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# Green purchasing, green manufacturing, and eco-design: Impact on operational performance

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**ABSTRACT**

**Purpose-**This study aims to determine the effect of green purchasing, green manufacturing, and eco-design on operational performance. By effectively managing these three environmentally friendly practices, it is hoped that the operational performance of batik micro, small, and medium enterprises can improve significantly.

**Methodology-**The population in this study was micro, small, and medium enterprises producing batik in Yogyakarta, Indonesia. The sample was taken using purposive sampling technique with 122 respondents. The sample was distributed online and offline to micro, small, and medium enterprises producing batik in Yogyakarta. Respondent data were tested using Smart PLS 4.0 with a structural equation model approach covering validity testing, reliability testing, multicollinearity evaluation, and hypothesis testing.

**Findings-**This study found that green purchasing and eco design have a positive impact on operational performance. Meanwhile, green manufacturing does not have a positive impact on operational performance. This condition occurs because most batik micro, small, and medium enterprises in Yogyakarta still face limitations in capital, technology, and resources, so that the manufacturing process cannot be implemented optimally.

**Research Limitations-**This study has limitations due to the small number of respondents and the scope of the research, which focuses on batik micro, small, and medium enterprises in Yogyakarta, so the findings do not represent the green practices of batik micro, small, and medium enterprises in other regions. This research can be expanded to other regions to obtain different findings. Further research can add variables to the research model to predict operational performance.

**Novelty-**This study analyzes the impact of environmentally friendly purchasing, environmentally friendly manufacturing, and environmentally friendly design on the operational performance of batik micro, small, and medium enterprises, which has rarely been researched. The results show the limitations of micro, small, and medium enterprises in implementing environmentally friendly manufacturing, while the effectiveness of operational performance is greatly influenced by the readiness and characteristics of the industrial sector.

## 1. Introduction

Operational performance measures a company's ability to maximize the use of available resources (Alkhatib & Momani, 2023). Operational performance refers to a company's ability to achieve its operational priorities, such as process flexibility, cost efficiency, product quality, delivery accuracy, and innovation capabilities, compared with competitors in the same industry (Prester, 2023). Operational performance is an indicator of business success because it enables companies to respond to change, reduce operating costs, and simplify internal and external company strategies (Gunawan et al., 2024). However, the relevance of measuring operational performance is increasing in the contemporary business environment. Environmental uncertainty, market turbulence, and rapid regulatory changes require companies to optimize their operational performance (Abou Kamar et al., 2023). In addition, as a result of environmental degradation, the government has established stricter emission policies, coupled with increases in raw material and energy costs, adding pressure on companies to improve their operational performance (Shan et al., 2025). Facing various external pressures, companies must develop reactive and proactive capabilities to maintain their operational performance (Belhadi et al., 2021).

Operational performance is influenced by environmentally friendly practices such as green purchasing, green manufacturing, and eco-design, which are now strategic requirements for the industry (Saqib, 2024). These three practices have received widespread attention because of their role in creating efficient and adaptive operational performance while maintaining environmental sustainability (Khan et al., 2022). Green purchasing encourages the use of environmentally friendly raw materials that strengthen a company's dynamic capabilities and operational performance, thereby impacting the environment and economy (Hazaea et al., 2022). Green manufacturing creates economic value without negatively impacting the environment, conserves energy and natural resources, and ensures sufficiency for future generations, thereby reducing production costs and optimizing operational performance (Hermawan et al., 2024). The application of eco-design oriented towards a circular economy encourages the development of products that are easy to recycle, durable, and modular, thereby increasing operational performance efficiency (Favi & Marconi, 2025). The integration of these practices can optimize operational performance (Khan et al., 2022).

Green purchasing positively affects operational performance (Liu et al., 2024). Companies that implement green purchasing achieve operational efficiency and better product quality through collaboration with suppliers with an environmentally friendly image (Abuzaid et al., 2024). Conversely, Mojumder et al. (2022) found that procurement that does not prioritize energy efficiency and the use of environmentally friendly resources indicates weak green purchasing, thereby increasing ecological pressure, risking waste, and hampering operations. Integrating environmentally friendly practices into green purchasing helps companies minimize operational risks arising from their dependence on conventional suppliers. According to Junejo et al. (2025), operational performance can be improved with effective green purchasing practices through the selection of suppliers with environmentally friendly standards and the use of eco-friendly raw materials. The implementation of effective green purchasing with the procurement of raw materials that consider environmental responsibility will increase operational performance efficiency, strengthen competitiveness, and promote the overall sustainability of the company (Machingura et al., 2024). Green purchasing practices not only support sustainability but also optimize the operational performance.

