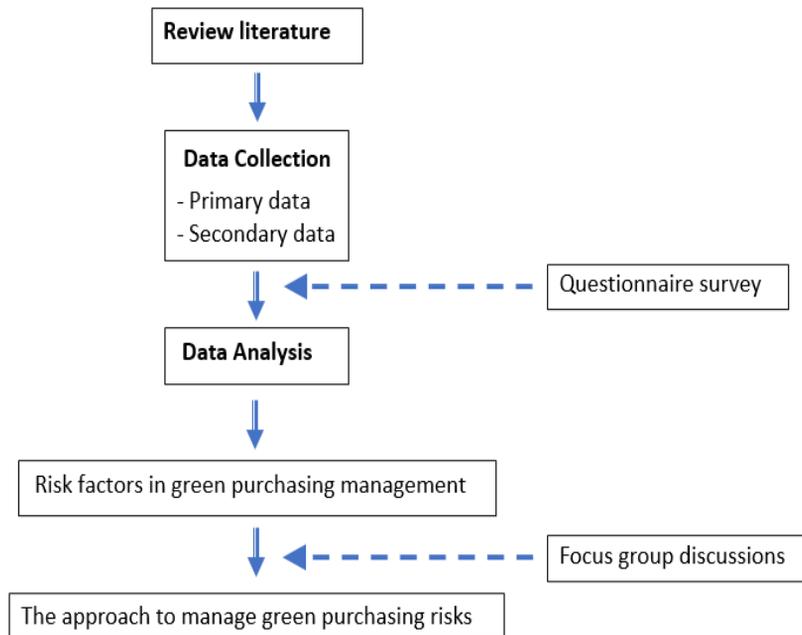
## **4T risk management**

The 4T risk management framework, comprising Transfer, Take, Treat, and

Terminate, provides a structured approach for effectively managing risks in various organizational contexts. According to Chen et al. (2019), the Transfer stage involves transferring risks to external parties through mechanisms like insurance or contractual agreements, reducing the organization's exposure. The Take stage involves accepting risks that cannot be easily transferred, and developing strategies to mitigate their potential impact. The Treat stage focuses on implementing measures to actively address and minimize identified risks through preventive actions, continuous monitoring, and timely interventions. Lastly, the Terminate stage aims to eliminate risks altogether by reassessing the need for certain activities or processes that pose substantial risks to the organization. By employing the 4T risk management framework, organizations can enhance their risk management practices, effectively allocating resources, and safeguarding against potential threats.

## **Research methodology**

This qualitative study was conducted to identify risk factors and risk management strategies for environmental purchasing in a case study company. The research methodology includes the following procedures.



**Figure 1** The framework of the research approach

## The population

The research participants (population) in this research were 31 employees who work in a case study company, all directly involved in procurement and inventory management, including those in the procurement department, operations department, and inventory department. The details are as follows: 2 top-level management, four middle-level management, seven supervisory-level management, seven purchasing staff, six operational staff, and five warehouse staff—the data collected from the case study company (Bangkok's mattress and bedding manufacturer).

## Research tools

The research tools used in this study were structured questionnaires, which collected general information from the respondents, including job positions, years of experience in procurement, and types of purchased goods. In addition, the five environmental purchasing risk factors were also collected, including policy risk, specification or quality risk, price risk, supplier risk, and fraud risk (Narayanan, & Ranganathan, 2014; Cummins, 2017)—the data collection using a 5-level proportional estimation scale.

After assessing the level of risk, focus on group discussions were conducted with top-level management, middle-level management, and supervisory-level management to identify approaches to



manage risks in all five areas: policy, specification or quality risk, price risk, supplier risk, and fraud risk.

## **Data collection**

1. Primary data collection through questionnaires and focus group discussions to gather information for this study.
2. The researcher collected secondary data by studying academic articles, research papers, and other relevant green purchasing risk management documents.

