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The Impact of Cost Information Type, Gender Differences, and Product Durability on Sustainable New Product Development

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Abstract

This study examines the influence of cost information type, gender differences, and product durability on sustainable new product development (S-NPD). This research uses a quantitative experimental method with a 2x2x2 factorial between-subjects design. Participants are active third-semester and fifth-semester students from the Accounting Study Program, Universitas Muhammadiyah Yogyakarta, representing professional designers. They will be given various tasks based on diverse combinations and information. Data is analyzed using the homogeneity test and ANOVA. The research results indicate that product durability significantly impacts S-NPD, in contrast to the type of cost information and gender differences, which do not have a significant impact on S-NPD. Furthermore, this study's findings support the TBL theory, which emphasizes the balance between economic, environmental, and social aspects in S-NPD. This research provides important implications for designers and companies in creating more environmentally friendly products through gender-based and sustainability strategies. However, this research is limited to the participation of students as experimental subjects, so the generalization of the results must be done with caution. Further research should involve professional designers and expand the variables to gain a more comprehensive understanding of S-NPD.

JEL Classification: M41, O31, Q56

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Introduction

In an era where sustainability is a key factor in business strategy, companies face significant challenges in developing products that are not only innovative but also environmentally friendly and sustainable. Sustainable New Product Development (S-NPD) has emerged as a strategic solution to balance product innovation's economic, social, and environmental aspects. S-NPD has become a strategic issue in the modern era. Thus, in this era, environmental challenges have become a significant focus [Brunn \(2017\)](#), given the increasing global attention to environmental issues such as climate change, depletion of natural resources, and the accelerated rate of environmental degradation [Lliso et al. \(2020\)](#), which encourages various industrial sectors to adopt environmental sustainability principles. Environmental issues have become a concern for the public [\(Qin & Peng, 2016\)](#). The increasing public awareness of sustainability impacts consumer behavior, especially among the younger generation. A report by First Insight and Baker Retailing Center shows that 75% of Gen Z prefer sustainable products over branded products, which aligns with a Nielsen survey in 2018 that found 73% of global consumers are willing to change their consumption habits to reduce environmental impact [\(Gusmiarti, 2024\)](#). This trend emphasizes that sustainability is a corporate social responsibility and a competitive advantage that can enhance customer loyalty and market share. According to [Schaltegger et al. \(2012\)](#), the development of the global economy presents opportunities and challenges for companies. In this context, companies face a significant challenge to create competitive products while supporting environmental, social, and economic sustainability per sustainability principles in the product innovation process. In this case, Patagonia is one of the real examples of a company implementing sustainability strategies by introducing the Worn Wear program, which encourages customers to repair their clothes instead of buying new ones to reduce textile waste.

Various studies have highlighted the importance of sustainability principles in the new product development (NPD) process, including the integration of social, economic, and environmental aspects. Most people agree that sustainability is important for business success [\(Hynds et al., 2014\)](#). Currently, the definition or interpretation of sustainable development is the most accepted [\(Gmelin & Seuring, 2014b\)](#). In an increasingly competitive business landscape, product innovation through NPD has become crucial to business sustainability. NPD is considered important for the existence and expansion of an organization [\(Rajeshwari, 2017\)](#). The high level of complexity in NPD extends the development cycle, making it increasingly challenging to achieve business value within this process [\(Wang et al., 2024\)](#). Sustainable development is based on three fundamental pillars: social, economic, and environmental [\(Safdie, 2024\)](#). S-NPD integrates these three aspects to minimize environmental impact and enhance social welfare. S-NPD has become an important element in modern business strategies, where new products are developed with sustainability factors in mind. S-NPD also offers a holistic approach to creating competitive products that support sustainability, the success of which is greatly influenced by various factors, including the integration of cost information, gender differences, and product durability. This research aims to answer the question of how these three factors influence the product design decision-making process that supports environmental, social, and economic sustainability.

In the process, NPD requires accurate and detailed cost data to ensure that decisions made during product development align with environmental sustainability and cost efficiency. Interactive research on the types of cost information and strategies is crucial to understand better how various strategies can affect product development performance [\(Jatiningsih & Sholihin, 2015\)](#). According to [Booker et al. \(2007\)](#), providing designers with different cost information can shift their focus toward cost considerations.

Gender has become one of the most debated and significant issues in modern companies [\(Rao & Tilt, 2016\)](#). The results of the research conducted by [Correll et al. \(2020\)](#) show how gender frames performance evaluations in a complex and nuanced manner. During the design process and decision-making, gender roles also influence the outcome of S-NPD later on. The roles and behavioral differences between men and women significantly impact solving environmental problems [\(Pardede et al., 2023\)](#). The perspective held by men is

undoubtedly different from that of women. [Wardani and Jatningsih \(2024\)](#) state that male and female designers will process information differently. This can affect the impact of information precision on decision-making performance, including the processing of cost information in NPD and the differing cost-effectiveness of NPD between male and female designers ([Wardani & Jatningsih, 2024](#)).