Green manufacturing improves operational performance (Musau & Rucha, 2021). Green manufacturing integrates sustainable practices to increase value for customers in terms of productivity, quality, and efficiency by reducing resource consumption through waste elimination, thereby increasing the competitiveness of companies (Abualfaraa et al., 2020). According to Ijaz et al. (2024), manufacturing has evolved into green manufacturing, which is more commercially viable and environmentally friendly, including increased resource efficiency, longer product life, and innovative and reconfigured value chains. The green manufacturing approach can improve the effectiveness of the production process and strengthen resource efficiency, enabling companies to reduce environmental degradation while

maintaining operational performance (Tiuncika & Bormane, 2024). Conversely, production processes that have not implemented green manufacturing have the potential to cause waste of resources, low process efficiency, and production processes that do not comply with environmental standards. As Abdulameer and Mohammed (2024) state, green manufacturing can improve operational performance through financial support from top management and efforts to minimize the ecological damage caused by products, services, and production processes. Thus, the comprehensive and integrated application of green manufacturing can be the key for companies to achieve efficient, environmentally friendly, and competitive operational performance.

Eco-design practices can improve operational performance (Fernando & Uu, 2017). The application of eco-design in products and packaging can reduce waste, achieve eco-efficiency, and reduce the use of materials that affect operational performance (Wungkana et al. 2023). The main objective of eco-design is to reduce environmental pollution and adverse impacts on the environment throughout the product life cycle (Franzén & Guo, 2021). The use of eco-design that facilitates products with recycled materials not only improves the environmental performance of products but also strengthens process efficiency and resource utilization, thereby impacting operational performance (Liu et al., 2025). However, eco-design that is only symbolic and inconsistent results in suboptimal resource use, low output quality, and reduced internal credibility of operational processes. Khoja et al. (2024) stated that operational performance can be improved through eco-design at the product design stage, supported by sustainable strategies and practices to increase efficiency, reduce costs, and meet environmental standards and customer demands. Therefore, eco-design not only complies with environmental regulations but also strengthens competitiveness through improved operational performance and resource-efficiency.

Based on the resource-based view (RBV) proposed by Barney (1991), companies will gain sustainable competitive advantage through the development of capabilities and resources that are difficult to imitate, rare, valuable, and irreplaceable. In the context of this study, green purchasing, green manufacturing, and eco-design become company resources that improve operational performance, thereby becoming a competitive advantage. Green purchasing capabilities enable companies to manage a chain of activities that facilitate the recycling, reuse, and reduction of resources, thereby minimizing operational costs (Balin & Balin, 2025). Green manufacturing capabilities encompass multidisciplinary practices that reduce material and energy intensity, minimize emissions and waste, and promote resource efficiency in production processes, which can become valuable and difficult-to-replicate strategic resources (Juráček et al., 2025). Eco-design capabilities include environmentally friendly packaging design, reducing the amount of waste disposed of, optimizing product design to reduce material use, and minimizing ecological impact to strengthen overall operational performance (Georgakoudis et al., 2025). Thus, the combination of these three capabilities strengthens the company's operational performance and becomes a strategic resource that provides a long-term competitive advantage. Companies that can utilize these capabilities effectively not only meet environmental standards but also influence their economic performance and competitiveness.

The context of this study involves batik micro, small, and medium enterprises (MSMEs) in Yogyakarta, Indonesia, which have not been studied in previous research because previous studies focused on areas other than Yogyakarta, such as the study by Nurhayati et al. (2025). Several previous studies have examined aspects of sustainability in the batik MSMEs sector, but there are still gaps that need to be further explored. Widjajanti and Sugiyanto (2023) examined eco-design in business performance in batik MSMEs. Another study focused on supply chain performance in relation to operational performance (Syukron & Solovida, 2021). This study offers something new by discussing green purchasing, green manufacturing, and eco-design together in relation to their influence on operational performance based on the RBV theory. This study provides a deeper understanding of the sustainability practices of batik MSMEs in Yogyakarta.