## **Data analysis**

The authors analyzed the data using content analysis, which involved categorizing data according to the predetermined study framework and analyzing quantitative data from the assessment tool using frequency distribution and percentages, as well as mean and standard deviation are utilized in preliminary data analysis to describe the characteristics of a dataset. The mean provides insight into the average value, giving an idea of the dataset's typical value. In contrast, the standard deviation

indicates the extent to which values deviate from the mean, revealing the spread or variability of the data points. Overall, the mean and standard deviation provide essential descriptive statistics that aid in summarizing and interpreting the dataset.

Subsequently, the authors analyzed the results to draw nominal conclusions about risk factors for developing risk management strategies based on the COSO risk management framework (Martin-Vegue, 2018; Anderson, 2018). In addition, the 4T risk management concept also addresses risk response questions per the research objectives (Welcher, 2017; Heller, 2018).

## ***Data interpretation***

The authors collected data from the assessment form, then calculated the overall level of risk by multiplying the likelihood of the risk occurrence by the severity of the impact of the risk. The average value was then obtained and used to analyze the level of risk by classifying it according to the color in the Risk Matrix and criteria as follows.

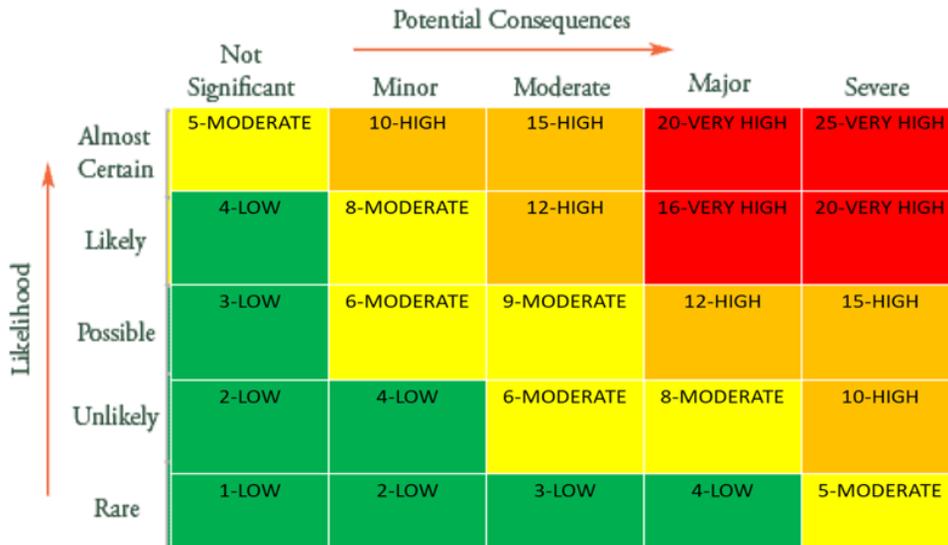


Figure 2 5x5 Risk matrix used for analyzing data

Adapted from: Can Public Health Risk Assessment Using Risk Matrices Be

Misleading? By Vatanpour, S., Hrudey, S., & Dinu, I., (2015).

VERY HIGH	HIGH	MODERATE	LOW
(16.00 – 25.00)	(10.00 - 15.99)	(5.00 – 9.99)	(1.00 – 4.99)

Figure 3 Criteria for Data Interpretation

**Statistics used to analyze data**

The authors used inferential statistics for analysis. The general data of the respondents were analyzed using frequency and percentage, while the data on risk factors in environmental purchasing were analyzed using mean and standard deviation.

**Research finding**

This study aims to examine the level of risk factors in green purchasing and provide guidelines for managing the risks involved. The following is a detailed data analysis divided into topics based on the study's objectives.