Sustainability also means a system that operates continuously for a long lifespan with minimal environmental impact ([Khannan et al., 2021](#)). On the other hand, to achieve sustainable goals, product durability becomes a key aspect that influences the success of S-NPD. [Wainwright \(2024\)](#) states that product durability measures how long a product can last without experiencing damage or requiring repairs. As one of the main pillars of S-NPD, product durability extends the product's lifespan, reduces waste, and lessens the pressure on natural resources. [Delaney and Liu \(2023\)](#) identified durability as one of the 18 key environmental sustainability factors identified by the literature, which is recommended to be applied in the NPD design stage. Durability is intended by developing a product with consideration of its lifespan and long-term potential, taking into account design elements to maximize the product's lifespan while maintaining its functionality ([Delaney & Liu, 2024](#)). Thus, product durability becomes an important aspect for customers and companies, affecting a product's overall cost and value. [Geiker et al. \(2023\)](#) state that the term "Durability" is beginning to be considered as important as "Structural Safety" in the national design code.

This research analyzes the relationship between cost information, gender, and product durability in S-NPD. Using an experimental approach, this research aims to identify how these three variables influence the decision-making process in sustainable new product development and their impact on environmental sustainability and company performance.

Previous research has extensively discussed the importance of sustainability in New Product Development (NPD), particularly in integrating social, economic, and environmental aspects to support the development of more environmentally friendly products ([Safdie, 2024](#); [Gmelin & Seuring, 2014b](#)). The role of cost information in NPD decision-making, where providing accurate data, can help companies balance cost efficiency and sustainability ([Booker et al., 2007](#)). As for gender in the context of product design, [Wardani & Jatningsih \(2024\)](#) show that male and female designers process information differently, which can ultimately affect the effectiveness of decisions related to product cost and durability. Other research also highlights studies on product durability, showing that extending product lifespan can reduce waste and pressure on natural resources, making it an important element in sustainability ([Delaney & Liu, 2023](#); [Geiker et al., 2023](#)).

This study's justification for selecting variables is based on their academic and practical relevance in sustainability literature. Cost information was chosen because previous research shows that more transparent cost management can enhance the effectiveness of business decision-making. Gender differences were included as a variable because previous literature shows that men and women have differences in information processing and risk-taking. Meanwhile, product durability was chosen due to its relevance in long-term sustainability strategies, where this research confirms that products with high durability better support sustainability than cost or gender considerations. Therefore, this research not only tests these variables individually but also explores how the interactions among the three can enrich the academic understanding of sustainability in new product development.

Although many studies examine the importance of sustainability in NPD, research specifically discussing the relationship between cost information variables, gender, and product durability in the context of S-NPD is still limited. This study presents a new perspective by integrating cost information, gender differences, and product durability within the S-NPD framework through an experimental approach using a 2x2x2 factorial design to test the combined impact. Unlike previous studies that analyzed these factors separately, this research explores how the interaction between variables can influence decision-making in S-NPD.

This research also aims to fill the literature gap with an experimental approach to understanding the factors influencing decision-making in S-NPD. According to [Hulme \(2006\)](#), there is a possibility of other factors outside the analysis that also influence a decision, so this study aims to identify the more complex relationships of variables in the context of sustainability. The results of this research are expected to help companies optimize production costs, meet consumer expectations for sustainable products, and improve performance and competitiveness in the market. This research makes an important contribution to sustainability practices in new product development, highlighting the role of durability as a key factor in sustainability. In the industrial context, these findings emphasize that companies should prioritize durability more in their product innovation strategies, especially considering the global trend towards a circular economy that demands more durable and environmentally friendly products. Therefore, this research provides academic insights into sustainability studies and offers practical recommendations for the industry in developing more competitive and environmentally oriented products.

Literature Review

Hypothesis Development

The Influence of Cost Information Type on Sustainable New Product Development (S-NPD)

The Triple Bottom Line (TBL) theory was first introduced by John Elkington in 1994 ([Salsabila, 2023](#)). Thinking about TBL is linked to sustainable development ([Hammer & Pivo, 2017](#)). TBL discusses the 3P concept, namely People, Planet, and Profit, which is the foundation for sustainable business. TBL has become an accounting framework used to assess sustainability, promote economic growth, and enhance the competitive advantage of companies ([Nogueira et al., 2023](#)). This concept was created to express the expansion of sustainability values in business practices ([Majid et al., 2012](#)).

Based on the TBL theory concept, cost information plays a role in the economic aspect by helping companies assess the efficiency and profitability of sustainability strategies. In the context of S-NPD, designers must balance cost efficiency with environmental sustainability and social welfare. Cost information plays an important role as a basis for management decision-making during the NPD process. According to [Jatiningsih and Sholihin \(2015\)](#), the ability to efficiently develop new products has become crucial in facing the ever-changing dynamics of the organizational environment, and this can be supported by having adequate cost information. Financial and non-financial information is important when managers make plans, control, and decisions ([Nugrahaningsih, 2024](#)). Cost efficiency is expected to be realized so that designers can use lower costs and achieve the best profits ([Maelani et al., 2022](#)).