MSMEs play an important role in the national economy because they can help the regional economy and absorb labor. Based on data from the Ministry of Cooperatives and

MSMEs, the number of MSMEs in 2019 reached 65,465,497, an increase of 1.98% from 2018 (Winarni, 2024). One of the prominent MSMEs sectors is batik, especially in the Special Region of Yogyakarta, which is known as the city of batik. This province has 400 distinctive batik motifs and well-developed traditional and modern batik MSMEs (Wibowo et al., 2023). Based on annual data published by the Central Statistics Agency in 2023, Yogyakarta is one of the provinces with the most batik MSMEs compared to other provinces, with 1,687 batik businesses employing 4,827 workers in total. This MSMEs sector contributes to SME income and expenditure of Rp. 9,665 million and Rp. 4,886 million, respectively, indicating the rapid growth of batik SMEs and their role as major economic drivers. However, batik production practices still pose serious environmental problems. Batik MSMEs still rely on synthetic dyes containing chemicals that negatively impact the environment (Susanto & Putranto, 2022). As stated by Sujiwo et al. (2023), the green performance of batik MSMEs is only 46% below the green industry standard set by the Ministry of Industry, Indonesia. This illustrates the gap between MSMEs growth and sustainable production practices.

On the other hand, batik MSMEs in Yogyakarta have become the focus of business-strengthening programs, such as creative economy training and digital initiatives organized. Various forms of community service often use batik MSMEs as a means of training in environmentally friendly production practices, such as eco-printing, the use of natural dyes, and waste management (Prasetyoningsih et al., 2022; Rahmawati et al., 2022; Ambarwati et al., 2024). These activities help batik MSMEs owners design batik products and packaging using environmentally friendly materials and market them through online networks, thereby increasing their competitiveness. This shows the possibility of implementing environmentally friendly practices in the operational processes of batik MSMEs, even though they have not been done optimally. Thus, this study is expected to fill and answer the gap between growth and sustainability practices. This study aims to answer the question: To what extent do green purchasing, green manufacturing, and eco-design influence the operational performance of batik MSMEs in Yogyakarta?

## 2. Literature Review and Hypothesis Development

RBV theory by Barney (1991) states that a company's competitive advantage and operational performance are achieved through its capabilities in managing suppliers and procuring environmentally friendly raw materials. Green purchasing fulfills these characteristics, as it involves selecting suppliers who are environmentally responsible, environmentally friendly warehousing and buildings, and efficient distribution management (Faizuddin & Kamil, 2025). By implementing green purchasing, companies can obtain more stable and consistent raw materials (Balin & Balin, 2025). The consistency in the quality and stability of suppliers makes operational processes run more effectively, reducing product variability and minimizing potential disruptions in the material flow (Albalushiet al., 2023). In addition, the implementation of green purchasing can reduce costs because environmentally friendly suppliers usually have strict standards for using resources (Balin and Balin 2025). This practice can strengthen a company's flexibility in facing market uncertainty, strengthen operational effectiveness, and improve overall operational performance (Xu et al., 2022). Green purchasing makes companies more efficient in their use of raw materials, reduces costs, and encourages responsible environmentally friendly procurement practices, all of which are key to effective operational performance (Gál et al., 2025). According to Nugroho et al. (2024), green purchasing affects operational performance through technical aspects such as inventory levels, waiting time quality, and customer satisfaction. Several previous studies have also found that green purchasing can have a positive effect on operational performance (Basana et al., 2022; Faizuddin & Kamil, 2025; Mugoni et al., 2025). Thus, green purchasing practices are not only a strategic capability, as described by the RBV theory, but also capable of improving overall operational performance. **H1: Green Purchasing Has a Positive Effect on Operational Performance.**