### The Level of risk factors in green purchasing management of a case study company

According to the green purchasing risk assessment questionnaire, there were 31 respondents in various positions. Of these

respondents, 2 (6.4%) were in top-level management, 4 (12.9%) were in middle-level direction, 7 (22.6%) were in supervisory-level direction, 7 (22.6%) were in purchasing staff, 6 (19.4%) were in operational staff, and 5 (16.1%) were in warehouse staff positions. The results shown in Tables 1 to 5

**Table 1** Green purchasing risk assessment- Policy Risk

Risk	Mean ( $\bar{x}$ )	S.D.	Level of risk
1. The process and operational methods for carrying out environmental purchasing operations have not been specified (Kittiwattamrong, 2017)	4.5	2.958040	Low
2. No budget is set for each purchase, and the purchasing budget does not include any measures to reduce environmental impacts (Kittiwattamrong, 2017)	5.75	4.023369	Moderate
3. The management team is not aware of the importance of having policies for environmental operations (Kittiwattamrong, 2017)	7	2.738613	Moderate
4. No communication or understanding with employees regarding environmental policies and green purchasing procedures for ecological sustainability (Kittiwattamrong, 2017)	6.25	3.766630	Moderate
<b>Total</b>	<b>5.88</b>	<b>0.536786</b>	<b>Moderate</b>

From Table 1, the analysis results of policy risk analysis in green purchasing show an overall average level ( $\bar{x}$ = 5.88). All three were at an intermediate level upon examining the specific items. Firstly, The management team needs to be made aware of the importance of having policies for environmental operations ( $\bar{x}$  = 7). Secondly, there needs to be more communication and understanding with employees regarding ecological policies

and green purchasing procedures for environmental sustainability ( $\bar{x}$  = 6.25). Lastly, no budget is for each purchase, and the purchasing budget does not include any measures to reduce environmental impacts ( $\bar{x}$  = 5.75). The process and operational methods for conducting ecological purchasing operations have not been specified; the mean score is low ( $\bar{x}$  = 4.5).



**Table 2** Green purchasing risk assessment - Product characteristics (Specification risk)

<b>Risk</b>	<b>Mean (<math>\bar{x}</math>)</b>	<b>S.D.</b>	<b>Level of risk</b>
1. The purchasing staff does not conduct a study on the environmental impact or reduction of the environmental effects of products before making purchasing decisions. (Kittiwattamrong, 2017; ESG Impact Assessment Report: THIS, 2021)	14.5	7.228416	High
2. No prior identification of environmental product characteristics before each purchasing process (Kittiwattamrong, 2017; ESG Impact Assessment Report: THIS, 2021)	13	2.738613	High
3. No inspection of product characteristics after receiving them (Kittiwattamrong, 2017; ESG Impact Assessment Report: THIS, 2021)	4.25	1.47902	Low
<b>Total</b>	<b>10.58</b>	<b>2.467578</b>	<b>High</b>

From Table 2, the overall level of risk analysis of green purchasing in terms of Specification Risk is high ( $\bar{x}$ = 10.58). However, when considering specific findings, there are two high-risk areas. The first is that the purchasing staff needs to conduct a study on the environmental impact or reduction of the environmental

effects of products before making purchasing decisions. ( $\bar{x}$  = 14.5). The second is no prior identification of environmental product characteristics before each purchasing process ( $\bar{x}$  = 13). Conversely, the low-risk area does not inspect product characteristics after receiving them ( $\bar{x}$ = 4.25).



**Table 3** Green purchasing risk assessment - Price Risk

Risk	Mean ( $\bar{x}$ )	S.D.	Level of risk
1. The approving authority must consider whether the product has environmental sustainability measures when approving the purchase price, even if the environmentally sustainable development has a higher price than the regular product. (Kittiwattamrong, 2017; ESG Impact Assessment Report: THIS, 2021)	6.75	1.785357	Moderate
2. The purchasing process did not involve requesting quotations from each vendor before making the purchase (Kittiwattamrong, 2017)	11.5	8.381527	High
3. No regular updating of purchase orders from the same supplier by the purchasing staff. (Kittiwattamrong, 2017)	6	3.082207	Moderate
4. If the price of the purchased product is higher than the set price, the purchasing staff proceeds with the purchase without seeking approval from the authorized person before the purchase (Kittiwattamrong, 2017)	11.75	8.166241	High
<b>Total</b>	<b>9</b>	<b>2.956809</b>	<b>Moderate</b>

