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Abstract. The concept of economic linearity that is, take, make, and discard, is no longer relevant in product design, this is due to product design must meet economically, safely and reliably shown by looking at the attributes inherent in the product, which aims to make customers feel satisfied, buy go back and recommend the product. However, with the increasing number of products that are not environmentally friendly it is necessary to minimize the negative impact of sustainability in designing products that require a recovery phase. This study aims to determine the effect of sustainable product design in minimizing the negative impacts caused by attitudes and behaviors that are influenced by the environment. The analysis technique uses PLS 3.0 warp. and the Process Hierarchy Analysis (AHP) method. The results of the design of this research product have a direct influence on the impact of negative sustainability with a parameter coefficient of 0.609. This means, sustainable product design is carried out, must pay attention to the negative impacts caused, then test the factors that are more dominant relationships between variables using AHP that produces. The most dominant factor in testing the sub-criteria that influence product design in Minimizing the Impact of Negative Sustainability, from the results of tests that have been done, then the behavior of the Environment with a value of 0.57 is the conclusion that in designing the product in order to minimize the negative impact of the influence due to the conditions used in Sustainable product design, the influence of human environmental behavior on the environment becomes a major factor

Keywords: Product design, negative impact, Sustainability

1. Introduction
Design is an effort to arrange, obtain and create new things that are beneficial to human life, so that their activities can be interpreted as an effort to be able to create new products or the development of existing products. So creating an environmentally friendly product by minimizing the environmental

impact caused by the product is a necessity because it has a dominant role in influencing sustainable design strategies, this is related to the definition, identification and implementation of the approach, so that it will affect the environment, resource consumption, waste control and efficiency.[1]. Much work has been done on the creation and implementation of methods to reduce the environmental impact of products created considering the environment will be able to have a negative impact and will require a long recovery phase. Conventionally, there are four different design processes [2]. The first stage is discussing the problem followed by conceptual design. Then, the second continued, do conceptual design, namely by discussing product functions, making alternative concepts and setting design specifications, installing a third for the initial design that governs elaboration and understands alternative concepts and the selection of the best concepts. The final stage is that the design must be detailed in which the chosen alternatives are explained in detail, further evaluation and optimization are carried out, requirements for creating and maintaining links, registering and communicating.

Plans and ongoing product design stresses the importance of the entire life cycle of a product from its raw material selection, conceptual and structural formation, manufacturing, and use to the end of its useful life, reuse, and recycling[3];[2]. Conventionally, the improvement of the design process has several main tasks, namely determining and prioritizing sustainability issues in product design, generating sustainability recommendations in the initial product design, evaluating design performance and producing sustainable strategies [4]. Laws and regulations that have required packaging businesses to list their products have standard packaging that is environmentally friendly, not fully carried out by manufacturers, this is evident on the packaging of certain products that many do not yet include the logo. so it is possible that the packaging will be difficult to decompose naturally. This study aims to test the design of sustainable products [3];[2] on the influence of negarfnya, and to determine the dominal factor in the improvement efforts that must be done by the designers, it is important to know how much influence the attitude and culture of the environment affect the negative impact, and what factors are more dominant for improvement.

1.1 Sustainable product design
Sustainable product development (SPD) is a method for product development that incorporates a Framework for Strategic Sustainable Development (FSSD), also known as the Natural Steps framework (TNS). As demand for products continues to increase worldwide and environmental factors such as climate change increasingly influence policies - and thus business - there will be more and more competitive advantages for businesses to consider sustainability aspects early in the product development process.

Sustainable product development (SPD) is not limited to actual product development, but also product design. Green design which is part of SPD has two main objectives: prevention of waste and to minimize environmental impact. Environmental impacts involve: deforestation, greenhouse gas emissions, and management of resources / materials, etc. The initial stages of design tend to be the areas that most adversely affect the environment, extraction and purification.
While Sustainable product design is a product design that produces products that can minimize their impact on the environment, so in the product design must pay attention to 4 indicators namely raw material selection, manufacturing, reuse, recycle [3][2].

1.2 Negative Sustainability Impacts
Sustainability is environmental, economic and social mutual integration in one domain[5], the environment can be influenced by attitudes and habits (culture)[6];[7].
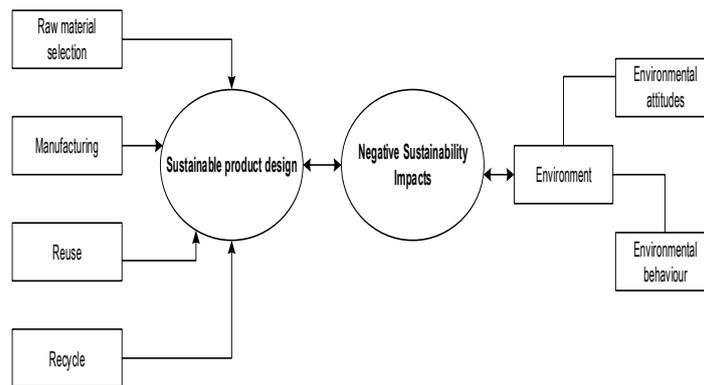
Figure 1. Conceptual framework and hypothesis