Based on RBV theory by Barney (1991), a company's superior performance depends on its ability to build valuable capabilities and resources. In this context, green manufacturing is considered a company's capability because it integrates environmentally friendly principles into production, such as the use of environmentally friendly materials, monitoring inventory, and improving process efficiency in an environmentally friendly manner (Haleem et al., 2023). Green manufacturing practices improve product attribute quality, including product durability and reliability, by implementing more controlled production, thereby reducing defective and failed products (Albalushi et al., 2023). This process improves the stability of the company's supply chain because product variability can be reduced, and the risk of process disruption can be minimized (Tu et al., 2025). In addition, green manufacturing practices play a role in the efficient use of resources, thereby reducing production costs, which affects operational performance (Fan et al., 2024). Although green manufacturing requires large initial investments and adequate high and intensive technology (Lubaba et al. 2025), it becomes a unique and valuable capability of the company that is difficult for competitors to imitate, as explained by the RBV. According to Musau and Rucha (2021), green manufacturing affects operational performance through product design, production, and marketing, which minimizes negative impacts on the environment throughout the product life cycle. Several previous studies have also found that green manufacturing has a positive effect on operational performance (Khan et al., 2022; Huang et al., 2024; Wardhani, 2025). **H2: Green Manufacturing Has a Positive Effect on Operational Performance.**

RBV theory by Barney (1991) explains that a company's performance advantage is derived from capabilities that prioritize valuable, rare, inimitable, and organized (VRIO) resources. Eco-design is considered a strategic capability because it integrates industrial product development with environmentally friendly design from the initial design to the entire product lifecycle (Camañes et al., 2024). Through this approach, companies can dismantle, repair, recycle, and reduce the environmental footprint of packaging throughout the product lifecycle (Silva et al., 2023). This capability creates more efficient operational mechanisms because it helps companies minimize waste and save energy and resources, thereby increasing process effectiveness and cost efficiency (Farizki, 2025). This practice results in more stable and reliable operating processes, thereby improving the company's operational performance (Saqib, 2024). In addition, the eco-design process uses minimum resources to create added value for the company, thereby increasing its competitive advantage and operational performance (Musau & Rucha, 2021). In line with this, Sahoo and Vijayvargy (2020) explained that eco-design can affect operational performance without compromising important product criteria such as quality, cost, and functionality. Thus, eco-design can become a strategic capability for companies by promoting environmentally friendly principles while considering cost aspects. Several previous studies have found that eco-design positively affects operational performance (Musau & Rucha, 2021; Khan et al. 2022; Jain et al. 2024). **H3: Eco-Design Has a Positive Effect on Operational Performance.**

Figure 1 shows the research model explaining the antecedents of operational performance. Green purchasing, manufacturing, and eco-design positively affect operational performance.

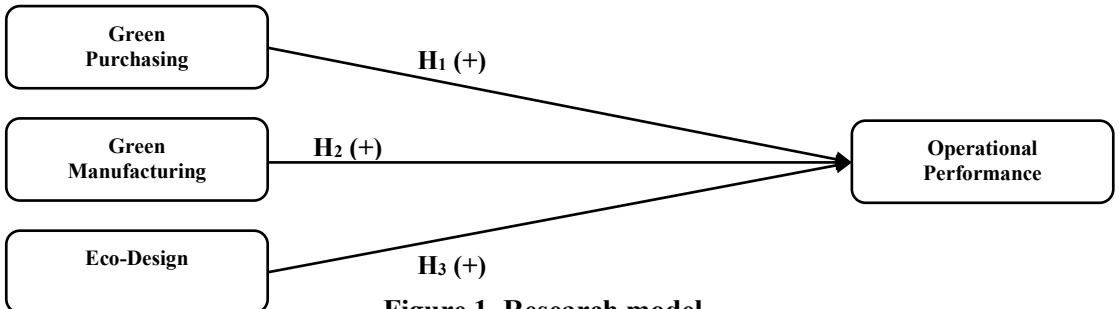


**Figure 1. Research model**

## 3. Research Methodology

The population in this study consisted of batik MSMEs entrepreneurs in Yogyakarta. The sample for this study consisted of 122 respondents. According to Hair et al. (2021), research using the PLS-SEM approach with moderate complexity requires a minimum sample size of 100 respondents. In line with this, Ghozali (2021) states that a sample size of 100-200 is adequate for a simple model. Thus, the sample size in this study met the recommended criteria. The sample in this study was taken using purposive sampling with several criteria: Respondents are owners/managers/operational managers who own MSMEs in the batik sector, reside in Yogyakarta, Indonesia, MSMEs have been operating for at least one year, and carry out their own procurement/production/design processes. The sample was distributed through G forms online and offline. The green purchasing (GP) has seven indicators from Yu et al. (2019), green manufacturing (GM) has five indicators from Rao and Bogale (2017), eco-design (ED) has three indicators from Habib et al. (2021), and operational performance (EP) has five indicators from Khan et al. (2022). Each indicator represented one question and was measured using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