From Table 3, the analysis of green purchasing risk considerations in terms of price (Price Risk) shows an overall moderate level ( $\bar{x}= 9$ ). However, when considering specific items, there are two high-risk areas. First, if the purchased product's price is higher than the set price, the purchasing staff proceeds without seeking approval from the authorized person before the purchase ( $\bar{x}= 11.75$ ). The second is that the purchasing process did not involve requesting quotations from each vendor before purchasing ( $\bar{x}=$

11.5). Conversely, there are also two moderate-risk areas. The first is that The approving authority needs to consider whether the product has environmental sustainability measures in place when approving the purchase price, even if the environmentally sustainable development has a higher price than the regular product. ( $\bar{x}= 6.75$ ). The second is no regular updating of purchase orders from the same supplier by the purchasing staff ( $\bar{x}= 6$ ).



**Table 4** Green purchasing risk assessment - Supplier Risk

Risk	Mean ( $\bar{x}$ )	S.D.	Level of risk
1. The company's vendors/supplier selection criteria do not specify any criteria for selecting vendors who conduct environmentally-friendly operations (such as being certified with ISO 14000 standards, having a green label, or complying with environmental requirements). (Kittiwattamrong, 2017; ESG Impact Assessment Report: THIS, 2021)	4.5	4.330127	Low
2. The company has no requirements for vendors/suppliers to comply with regarding the environment, such as treating wastewater, using resources efficiently, and reducing greenhouse gas emissions in transportation. (Kittiwattamrong, 2017; ESG Impact Assessment Report: THIS, 2021)	12.5	8.616844	High
3. The company needs a better relationship with a vendor/supplier. (Kittiwattamrong, 2017; ESG Impact Assessment Report: THIS, 2021)	3.5	2.061553	Low
4. The company needs the authority to negotiate with vendors/suppliers the authorized person before the purchase. (Kittiwattamrong, 2017)	6	3.535534	Moderate
<b>Total</b>	<b>6.63</b>	<b>2.43821</b>	<b>Moderate</b>

From Table 4, the analysis result of supplier risk level for green purchasing shows that the overall level is moderate ( $\bar{x}$  = 6.63). Upon reviewing each item, one item is at a high level, which is that the company does not have any requirements for vendors/suppliers to comply with regarding the environment, such as treating wastewater, using resources efficiently, and reducing greenhouse gas emissions in transportation ( $\bar{x}$  = 12.5). One item is at a moderate level: the company does not have the authority to

negotiate with vendors/suppliers the authorized person before the purchase ( $\bar{x}$  = 6). And two items are at a low level, which is that The company's vendors/supplier selection criteria do not specify any criteria for selecting vendors who conduct environmentally-friendly operations (such as being certified with ISO 14000 standards, having a green label, or complying with environmental requirements) ( $\bar{x}$  = 4.5) and that The company has a poor relationship with a vendor/supplier ( $\bar{x}$  = 3.5)



**Table 5** Green purchasing risk management- Fraud Risk

Risk	Mean ( $\bar{x}$ )	S.D.	Level of risk
1. No counting or environmental feature checking of the delivered products (Kittiwattamrong, 2017) (ESG Impact Assessment Report: THIS, 2021)	16.75	8.613217	Very high
2. After inspecting the products, the poor storage caused frequent loss of the products (Kittiwattamrong, 2017)	12.5	8.616844	High
3. No system in place to prevent corruption between decision-makers and suppliers during purchasing (Kittiwattamrong, 2017)	16.75	8.613217	Very high
4. No penalty is specified for those who engage in purchasing fraud (Kittiwattamrong, 2017)	16.75	8.613217	Very high
<b>Total</b>	<b>15.69</b>	<b>0.001571</b>	<b>High</b>

From Table 4.1.5, the analysis results of green purchasing fraud risk show that the overall level is high ( $\bar{x} = 15.69$ ). Upon further examination, it found that all three issues are at a very high level, which is: 1) No counting or environmental feature checking of the delivered products ( $\bar{x} = 16.75$ ), 2) No system in place to prevent corruption between decision makers and suppliers during purchasing ( $\bar{x} = 16.75$ ), and 3) No penalty specified for those who engage in purchasing fraud ( $\bar{x} = 16.75$ ). One issue is at a high level, which is that After inspecting the products, the poor storage caused frequent loss of the products ( $\bar{x} = 12.5$ )