Previous research shows that the type of cost information provided to designers affects their design focus ([Booker et al., 2007](#)). Meanwhile, research conducted by [Jatiningsih and Sholihin \(2015\)](#) found that providing designers with cost information (specific or relative) improved the cost-effectiveness of new product design. Therefore, cost information is important to balance economic efficiency and environmental impact in business decision-making. In the context of S-NPD, the availability of detailed cost information can contribute to designers in identifying costs for sustainability, whether in handling waste reduction, energy efficiency, or environmentally friendly raw materials. The relationship between TBL and S-NPD in accounting is closely related to management accounting and sustainability accounting. Management accounting provides cost information that supports operational efficiency, budget planning, and the profitability analysis of new products. Meanwhile, sustainability accounting helps identify business activities' environmental and social impacts.

Transparent cost information allows designers and managers to evaluate the trade-off between cost efficiency and product sustainability. For example, implementing Activity-Based Costing (ABC) can provide a more detailed mapping of costs related to resource usage, thereby assisting in managing environmentally friendly raw material costs and energy efficiency. Additionally, the Life Cycle Costing (LCC) approach in

sustainability accounting allows companies to analyze the total cost of a product from the development stage to disposal to optimize sustainability aspects.

Thus, accounting serves as a tool for recording and reporting financial information and as a strategic instrument in sustainable business decision-making. The integration of cost information in S-NPD has proven to contribute to improving cost-effectiveness and achieving the company's sustainability goals. Based on this, designers who effectively use cost information will be more capable of developing new products that support environmental sustainability. Therefore, the first hypothesis in this study is:

H1: Cost Information Affects Sustainable New Product Development (S-NPD)

The Influence of Gender Differences on Sustainable New Product Development (S-NPD)

The Stakeholder Theory was first proposed by R. Edward Freeman in 1984, which explains the relationship between companies and stakeholders. In the context of S-NPD, this theory is relevant to the research because sustainable product innovation must consider the interests of various stakeholders involved, including gender perspectives in product design decision-making. By considering gender perspectives in decision-making, companies can enhance the balance between economic, social, and environmental aspects, as emphasized in the Triple Bottom Line (TBL). Therefore, gender equality in S-NPD is a social issue and a business strategy that can enhance competitive advantage and stakeholder satisfaction.

Gender differences influence the decision-making process, including in the context of sustainable new product design. Considering the importance of gender diversity for companies, policymakers, and academics (Rao & Tilt, 2016). Cahyono (2017) states that there are differences in the process and results of critical thinking tests between males and females in the learning process. The demand for gender equality has led many companies to provide equal opportunities for all individuals to occupy various important positions (Farida, 2019). The effect of gender also influences decision-making in accounting (Francis et al., 2015). Wibowo (2010) concluded from his research that there is a difference in understanding the code of ethics between female and male auditors. Previous research conducted by Meyers-Levy and Sternthal (1991) showed that compared to men, women often have a lower threshold for decoding message signals, resulting in a more significant impact on the implications of signals in evaluations. Previous research conducted by Wardani and Jatningsih (2024) showed that the results of the experiments indicated a joint effect where gender differences interact with cost information and management control systems in influencing the cost-effectiveness of NPD as a performance metric. This supports the idea that gender differences can influence S-NPD through the different perspectives, values, and approaches men and women bring.

About the Triple Bottom Line (TBL) theory, gender plays an important role in strengthening sustainability. Women are often more sensitive to environmental and social issues, which can drive product innovations focused on long-term sustainability. Conversely, men tend to focus more on economic efficiency and financial outcomes, which can accelerate the adoption of innovative technologies in the S-NPD process. Meyers-Levy and Sternthal (1991) explain the differences in information processing strategies based on gender, where women tend to use a more comprehensive approach and men more heuristic. This combination of perspectives creates a strategic balance in integrating TBL values, where innovation is oriented towards economic profit and considers social and environmental impacts.

This approach is also supported by Behavioral Decision Theory (BDT), which studies how individuals make decisions under conditions of uncertainty by considering several factors. According to Hogarth (1993), the central topic of BDT theory is the theory of how individuals make decisions. BDT emphasizes that decision-making is influenced by the limitations of rationality and cognitive biases, which differ between men and women. In management accounting, this reinforces the importance of cost information systems that support sustainability-based decision-making, as gender differences can influence how financial and non-financial information is processed in business strategies. Thus, the BDT theory provides a stronger foundation for

understanding how gender factors influence decision-making in S-NPD, particularly in balancing cost efficiency with sustainability.

Gender diversity plays an important role as a determinant of the type of innovation (Díaz-García et al., 2013). Studies show that teams with gender diversity are more likely to produce creative and innovative solutions relevant to developing products that support global sustainability. Therefore, the influence of gender on S-NPD not only enhances product sustainability but also helps companies become more adaptive to dynamic market needs. Therefore, the second hypothesis in this study is:

H2: Gender differences affect Sustainable New Product Development (S-NPD)

The Influence of Product Durability on Sustainable New Product Development (S-NPD)

With the TBL approach, a company can be evaluated based on its impact on the economy, environment, and society (Oppon et al., 2024). The sustainability of resources and the environment ensures businesses can operate long-term and generate sustainable profits (Nabilah & Murwaningsari, 2023). Economic sustainability in the TBL theory implies practices that ensure long-term economic continuity without negatively impacting social and environmental aspects (Chen & Kamarudin, 2024). The relationship between TBL and NPD must be achieved in order to design and produce sustainable products (Gmelin & Seuring, 2014a). Durability directly contributes to environmental aspects because high durability can reduce waste and resource consumption, which is also in line with the concept of a circular economy. Product durability significantly impacts S-NPD because it increases resource efficiency, reduces waste (Iraldo et al., 2017), and extends the product lifecycle. Delaney and Liu (2023) demonstrate a design process that has been adjusted based on interview results and identify specific factors applied for environmental sustainability based on considerations by 50% or more of the survey participants, one of which is the durability factor. In the context of the Triple Bottom Line (TBL) theory, durability supports the three pillars of sustainability in the economic aspect through long-term cost reduction and increased customer value, in the environmental aspect by reducing the frequency of product disposal and the use of new raw materials, and in the social aspect by providing benefits to consumers in the form of durable and reliable products.