This study uses the structural equation modeling (SEM) approach with the help of Smart PLS version 4.0. The analysis was carried out in two stages: outer and inner model evaluations. In the first stage, validity testing was conducted by examining the outer loading value. If the outer loading value is above 0.7, the question indicator is declared valid and capable of accurately representing the variable (Ghozali, 2021). A reliability test was then conducted by examining the Cronbach's alpha and composite reliability values. According to Ghozali (2021), a variable is considered reliable if it has a Cronbach's alpha value and composite reliability value above 0.7. In addition, this study tested multicollinearity using the Variance Inflation Factor (VIF). According to Hair et al. (2021), indicators must have a VIF value below 5 to avoid multicollinearity problems. After the outer model met the validity and reliability criteria, the next stage was to evaluate the inner model. This study tested the R-squared ($R^2$) to determine the level of contribution of independent variables in explaining the dependent variable. According to Hair et al. (2021), a higher $R^2$ value indicates that the model can explain a greater variance in the dependent variable. Finally, hypothesis testing was conducted using a bootstrapping procedure. The hypothesis was accepted if the p-value was below 0.05 (Ghozali, 2021).

## 4. Result and Discussion

### Characteristics of Respondent

Table 1 presents the characteristics of the respondents. Based on gender, the majority of respondents were female, with a total of 80 respondents. Based on age, the majority were aged 36-45 years, with 54 respondents. Based on the highest level of education, most respondents had a high school education (77 respondents). Based on domicile, most respondents lived in Sleman Regency, with a total of 45 respondents. Based on monthly income, the majority of respondents had an income between IDR 6-10 million, with a total of 71 respondents. Finally, based on the length of time running a business, the majority of respondents have been running a business for >10 years, with a total of 62 respondents.

**Table 1. Characteristics of Respondent**

| Characteristics | Description | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 42 | 34.4 |
| | Female | 80 | 65.6 |
| Age | 26-35 | 15 | 12.3 |
| | 36-45 | 54 | 44.3 |
| | 46-55 | 39 | 32 |
| | > 55 | 14 | 11.5 |
| Education Level | Junior High School | 24 | 19.7 |
| | Senior High School | 77 | 63.1 |
| | Bachelor | 21 | 17.2 |

| Characteristics | Description | Frequency | Percentage |
|---|---|---|---|
| Domicile | Yogyakarta | 44 | 36.1 |
| | Sleman Regency | 45 | 36.9 |
| | Bantul Regency | 33 | 27 |
| | Kulon Progo Regency | 0 | 0 |
| | Gunungkidul Regency | 0 | 0 |
| Monthly Income | IDR 3-5 million | 31 | 25.4 |
| | IDR 6-10 million | 71 | 58.2 |
| | IDR 11-15 million | 20 | 16.4 |
| Business Age | 1-3 years | 0 | 0 |
| | 4-6 years | 31 | 25.4 |
| | 7-9 years | 29 | 23.8 |
| | >10 years | 62 | 50.8 |

**Validity Test**

Figure 2 and Table 2 present the validity test results. Each variable, namely green purchasing, green manufacturing, and eco-design, had an indicator above 0.7, so it was declared valid. According to Ghozali (2021), indicator values with outer loadings exceeding 0.7 are declared valid and usable. For green purchasing, the strongest or most dominant indicator was GP5 at 0.814. For the green manufacturing variable, the most dominant indicator is GM4, at 0.814. For the eco-design variable, the strongest indicator was ED1 (0.867). Finally, for the operational performance variable, the strongest indicator was OP1 at 0.780. All variables had outer loading values above 0.7; therefore, all variables were declared valid and could be used.