2. Methods

This study aims to test the Sustainable product design variable with raw material selection, manufacturing, reuse, recycle indicators of Negative Sustainability Impacts with the Environmental indicators and in this case the environmental indicators focus on environmental attitudes and environmental behavior then test the dominal factors that must be improved by using AHP. This test is carried out by using the Warp PLS 3.0 approach to determine the relationship between variables with a population of students who consume food packaged into packaged products, by taking samples of bottled drinking water products. Primary data comes from questionnaire data distributed to students while secondary data comes from packaging product data that has been consumed by students whose packaging has included the green ecco logo which means that the packaging design has been environmentally friendly variables used in this study can be seen from the table below:

Table 1. Variables and Indicator

Variable	Indicator
Sustainable product design	Raw material selection
	Manufacturing
	Reuse
	Recycle
Negative Sustainability Impacts	Environmental attitudes
	Environmental behaviour

3. Results and Discussion
3.1 Measuring variable relationships
3.1.1 Modeling

Figure 2. Direct effect model

3.1.2 Output General Result

Table 2. Model fit indices and P Value

APC	0.694	P<0,001
ARS	0,482	P<0,001
AVIF	1.000	good If < 5

Table 2. The fit indices and P value models section shows the results of three fit indicators, namely the average part coefficient (APC), average R-squared (ARS) and Average variance inflation factor (AVIF). The p value is given for the APC and ARS indicators which are calculated by estimating

resampling and bonfeeroni like corrections. This is necessary because both of them are calculated as a parameter average. Based on table 4, it can be explained that the probability value (P Value) of APC and ARS is significant, namely the values of P <0.001 and P <0.001, which means that the P value is smaller than the significant level allowable value of 0.05 while AVIF value is 1 which means less than 5 which means that the model is fit.

3.1.3   Output Part coefficients and P value

Table 3. Part Coefficients dan P Value

Part Coefficients	Sustainable product design	Negative Sustainability Impacts
Sustainable product design		
Negative Sustainability Impacts	0,694	
P Values	Sustainable product design	Negative Sustainability Impacts
Sustainable product design		
Negative Sustainability Impacts	<0,001	

Table 3. Presents the results of the estimated path coefficients and p values. The result is that the sutainable product design influences the negative sustainable impact of 0.694 and is significant at <0.001

3.1.4   Output combined loadings and cross loadings

The criteria for decision making is that if the loading value is above 0.7, if the loading value of the factor is below 0.4, it is automatically removed from the model, and if the loading value is between 0.4 and 0.7, the effect or impact of deletion must be seen. but if possible it is still maintained.

Table 4. Testing convergent validity based on loading

	Sustainable product design	Negative Sustainability Impacts	SE	P Value
Raw material selection	(0,835)	-0,101	0,077	<0,001
Manufacturing	(0,857)	0,031	0,059	<0,001
Reuse	(0,836)	-0,031	0,069	<0,001
Recyle	(0,804)	0,208	0,056	<0,001
Environmental attitudes	0,036	(0,968)	0,036	<0,001
Environmental behaviour	-0,036	(0,968)	0,042	<0,001

Table 4. Testing of convergent validity based on loading shows that the factor loading value is above 0.7 so that the model can be maintained both on factors that affect Sustainable product design and factors that affect Negative Sustainability Impacts.

3.1.5   Ouput laten variable coefficients

Table 5. Output laten Variable coefficients

	Sustainable product design	Negative Sustainability Impacts
R-squared		0,482
Composite reliab	0,901	0,968
Combach's Alpha	0,853	0,933
Avg. Var. extrac	0.695	0,937
Full colln. VIF	1,928	1,928
Q-squared		0,481

Table 5 AVE and CR values in the table can be explained that the AVE value in Sustainable product design is 0.6 while the AVE value in Negative Sustainability Impacts is 0.9, while to meet the

requirements of convergent validity the AVE value must be above 0.5, so with referring to the AVE value in the table, the convergent validity based on AVE meets the requirements. While the CR fulfillment requirement is that the CR value must be above 0.7, so based on the above data table the CR values are 0.901 and 0.968, which means that the loading value based on the CR meets the requirements.

### 3.1.6 *Ouput Correlation Among Laten Variable*

Table 6. Ouput Correlation Among Laten Variable

Latent Variable Corelation

	Sustainable product design	Negative Sustainability Impacts
Sustainable product design	(0,834)	0,694
Negative Sustainability Impacts	0,694	(0,968)

P Values for Correlations

	Sustainable product design	Negative Sustainability Impacts
Sustainable product design	1,000	<1,000
Negative Sustainability Impacts	<1,000	1,000

Table 3. Explain that the correlation coefficient between latent variables and their significance (p value), by comparing the square roots of average variance extracted (AVE) must be higher than the correlation between variables in the same column. So that in table 3. The validity of the discriminating construct of Sustainable product design has been fulfilled because the root of AVE is 0, 834 greater than 0.694.