Creating durable goods poses a challenge for designers in developing a strategy (Jetti & Dhar, 2024). A product's durability and long lifespan play an important role in the product development process (Carlisle & Friedlander, 2016). Products designed to last reduce the need for repeated consumption, thereby minimizing the carbon footprint generated from production and distribution. This is also supported by research conducted by Jensen et al. (2021), which indicates that decisions made during the product development process significantly affect customer engagement and are directly related to the product's lifespan.

About accounting, product durability affects cost recognition, depreciation estimation, and production cost control strategies in management accounting. Products with high durability tend to have lower maintenance costs and longer utility value, impacting asset depreciation calculations and product lifecycle management strategies in financial statements. From a sustainability accounting perspective, product durability helps companies optimize their cost structure by minimizing re-production and waste management costs, aligning with the TBL's economic efficiency principle. Thus, the integration of sustainability into S-NPD strengthens the principle of sustainability and creates long-term value in line with the goals of the Triple Bottom Line (TBL) theory. Therefore, how sustainability affects the integration of economic, environmental, and social aspects in S-NPD can generate a hypothesis in the form of:

H3: Product Durability Affects Sustainable New Product Development (S-NPD)

Method

Sample Selection

This quantitative study uses experimental methods to test the influence of cost information type, gender differences, and product durability on the sustainable new product development process (S-NPD).

Participation in this study consists of active students in their third and fifth semesters from the Accounting Study Program at the Faculty of Economics and Business, Universitas Muhammadiyah Yogyakarta, who act as product designers in sustainable product development. The sample in this study consisted of 141 students who had taken and studied cost accounting and management accounting courses.

The selection of accounting students as experimental participants is based on the assumption that they have a basic understanding of cost analysis, business decision-making, and sustainability concepts, as well as the knowledge gained after taking cost accounting and management accounting courses. Students are often employed in experimental research because they can provide initial insights into how individuals process information in decision-making, which can later be tested further on a broader population. Additionally, using students as experimental participants helps reduce bias due to diverse work experiences and professional backgrounds. However, the limitation of selecting student samples as experimental participants is that they do not yet have practical experience in actual product development, so the results of this study may have limitations in generalizing to industry professionals. Therefore, further research involving product managers or professional designers will be necessary to confirm the results obtained in this study and to gain a more comprehensive understanding of the impact of these factors in a real industrial context.

Based on the method used, this study forms a 2x2x2 between-subject factorial experimental design (Table 1 and 2) consisting of eight experimental conditions that reflect the combination of three independent variables: type of cost information (specific vs. relative), gender difference (male vs. female), and product durability (long-lasting vs. short). This factorial design was chosen because it allows for the simultaneous testing of interactions between variables, making the research results more efficient in revealing the influence of these variables on sustainable new product development (S-NPD).

Table 1. Research Matrix – Cost Information & Gender

Cell	Cost Information	Gender	Description
1	Specific	Male	Participants will be given specific cost information with a male product designer
2	Specific	Female	Participants will be provided with specific cost information with a female product designer
3	Relative	Male	Participants will be given cost information relative to their male product designer
4	Relative	Female	Participants will be provided with cost information relative to their female product designer

Table 2. Research Matrix – Product Durability & Gender

Cell	Product Durability	Gender	Description
5	Lasts Longer	Male	Participants will be given information about the product's long-lasting durability with a male product designer
6	Lasts Longer	Female	Participants will be given information about the product's long-lasting durability with a female product designer
7	Lasts Shorter	Male	Participants will be given information about the product's short durability with a male product designer
8	Lasts Shorter	Female	Participants will be given information about the product's short durability with a female product designer

Tasks and Experimental Procedures

The experimental procedure involves assigning participants to design a product as a dollhouse. Before the experiment begins, participants receive a set of toy blocks, a guidebook, and a worksheet. And manipulation check sheets. Participants were given brief training and instructions on the tasks to be performed. In certain experimental conditions, participants were provided with cost information (specific or relative) as well as product durability information (long-lasting or short) according to gender roles (male or female). All these

conditions are designed to evaluate how participants considered to represent professional product designers consider sustainability in the product development process.