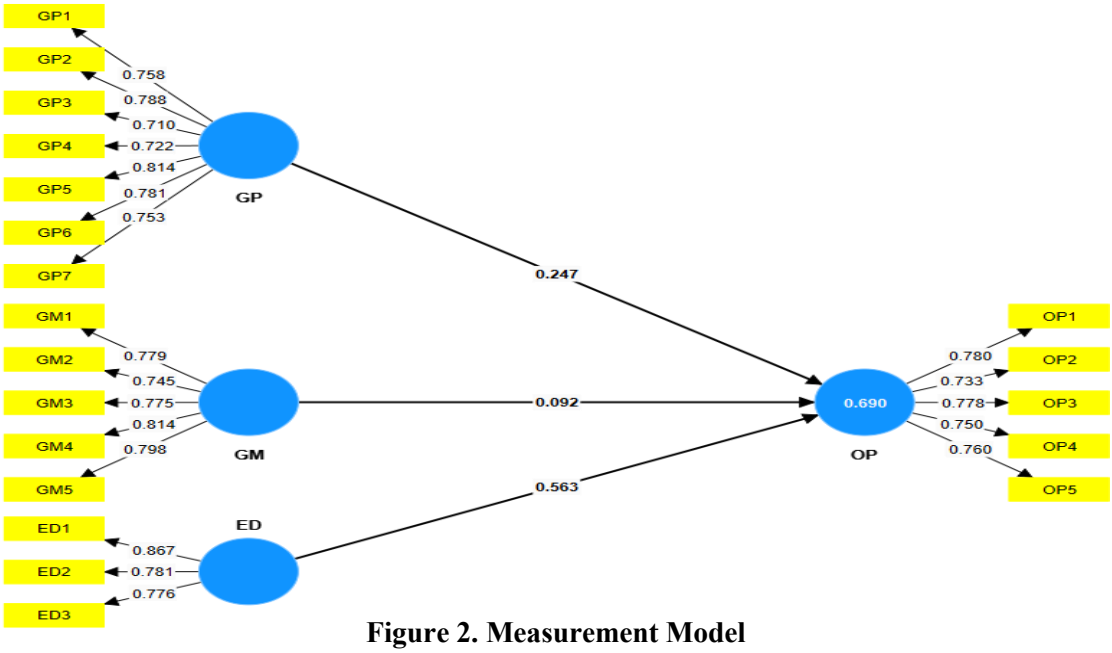


**Figure 2. Measurement Model**

**Table 2. Validity Test Result**

| Indicator | Green Purchasing | Green Manufacturing | Eco-Design | Operational Performance |
|---|---|---|---|---|
| GP1 | 0.758 | | | |
| GP2 | 0.788 | | | |
| GP3 | 0.710 | | | |
| GP4 | 0.722 | | | |
| GP5 | 0.814 | | | |
| GP6 | 0.781 | | | |
| GP7 | 0.753 | | | |
| GM1 | | 0.779 | | |

| Indicator | Green Purchasing | Green Manufacturing | Eco-Design | Operational Performance |
|---|---|---|---|---|
| GM2 | | 0.745 | | |
| GM3 | | 0.775 | | |
| GM4 | | 0.814 | | |
| GM5 | | 0.798 | | |
| ED1 | | | 0.867 | |
| ED2 | | | 0.781 | |
| ED3 | | | 0.776 | |
| OP1 | | | | 0.780 |
| OP2 | | | | 0.733 |
| OP3 | | | | 0.778 |
| OP4 | | | | 0.750 |
| OP5 | | | | 0.760 |

**Reliability Test**

Table 3 presents the reliability test results. Each variable, namely green purchasing, green manufacturing, eco-design, and operational performance, met the reliability requirements. According to Ghozali (2021), a variable is considered reliable if the Cronbach's alpha value is above 0.7 and the composite reliability value exceeds 0.7. The green purchasing variable had a Cronbach's alpha value of 0.879 and a composite reliability of 0.906. The green manufacturing variable had a Cronbach's alpha value of 0.842 and composite reliability value of 0.888. The eco-design variable had a Cronbach's alpha value of 0.735 and composite reliability value of 0.850. Finally, the operational performance variable had a Cronbach's alpha value of 0.818 and composite reliability value of 0.873. Thus, all the variables in this study were considered reliable.