**The approach strategies for managing green purchasing risks in the case study company.**

After conducting a risk assessment, a focus group discussion was held with all 13 individuals with decision-making power in direct purchasing management, including top-level, middle-level, and supervisory-level management. The goal was to identify ways to manage risks in all five aspects: policy, specification or quality, price, supplier, and fraud. The results from the focus group discussion were collected and analyzed using the COSO risk management framework. The responding to risk issues, the 4T risk management concept was applied, as outlined in Table 6-10



**Table 6** Green purchasing risk management - Policy Risk

<b>Risk</b>	<b>Level of risk</b>	<b>4T Risk management framework</b>	<b>The implementation of risk management strategies</b>
1. The process and operational methods for carrying out environmental purchasing operations have not been specified	Low	Treat	To set the operational processes and procedures for green purchasing and ensure all have documented in writing
2. No budget sets for each purchase, and the purchasing budget does not include any measures to reduce environmental impacts	Moderate	Treat	To Establish a purchase budget that takes into account environmental considerations
3. The management team is not aware of the importance of having policies for environmental operations	Moderate	Take	The purchasing staff must monitor and manage environmental risks themselves.
4. No communication or understanding with employees regarding environmental policies and green purchasing procedures for ecological sustainability	Moderate	Treat	Provide staff training on environmental purchasing processes and require them to study the company's environmental policies.

*Source: Focus group discussion, 2023*

From Table 6, the Policy Risk category consists of a total of four risks, with all four falling under the moderate risk level. However, it is still crucial for the company to prioritize these risks as policies remain integral in managing the

organization and providing a direction for green purchasing practices to achieve success. These risks present a certain level of risk, and the risk mitigation strategies to prevent such risks are indicated in Table 6.



**Table 7** Green purchasing risk management - Product characteristics (Specification risk)

<b>Risk</b>	<b>Level of risk</b>	<b>4T Risk management framework</b>	<b>The implementation of risk management strategies</b>
1. The purchasing staff does not conduct a study on the environmental impact or reduction of the environmental impact of products before making purchasing decisions.	High	Treat	The purchasing staff must study environmentally-friendly products and the purchasing criteria for each product type. They must fully understand this information before checking the actual products before purchase
2. No prior identification of environmental product characteristics before each purchasing process	High	Transfer	Before making any purchase, the requester must specify the environmental characteristics of the desired product.
3. No inspection of product characteristics after receiving them	Low	Transfer	The recipient of goods must inspect the product characteristics before accepting the goods.

*Source: Focus group discussion, 2023*

From Table 7, upon careful consideration, it is evident that the Product Characteristics (Specification risk) entails three risks, with two of them classified as high risks that require significant attention from the organization. One such high-risk factor is "The purchasing staff does not conduct a study on the environmental impact or reduction of the environmental impact of products before making purchasing decisions." To manage this risk, the 4T framework, specifically the Treat approach, should be employed. The recommended risk management strategy involves the purchasing staff conducting a thorough examination of

environmentally-friendly products and familiarizing themselves with the purchasing criteria specific to each product category. It is crucial for them to possess comprehensive knowledge in this regard before conducting physical inspections of the products and making any purchases. Additionally, the risk of "No prior identification of environmental product characteristics before each purchasing process" is another matter that the company deems important and addresses by requiring the requester to explicitly outline the desired product's environmental attributes prior to initiating any purchase.