To ensure internal validity, this study uses a randomization process conducted through randomization (Sihotang, 2020). Randomization was done through the random distribution of task sheets and the freedom for participants to choose their seating with different task sheets. This randomization aims to reduce bias and ensure an even distribution of sample characteristics across each research group. In addition, manipulation checks are also conducted to ensure that the participants correctly understand the treatment in the experiment. Manipulation checks are one of the important ways to assess the strength of experimental results in studies based on subjects' attention to the treatment (Aronow et al., 2019). This process is carried out by providing five questions that measure participants' understanding of cost information, gender context, and differences in product durability presented in the experiment. Manipulation was carried out through a series of questions after each experimental session, designed to measure the extent to which participants could identify the type of cost information they received (specific vs. relative), the influence of gender factors in decision-making scenarios, and the durability of the products they evaluated (durable vs. short-lived). These questions also confirm understanding regarding the tasks assigned in the experiment, such as whether they understand their role as product designers in the S-NPD scenario. The manipulation check results are used to ensure that the effects measured in the study genuinely originate from the experimental treatment, not from other interpretations by the participants.

Data Analysis Techniques

The data analysis used in this research employs the Statistical Package for the Social Sciences (SPSS) software, using the Two Way ANOVA statistical method. Due to the three independent variables in this study, this method ensures that every combination of variables can be tested simultaneously, thereby obtaining more substantial results in identifying the individual effects and interactions between variables on S-NPD. Before further analysis, the first step is to analyze the data distribution using descriptive statistics that provide an overview of the experimental data, including the mean, standard deviation, and others. After that, the data were first analyzed using a homogeneity test to show that two or more groups of data samples were taken from populations with the same variance or are homogeneous. This study conducted the homogeneity test using Levene's Test, O'Neill and Mathews (2000) at a significance level of 0.05. After conducting the homogeneity test, the hypothesis test was continued using the Analysis of Variance (ANOVA) test, Stahle and Wold (1989) to evaluate the data to determine whether there is a correlation between variables in two or more data sets.

Result and Discussion

Tables 3 and 5 present descriptive statistics, including the mean, standard deviation, and the number of participants in each experimental group. This experimental activity was conducted by accounting students as substitutes for professional designers, totaling 141 students.

Table 3. Descriptive Statistics of Cost Information and Gender Differences

Descriptive Statistic				
Dependent Variable: Eco-Friendly				
Cost Information Type	Gender	Mean	SD	N
Specific	Male	541.58	110.04	55
	Female	556.75	146.75	12
Total		544.29	116.33	67
Relative	Male	544.25	94.14	56
	Female	525.66	144.40	18
Total		539.72	107.69	74
Total	Male	542.92	101.87	111
	Female	538.10	143.64	30

Total **541.90** **111.50** **141**

Source: SPSS Output

Table 4. Profile Plots of Cost Information and Gender Differences



Source: SPSS Output

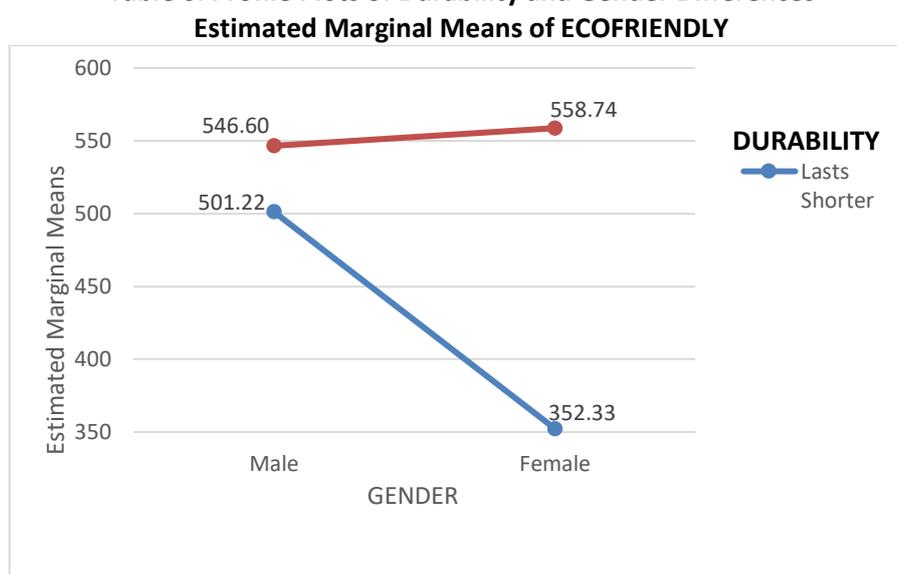
Table 5. Descriptive Statistics of Durability and Gender Differences

Descriptive Statistic
Dependent Variable: Eco-Friendly

Gender	Product Durability	Mean	SD	N
Male	Lasts Shorter	501.22	109.48	9
Male	Lasts Longer	546.60	100.92	102
	Total	542.92	101.87	111
Female	Lasts Shorter	352.33	123.67	3
Female	Lasts Longer	558.74	131.95	27
	Total	538.10	143.64	30
Total	Lasts Shorter	464.00	126.62	12
	Lasts Longer	549.14	107.69	129
	Total	541.90	111.50	141

Source: SPSS Output

Table 6. Profile Plots of Durability and Gender Differences



Source: SPSS Output

Based on the descriptive statistics results in [Table 3](#), the average value of eco-friendly design for specific cost information is 544.29, with a standard deviation of 116.33. Meanwhile, for relative cost information, the average value is 539.72, with a standard deviation of 107.69. This indicates that specific cost information is superior to relative cost information.