**Table 3. Reliability Test Result**

| Variable | Cronbach's Alpha | Composite Reliability | Average Variance Extracted |
|---|---|---|---|
| Green Purchasing | 0.879 | 0.880 | 0.580 |
| Green Manufacturing | 0.842 | 0.846 | 0.612 |
| Eco-Design | 0.735 | 0.741 | 0.655 |
| Operational Performance | 0.818 | 0.821 | 0.578 |

**Hypothesis Test**

Based on Table 4, the results of the hypothesis testing were obtained. According to hypothesis testing, two of the three hypotheses were accepted, while one was rejected. Green purchasing and eco-design positively affect operational performance, whereas green manufacturing does not. In accordance with Ghozali (2021), a hypothesis is accepted if the p-value is less than 0.05. Thus, hypotheses 1 and 3 are accepted because they have p-values below 0.05, while hypothesis 2 is rejected because the p-value is above 0.05, namely, 0.684.

**Table 4. Hypothesis Test Result**

| Variable | Original Sample | Sample Mean | Standard Deviation | T-Statistics | P Values |
|---|---|---|---|---|---|
| Green Purchasing → Operational Performance | 0.247 | 0.242 | 0.110 | 2.249 | 0.025 |
| Green Manufacturing → Operational Performance | 0.092 | 0.105 | 0.113 | 0.810 | 0.418 |
| Eco-Design → Operational Performance | 0.563 | 0.554 | 0.092 | 6.144 | 0.000 |

**Discussion**

**The Effect of Green Purchasing on Operational Performance**

This study found that green purchasing positively affects operational performance. These findings are consistent with those of previous studies (Ahmed 2022; Balin & Balin

2025). This hypothesis is based on RBV theory by Barney (1991), which explains that companies can achieve superior performance by developing valuable resources. Green purchasing is one of the capabilities that plays a role in strengthens the internal aspects of a company, thereby improving its operational performance. According to Li and Zhong (2024), green purchasing can improve operational performance through strategic partnerships with suppliers that have green processes and environmentally friendly technologies. Through this mechanism, companies can implement environmentally friendly standards for suppliers so that input products are of higher quality and have minimal environmental impact (Priyashani & Jayasuriya, 2019). Good input quality can maintain production process stability and enhance reputation and environmentally friendly supply chains (Nazir et al., 2024). Effective input management through green purchasing helps companies achieve competitiveness by reducing energy consumption, resources, and waste, enabling them to achieve superior operational performance (Opoku & Li, 2025). Khan et al. (2022) found that green purchasing in large manufacturing companies in Pakistan can improve operational performance (Khan et al., 2022). Basana et al. (2022) found similar results for manufacturing companies in East Java, Indonesia. The similarity of these results shows that green purchasing as an internal capability improves operational performance not only in the large manufacturing sector but also in the MSMEs sector, especially batik MSMEs in Yogyakarta. Batik MSMEs that implement green purchasing by selecting suppliers with environmentally friendly standards tend to obtain safe, stable, and defect-free product inputs. This improves the reliability of operational performance owing to smooth and efficient work processes. Thus, implementing green purchasing in batik MSMEs in Yogyakarta can improve operational performance.