**Table 8** Green purchasing risk management - Price Risk

Risk	Level of risk	4T Risk management framework	The implementation of risk management strategies
1. The approving authority needs to consider whether the product has environmental sustainability measures in place when approving the purchase price, even if the environmentally sustainable product has a higher price than the regular product.	Moderate	Terminate	Purchasing must conduct while considering other conditions, not just environmental aspects
2. The purchasing process did not involve requesting quotations from each vendor before making the purchase	High	Treat	Purchasing staff must request a quotation and negotiate prices with the vendors every time before making a purchase.
3. No regular updating of purchase orders from the same supplier by the purchasing staff.	Moderate	Transfer	The vendor must provide a new quotation to the purchasing staff every time there is a change in the price.
4. If the price of the purchased product is higher than the set price, the purchasing staff proceeds with the purchase without seeking approval from the authorized person before the purchase	High	Treat	The purchasing manager must check the purchase order prices every time before signing it.

*Source: Focus group discussion, 2023*

Table 8 presents the Price Risk, highlighting a specific high risk that requires special attention in terms of risk mitigation. The risk involves “The purchasing process did not involve requesting quotations from each vendor before making the purchase”. To address this, the recommended approach is the 4T framework, specifically the Treat approach. This approach emphasizes that purchasing staff must request quotations

and negotiate prices with vendors for every purchase. Furthermore, another risk is identified, wherein “If the price of the purchased product is higher than the set price, the purchasing staff proceeds with the purchase without seeking approval from the authorized person before the purchase”. To resolve this issue, the purchasing manager should carefully review the purchase order prices before signing them.



**Table 9** Green purchasing risk management- Supplier Risk

<b>Risk</b>	<b>Level of risk</b>	<b>4T Risk management framework</b>	<b>The implementation of risk management strategies</b>
1. The company's vendors/supplier selection criteria do not specify any criteria for selecting vendors who conduct environmentally-friendly operations (such as being certified with ISO 14000 standards, having a green label, or complying with environmental requirements).	Low	Treat	The purchasing manager will improve the vendor selection criteria by adding environmental standards and registering relevant documents for purchasing staff to select vendors/suppliers.
2. The company has no requirements for vendors/suppliers to comply with regarding the environment, such as treating wastewater, using resources efficiently, and reducing greenhouse gas emissions in transportation.	High	Transfer	In the vendors/supplier selection criteria or evaluation, it requires to specify that vendors/suppliers have environmental practices
3. The company has a bad relationship with a vendor/supplier	Low	Transfer	Purchasing staff must build a good relationship with vendors/suppliers by establishing trust and engaging in product development together
4. The company does not have the authority to negotiate with vendors/suppliers the authorized person before the purchase	Moderate	Treat	Purchasing staff must establish good relationships with vendors/suppliers and may need to place orders in large quantities or find multiple vendors/suppliers for a single raw material.

*Source: Focus group discussion, 2023*

According to Table 9, Supplier Risk presents a total of 4 risks, all of which are categorized as high level. The specific risk identified is that “The company has no requirements for vendors/suppliers to comply with regarding the environment, such as treating wastewater, using resources efficiently, and reducing

greenhouse gas emissions in transportation” aligns with the Transfer approach within the 4T Risk management framework. The recommended risk management implementation involves including environmental practices as a criterion or evaluation requirement in the vendors/supplier selection process.

**Table 10** Green purchasing risk management- Fraud Risk

<b>Risk</b>	<b>Level of risk</b>	<b>4T Risk management framework</b>	<b>The implementation of risk management strategies</b>
1. No counting or environmental feature checking of the delivered products	Very High	Transfer	The product receiver must inspect the consequences' characteristics before accepting them.
2. After inspecting the products, the poor storage caused frequent loss of the products	High	Transfer	Warehouse staff must record every product entering the warehouse and store them appropriately according to their types
3. No system in place to prevent corruption between decision-makers and suppliers during procurement	Very High	Treat	To Implement a system to prevent corruption, such as allowing others to see the price during the bidding process, for example, the approving authority
4. No penalty is specified for those who engage in purchasing fraud	Very High	Treat	To establish a strict penalty system for individuals who engage in purchasing fraud, such as pursuing legal action against the offender.