For the gender variable results displayed in [Tables 3](#) and [5](#), the average score for males is 542.92 with a standard deviation of 101.87; for females, it is 538.10 with a standard deviation of 143.64. These results show that males excel in producing eco-friendly product designs and have a higher perspective on prioritizing sustainability.

Meanwhile, based on the descriptive statistics for product durability in [Table 5](#), the average value for products with extended durability is 549.14, with a standard deviation of 107.69. For products with short durability, the average is 464.00, with a standard deviation of 126.62. This data shows that durability with a long lifespan has a higher score than durability with a short lifespan.

**Table 7. Homogeneity Test
Levene’s Test of Equality of Error
Variances^a**

Dependent Variable: Eco-Friendly

Variable	F	df1	df2	Sig.
Cost Information*Gender Differences	2.122	3	137	0.100
Gender Differences*Durability Product	1.125	3	137	0.341

Source: SPSS Output

The homogeneity test is conducted before the ANOVA test is performed to analyze whether the variance in each sample is homogeneous. The results of Levene's test in [Table 7](#) show a Sig. Value 0.100 > alpha 0.05 for the variable type of cost information and gender difference, while the Sig. Value 0.341 > 0.05 is shown for the variable of gender difference and product durability. This means that the three independent variables (type of cost information, gender difference, and product durability) have the same or homogeneous variance. Therefore, to analyze the significant influence between variables, these three independent variables can proceed to the ANOVA test.

**Table 8. ANOVA Test on Cost Information and Gender Differences
Tests of Between-Subjects Effects**

Dependent Variable: Eco-Friendly

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7704.478 ^a	3	2568.159	.203	.894
Intercept	26875660.42	1	26875660.42	2124.720	.000
INFOBIAYA	4615.736	1	4615.736	.365	.547
GENDER	66.675	1	66.675	.005	.942
INFOBIAYA*GENDER	6512.198	1	6512.198	.515	.474
Error	1732918.132	137	12649.037		
Total	43146172.00	141			
Corrected Total	1740622.610	140			

R Squared = .004 (Adjusted R Squared = -.017)

Source: SPSS Output

Based on the ANOVA test results in [Table 8](#), it shows a Sig. Value. 0.547 > 0.05 (alpha), which means there is no significant influence of the cost information type variable on Eco-Friendly (S-NPD). [Table 5](#) also shows a Sig. The value of 0.942 > 0.05 (alpha) means that there is no significant influence of the gender variable on eco-friendliness (S-NPD). Meanwhile, the interaction between the cost information type variable and gender

has a Sig. Value of 0.474 > 0.05 (alpha), indicating that there is no significant interaction effect between these two variables on Eco-Friendly (S-NPD).

Table 9. ANOVA Test for Durability and Gender Differences
Tests of Between-Subjects Effects

Dependent Variable: Eco-Friendly

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	132616.889 ^a	3	44205.630	3.766	.012
Intercept	7810745.859	1	7810745.859	665.465	.000
GENDER	38067.895	1	38067.895	3.243	.074
DURABILITY	129048.673	1	129048.673	10.995	.001
GENDER*DURABILITY	52775.872	1	52775.872	4.496	.036
Error	1608005.721	137	11737.268		
Total	43146172.00	141			
Corrected Total	1740622.610	140			

R Squared = ,076 (Adjusted R Squared = ,056)

Source: SPSS Output

Based on the ANOVA test results in [Table 9](#), the Sig. A value of 0.074 > 0.05 (alpha) indicates that there is no significant influence of the gender variable on Eco-Friendly (S-NPD). In [table 9](#), it also shows a Sig. Value of 0.001 < 0.05 (alpha), which means there is a significant influence of the product durability variable on Eco-Friendly (S-NPD). Meanwhile, the interaction between the gender variable and product durability has a Sig. Value of 0.036 < 0.05 (alpha), indicating that this interaction has a significant effect on Eco-Friendly (S-NPD).

Cost Information Types Affect Sustainable New Product Development (S-NPD)

This research shows that the type of cost information, whether specific or relative, does not significantly impact sustainability in new product development (S-NPD). This finding contradicts previous research by [Jatiningsih and Sholihin \(2015\)](#), which stated that specific cost information can enhance the effectiveness of management decisions in new product development. These findings indicate that both male and female designers do not show specific advantages based on certain types of cost information, which contradicts the research conducted by [Wardani and Jatiningsih \(2024\)](#) that women are more effective with specific information and men are more effective with relative information. These results also contradict the research by [Booker et al. \(2007\)](#), which states that providing different types of cost information can shift designers' focus on cost considerations. In addition, the research results also did not find a significant interaction between the type of cost information and gender, which is different from the findings of the study conducted by [Wardani and Jatiningsih \(2024\)](#) that women are more effective with specific information and men are more effective with relative information. This difference in results is likely due to the fact that the research experiment participants were students who had not yet gained practical experience in managing costs in actual product development, although they had a basic understanding of cost analysis and sustainability. Managers and product designers are more likely to consider cost aspects in depth in a real business environment because they relate to long-term profitability and operational sustainability. However, in this experimental setting, participants might focus more on other factors that are easier to understand, such as product durability, rather than cost considerations in sustainable product design. Furthermore, the lack of deeper integration between cost information and gender differences indicates that factors beyond the combination of cost information types and gender influence sustainability decisions in new product design.