3.2 *Looking for Variable Domination with AHP*
a. Define the problem
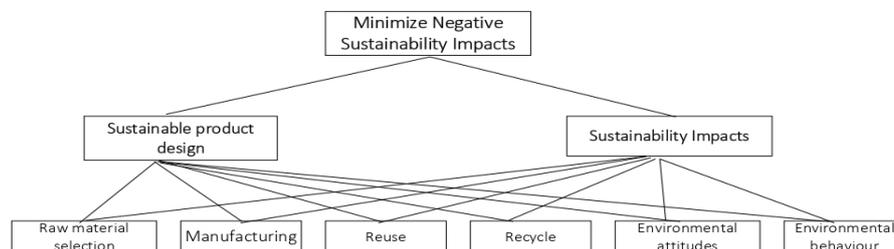
Figure 3. Hierarchy of the Minimize Negative Sustainability Impacts process

Fig 2. The objectives to be achieved in designing products are Minimize Negative Sustainability Impacts with 2 (two) criteria, namely sustainable product design consisting of 4 (four) sub criteria, namely raw material slection, manufacturing, reuse and reycle and sustability impact consists of environmental attitude and environmental behavior.

b. Criteria Comparison Matrix

Table 7. Criteria Comparison Matrix

	Raw material selection	Manufacturing	Reuse	Recycle	Nilai Eigen				Jumlah	rata-rata
Raw material selection	1,00	0,33	1,00	0,33	0,13	0,07	0,14	0,17	0,50	0,13
Manufacturing	3,00	1,00	2,00	0,33	0,38	0,21	0,29	0,17	1,03	0,26
Reuse	1,00	0,50	1,00	0,33	0,13	0,10	0,14	0,17	0,54	0,13
Recycle	3,00	3,00	3,00	1,00	0,38	0,62	0,43	0,50	1,92	0,48
SUM	8,00	4,83	7,00	2,00						1,00

c. Alternative Comparison Matrix

Table 8. Criteria Comparison Matrix

Raw material selection	Environmental attitude	Environmental behaviour	Nilai Eigen		Jumlah	rata-rata
Environmental attitude	1,00	0,14	0,10	0,13	0,23	0,11
Environmental behaviour	9,00	1,00	0,90	0,88	1,78	0,89
sum	10,00	1,14				1,00

Manufacturing	Environmental attitude	Environmental behaviour	Nilai Eigen		Jumlah	rata-rata
Environmental attitude	1,00	9,00	0,90	0,90	1,80	0,90
Environmental behaviour	0,11	1,00	0,10	0,10	0,20	0,10
sum	1,11	10,00				1,00

Manufacturing	Environmental attitude	Environmental behaviour	Nilai Eigen		Jumlah	rata-rata
Environmental attitude	1,00	9,00	0,90	0,90	1,80	0,90
Environmental behaviour	0,11	1,00	0,10	0,10	0,20	0,10
sum	1,11	10,00				1,00

Reuse	Environmental attitude	Environmental behaviour	Nilai Eigen		Jumlah	rata-rata
Environmental attitude	1,00	9,00	0,90	0,90	1,80	0,90
Environmental behaviour	0,11	1,00	0,10	0,10	0,20	0,10
sum	1,11	10,00				1,00

The results of tests carried out indicate that the total average value is 1.00 which means that all sub criteria have been met and the CR value is below 1.0 which means that the tests that have been carried out are consistent. However, comparison matrix testing conducted on 4 (four) sub-criteria of Sustainable Product Design against the sub-criteria of the Negative Sustainability Impacts test meets the requirements with CR values of 0.00 and 1.00.

d. Ranking

Table 9. Ranking of dominant factors

Environmental attitude	0,43
Environmental behaviour	0,57

After calculating the consistency value by calculating the CR in each sub-criterion, the next step is to rank the product design sub-industry criteria, this aims to determine the sub-criteria for Minimize Negative Sustainability Impacts in product design. after calculating, the most dominant sub-criterion is Environmental behavior with a value of 0.57.

4. Conclusion

Based on the results of research conducted, when viewed from the influence of variables, Sustainable product design has a direct effect on Negative Sustainability Impacts with a parameter coefficient of 0.69. thus for Minimize Negative Sustainability Impacts when doing product design, designers always pay attention to the principles of product design including how raw materials are selected, how the production process is carried out, whether the product can be used again repeatedly without causing negative effects or how products that are designed to be able to be recycled and without causing negative effects.

AHP method is used to determine the most dominant factor in testing sub-criteria that affect product design in Minimize Negative Sustainability Impacts, from the results of tests that have been done, then Environmental behavior with a value of 0.57

So it was concluded that in designing the product to be able to minimize the negative impact of the influence caused by the conditions used in Sustainable product design, the influence of Environmental human behavior on the environment becomes a major factor.

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