*Source: Focus group discussion, 2023*

From Table 10, it is found that Fraud Risk consists of a total of 4 risks, each with its corresponding risk level as shown in Table 10. These risks can be managed through the Transfer approach, which involves addressing the risks associated with "No counting or environmental feature checking of the delivered products" and "After inspecting the products, the poor storage caused frequent loss of the products." Additionally, two other risks require management according to the 4T Risk management framework, specifically using the Treat approach. These risks are related to "No system in place to prevent corruption between decision-makers and suppliers during

procurement" and "No penalty is specified for those who engage in purchasing fraud". The information regarding the risk management implementation is presented in the Risk management implementation column.

The research findings have successfully achieved the research objectives, which were to identify risk factors in green purchasing within a case study company, as presented in Tables 1, 2, 3, 4, and 5, and to propose strategies for effectively managing green purchasing in the same case study company, as depicted in Tables 6, 7, 8, 9, and 10. The results have revealed a total of 19 risks across five



domains: Policy Risk, Product characteristics (Specification risk), Price Risk, Supplier Risk, and Fraud Risk. These risks align with the risk factors identified by Kittiwattamrong (2017) and the ESG Impact Assessment Report (2021). The identification of risk levels helps prioritize the significance of risks in the purchasing process, and the derived risk management strategies, after applying the 4T risk management framework in this research, can serve as a guideline for the case study company to enhance its green purchasing practices and improve purchasing efficiency.

## Conclusion

The analysis of risk levels in green purchasing for the case study company reveals important findings. Firstly, the level of policy risk in green purchasing is generally moderate. To address this risk, it is recommended to establish environmental processes and procedures while creating a distinct identity for green purchasing through budget allocation and employee training. In cases where management does not recognize the ecological importance, purchasing staff should be responsible for monitoring and managing environmental risks.

Secondly, the level of specification risk in green purchasing is generally high. To mitigate this risk, purchasing staff should receive education on products and buying criteria that consider environmental factors before making purchases. Additionally, buyers should be required to specify the environmental characteristics of products they wish to purchase, with

the receiver verifying these characteristics to transfer the risk.

Thirdly, the level of price risk in green purchasing is generally moderate. It is suggested to reduce this risk by purchasing from new vendors and engaging in price negotiation before making decisions. Management should verify prices on purchase orders. To transfer the risk, vendors should be required to provide updated quotes for any changes in product prices. In cases where the product is priced too high, alternative products without environmental considerations can be selected to avoid the risk.

Fourthly, the level of supplier risk in green purchasing is generally moderate. To mitigate this risk, careful vendor selection should be based on their ability to deliver products on time. In anticipation of potential delays, purchasing personnel should track delivery progress and maintain backup plans. Risk transfer can be achieved by requiring vendors to provide delivery guarantees or insurance.

Finally, the level of fraud risk in green purchasing is generally high. To address this risk, vendor selection should prioritize reputation and performance history. Risk transfer can be accomplished by having vendors assume responsibility for the quality and environmental characteristics of the products through warranties or guarantees. Purchasing personnel should actively monitor and manage vendor performance to accept this risk.

This research employed a preliminary data analysis approach, incorporating frequency distribution, percentages, mean, and standard deviation. This approach facilitated the identification of



risk factors in the green purchasing practices of a specific case study company. However, to further investigate the interconnections among various risk factors and explore their associations, future research will involve testing these factors using a multivariate model, such as structural equation modeling. This analysis will enable a comprehensive examination of the relevance of these risk factors. Subsequently, the identified risk factors can be applied to assess the risks associated with green purchasing in other companies or industries.

Recommendations for application, In both business and government purchasing, the data obtained from this research should be used as information to manage environmental risk. There must be an identification, evaluation, and development of risk management

strategies that cover all five aspects: policy, product characteristics, price, vendor, and corruption. The research findings can be transformed into practical actions that drive change within the company. Management should leverage the risk factors and strategies acquired from this research to establish standardized operating procedures specifically tailored to green purchasing practices. These procedures must be effectively communicated to the relevant departments, ensuring seamless implementation throughout the organization. By adopting green purchasing initiatives, companies can not only contribute to environmental objectives but also unlock tangible benefits that positively impact their financial performance and long-term success.

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