If linked to the Triple Bottom Line (TBL) theory, cost information is considered relevant in supporting NPD's balance of economic, social, and environmental aspects. Cost information also supports the concept of "Profit" in enhancing cost efficiency, which is relevant for companies facing market pressure to provide sustainable products at competitive prices. Although cost information is important to support economic

sustainability, its effectiveness requires synergy with social and environmental aspects to provide a more significant impact. In other words, the results of this research indicate that sustainability in product design is not solely influenced by the type of cost information, but requires a broader approach. On the contrary, integration with a more comprehensive design strategy is needed to achieve sustainability and align with TBL principles. Therefore, H1 proposed in this study, which states that the type of cost information affects sustainable new product development (S-NPD), **is rejected**.

Gender differences affect Sustainable New Product Development (S-NPD)

The research results indicate that gender does not significantly impact sustainability in S-NPD. These findings contrast with the study conducted by [Wardani and Jatningsih \(2024\)](#), highlighting the importance of gender diversity in team development and the proper arrangement of control systems to achieve optimal performance in NPD. This study also contradicts the findings of the research conducted by [Meyers-Levy and Sternthal \(1991\)](#), which revealed that there are differences in information processing strategies based on gender, where women tend to use a more comprehensive approach and men more heuristic. The possibility of this result discrepancy is due to the more controlled structure of the experimental task, which inadvertently limits the participants' space to demonstrate differences in gender-based decision-making patterns. Thus, in situations of more formal decision-making based on experimental instructions, gender factors may not have as significant an impact as assumed in previous research.

Within the Triple Bottom Line (TBL) theory framework, gender diversity is recognized as a means to balance economic, social, and environmental sustainability goals while implementing the "People" aspect in sustainability practices. However, the results of this study emphasize that sustainability in product design cannot solely rely on gender diversity but instead requires a more systematic approach, such as training to raise sustainability awareness among designers, as well as strategies that consider other factors, such as professional experience and work culture, which can influence design decision-making.

Thus, although the TBL theory supports diverse perspectives to achieve sustainability, this study shows that the gender factor in limited experimental conditions does not significantly contribute to the sustainability of new products. This provides an opportunity for further research by involving professional designers or more complex experimental environments. This difference indicates that the gender factor in S-NPD decision-making may be more influenced by other aspects, such as professional experience, organizational culture, or individual preferences that were not tested in this study. Therefore, based on the results of the data analysis, H2, which states that gender differences influence the development of sustainable new products (S-NPD), **is rejected**.

Product Durability affects Sustainable New Product Development (S-NPD)

Product durability has been proven to impact sustainability in S-NPD significantly. These results support the research by [Delaney and Liu \(2023\)](#), which identifies "Durability" as one of the 18 key factors of environmental sustainability recommended for application in the NPD design stage. Moreover, these findings are consistent with the Triple Bottom Line (TBL) theory, which emphasizes balancing environmental, economic, and social aspects in creating sustainability. The TBL theory emphasizes that durability supports resource efficiency (environmental aspect) and provides higher economic value through long-term cost reduction and increased consumer satisfaction. This is also in line with the study by [Iraldo et al. \(2017\)](#), which shows that products with high durability contribute to reducing environmental impact and lowering costs for consumers. Thus, this research emphasizes the importance of considering durability as a strategic component in sustainable product design.

Additionally, the results of the ANOVA test also found that the interaction between product durability and gender has a significant impact on S-NPD. This indicates that there are differences between men and women in processing information and determining priorities in product design. The combination of perspectives from gender diversity can create balanced strategies and form design teams that produce more innovative

and complementary solutions in integrating TBL aspects and decision-making to create new sustainable products. Based on the research findings that product durability significantly affects S-NPD, the company can implement this by prioritizing durable materials and designs. This aims to reduce waste, increase customer satisfaction, and align with sustainability goals, making the product more competitive in the environmentally friendly market. In industrial practice, companies like Patagonia and Fairphone have implemented business models focused on high-durability products and repair options, reducing waste and enhancing customer satisfaction and loyalty. Therefore, companies that want to enhance their competitiveness in the sustainability market should consider a similar approach, such as developing more durable materials, introducing product repair services, and offering recycling schemes. Additionally, governments and policymakers can support these initiatives through regulations and incentives, such as the "Right to Repair" policy in the European Union, which requires manufacturers to provide spare parts and repair documentation to extend product lifespan and reduce electronic waste.

Thus, this research provides insight that durability has a greater impact on product sustainability than cost and gender information in design decision-making. In other words, durability significantly affects S-NPD both directly and through the interaction of durability. It can be concluded that H3, which states that product durability affects Sustainable New Product Development (S-NPD), **is accepted**.

Contribution, Implications, and Research Recommendations

This research provides a theoretical contribution by reinforcing the Triple Bottom Line (TBL) concept, which emphasizes the balance between economic, environmental, and social aspects in S-NPD. It enriches the literature by supporting the circular economy concept, explicitly emphasizing that product durability impacts sustainability more significantly than cost information or gender differences. From a managerial contribution perspective, these findings provide insights for companies to prioritize durability as a key focus in their S-NPD strategy, considering that more durable products can enhance resource efficiency and customer satisfaction while reducing re-production costs and industrial waste.