**The Positive Effect of Green Manufacturing on Operational Performance**

The results of hypothesis testing show that this hypothesis is rejected, meaning that green manufacturing has no effect on the operational performance of batik MSMEs in Yogyakarta. This finding can be explained through the contingency theory by Lawrence and Lorsch (1967), which states that the success of a managerial practice depends on the fit of that practice with the internal and external conditions of the company. Small and medium-sized manufacturing businesses usually face obstacles in implementing green manufacturing, such as inadequate skills, lack of financial support, technology, and market and business contexts (Khan et al. 2024). This mismatch indicates that the implementation of green manufacturing does not improve efficiency, process consistency, and operational performance because the effectiveness of this practice is highly dependent on the readiness and conditions of the company (Ahmadi-Gh & Bello-Pintado 2022). Jain et al. (2024) add that the apparel industry often experiences capacity and capital constraints when implementing green manufacturing. According to the contingency theory by Lawrence and Lorsch (1967), unfavorable company conditions hinder the implementation of changes, resulting in inefficient processes, unstable workflows, and increased operational costs. As found by Primandaru et al. (2023), many MSMEs have adopted green manufacturing, but internal competency development, relative advantages, and company resources that support these practices are needed. Batik MSMEs in Yogyakarta face obstacles in implementing green manufacturing due to limited capital for investing in environmentally friendly equipment. Many batik MSMEs still rely on traditional production methods; therefore, the implementation of green manufacturing has not improved operational performance. The results of this study were also found in previous studies by Jain et al. (2024), Wardhani (2025), and Songkhwan et al. (2025). This shows that the effect of green manufacturing on operational performance depends on the context and is not always beneficial. Thus, green manufacturing does not positively affect operational performance, especially in batik MSMEs in Yogyakarta.

**The positive impact of eco-design on operational performance**

The results of the hypothesis testing show that eco-design positively affects operational performance. Based on RBV theory by Barney (1991), companies that consistently develop their resources can achieve competitive advantage. Eco-design is a company resource for

designing products that are in line with environmentally friendly principles, such as recycling, durability, and modularity (Favi & Marconi, 2025). The application of eco-design reduces risk, opens up opportunities for market and new model development, and strengthens brand equity, which can reduce operational costs (Rodrigues et al., 2018). In addition, eco-design has been proven to strengthen competitiveness through environmentally friendly design and packaging, creating more efficient production stages, and reducing resource waste (Mansour et al., 2024). Energy consumption and resource-use efficiency can improve operational performance because a good design simplifies the production process (Kouser et al., 2025). According to Prasasta and Nurcaya (2021), eco-design reduces the adverse impact of a company's operational activities by integrating environmental responsibility into the entire product lifecycle. Suhery et al. (2024) added that eco-design can improve company performance because it helps companies improve management expertise through the development of sustainable-oriented designs. The results of this hypothesis are consistent with previous studies that confirm that eco-design has a positive effect on operational performance (Ahmed et al., 2023; Favi & Marconi, 2025). This similarity shows that the effectiveness of eco-design in improving operational performance is consistent across various industries. In small industries such as batik MSMEs, eco-design can be implemented through product structure simplification, material savings, and the use of environmentally friendly products. This design makes the production process smoother, more stable, and resource-efficient, thereby improving operational performance. Thus, the implementation of eco-design in batik MSMEs in Yogyakarta can improve their operational performance.

## Conclusion

This study aims to determine the effects of green purchasing, green manufacturing, and eco-design on the operational performance of batik MSMEs in Yogyakarta. The results show that two hypotheses were accepted, and one was rejected. The study found that green purchasing and eco-design affect operational performance, while green manufacturing does not have a positive effect on operational performance. Theoretically, this study contributes to strengthening the understanding of environmentally friendly practices carried out by MSMEs through resource-based view theory. The RBV theory explains how green purchasing and eco-design can become competitive advantages for MSMEs and improve their operational performance. The rejected hypothesis in this study is explained by contingency theory, whereby green manufacturing has not been able to optimize the operational performance of MSMEs due to the internal and external conditions of the MSMEs themselves. These findings have important implications for future research. Further research can explore mediating or moderating variables, such as technological turbulence, environmental performance, and relational capital, to determine the effect of green manufacturing on operational performance (Xu et al. 2022; Machingura et al., 2024; Ta'Amnha et al., 2024). This study has limitations in that the small number of respondents and the limited scope of the research, which focused on batik MSMEs in Yogyakarta, meant that the findings did not represent environmentally friendly practices in batik MSMEs in other regions. This research could be expanded to other regions to obtain findings that differ in terms of region, culture, and society. Future research could add variables to the research model, such as outsourcing strategies, green management, lean management, and top management commitment (Nsowah & Phiri 2021; Opoku & Li, 2025), to predict the operational performance of MSMEs. Practically, these findings suggest that batik SMEs in Yogyakarta should maintain green purchasing by selecting environmentally friendly suppliers, improve green manufacturing as the business progresses, and develop eco-design in motif design and material use so that their overall operational performance can be more stable, safe, and competitive.

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