Theoretically, this research has implications by opening up opportunities for further exploration related to other factors in the sustainability of S-NPD, such as sustainability awareness, green technology, consumer preferences, and so on. In addition, this research provides a new perspective in management accounting, particularly in applying Life Cycle Costing (LCC) and Activity-Based Costing (ABC) to assess the long-term economic impact of sustainable products. Practically, this research provides implications for several parties. For companies, these findings underscore the importance of integrating product durability as a key factor in S-NPD, considering that products with a longer lifespan can reduce re-production costs, enhance customer loyalty, and strengthen the brand image as a sustainability-oriented company. Therefore, management must adopt strategies focusing on modular design, using high-quality materials, and investing in research and development to enhance product durability. For product designers, these findings emphasize the importance of considering long-term cost aspects. Using cost accounting methods such as Life Cycle Costing (LCC) and Activity-Based Costing (ABC) can help in designing more economically and environmentally efficient products and understanding the long-term cost impact of products. From the policymakers' perspective, the results of this research support the need for stricter regulations regarding product durability standards. Policymakers need to take concrete actions to support sustainability, such as providing tax incentives or subsidies for companies that implement sustainability strategies and tightening regulations related to resource efficiency and durability standards to encourage the industry towards a circular economy.

Sustainable product development also has a wide impact on society. With the increasing consumer awareness of environmentally friendly products, this trend has become a corporate social responsibility and a significant business opportunity. More durable products can reduce the frequency of repeat purchases, allowing consumers to save on expenses and contribute to the reduction of industrial waste. Therefore, companies can adopt these findings by using durability as the primary metric in product design, adjusting

marketing strategies to attract consumers who care about sustainability, and developing internal education programs for design teams to better understand sustainability principles in NPD.

In the context of academic and policy, this research can serve as a reference for management accounting studies and sustainable business strategies. These findings can also assist regulators in developing product sustainability standards and providing incentives for industries that implement S-NPD practices. Furthermore, this research emphasizes that consumer preference for sustainable products is increasing, as shown by the First Insight and Baker Retailing Center report states that 75% of Gen Z prefer sustainable products over branded ones. This proves that S-NPD impacts the environment, influences consumer behavior, enhances customer loyalty, and shapes more responsible consumption patterns.

From an economic and environmental perspective, sustainable products have various benefits. Economically, product durability helps reduce re-production costs, enhance brand value, and optimize the supply chain by reducing raw material consumption. Meanwhile, from an environmental perspective, durability contributes to reducing electronic and industrial waste and minimizing the carbon footprint resulting from repeated production and distribution. Therefore, the findings in this study are directly related to empirical results that show product durability has a significant impact on sustainability in S-NPD.

Although the research results show that cost information does not have a significant impact, indirectly, cost information affects S-NPD decisions, where sustainability strategies in NPD still require long-term cost analysis to optimize resource efficiency. Thus, the recommendations in this study remain consistent with the empirical findings. Several global companies, such as Patagonia, have successfully implemented this strategy, designing outdoor clothing with high durability standards and providing repair services. Moreover, the company IKEA has switched to a circular business model by offering products that can be recycled and repaired and has also adopted the concept of green marketing.

Overall, this research provides an academic contribution to understanding the factors influencing S-NPD and also offers practical guidance for the industry and policymakers to create more sustainable and innovative product development strategies. Therefore, the findings of this research should be utilized as a foundation in business strategy planning, policy formulation, and industry education to accelerate the transition toward a more sustainable economy.

Conclusions and Recommendations

This study found that the type of cost information and gender differences do not significantly affect S-NPD. This indicates that cost information and gender differences require a broader integration of sustainability strategies and a holistic approach involving more comprehensive design strategies and sustainability training for designers. On the contrary, product durability has a significant impact on S-NPD. This is in line with the research conducted by [Delaney and Liu \(2023\)](#), which mentions durability as a key factor for sustainability in product design. This indicates that diverse gender perspectives have the potential to create innovative design strategies and enable more comprehensive information processing and effective sustainability solutions by integrating the three aspects of the TBL theory.

Theoretically, this research contributes to strengthening the TBL theory by emphasizing the role of sustainability in making sustainability decisions, as well as enriching the literature by supporting the concept of a circular economy, which shows that sustainability-based design is more effective in enhancing product sustainability. This research also contributes managerially by providing insights for companies to prioritize durability in product design specifications and to form more gender-diverse design teams to enhance innovation. This research provides theoretical implications by opening up opportunities for further exploration of other factors in the sustainability of S-NPD. Practically, this research provides implications for companies to implement strategies to enhance the durability of their products.

However, this study has a limitation in that it used accounting students as participants, who may not yet have practical experience in decision-making, so that future research could involve professional designers. Furthermore, future research could further analyze the interactions between variables or explore additional factors such as sustainability awareness, green technology, consumer preferences, etc. Therefore, future research can expand the understanding of sustainability factors in S-NPD and provide more applicable insights for companies, policymakers, and academics in developing more environmentally friendly and economical product strategies.

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