1. Introduction

Plastic is a material with a very high amount of consumption in the world. From the last ten years, the use of plastic has continued to increase from 250 million tons in 2009 to 368 million tons in 2019 [1]. Plastic waste contaminates the environment and becomes a serious global problem that must be solved immediately [2]. Plastic waste cannot be degraded for a long time and accumulates on land. Some other plastic waste pollutes the oceans and changes the marine ecosystem, which negatively impacts marine animals. These plastic components can turn into smaller molecules, consumed by plankton, and enter the food chain until they finally enter the human body and harm health [3]. The plastic problems continue to grow over time, along with the increase in the use of plastic [4]. In Indonesia, plastic waste reaches 61% of total waste generated by 2020, and it is estimated that the flow of plastic waste into national waters increase to 780 thousand tons per year in 2025 [5]. Based on Chelsea's research, 55% of marine species sold in Makassar city market contain micro plastics and have the potential to be consumed [6].

The largest use of plastic materials is packaging with the percentage of 39.9% [7]. According to Gill, plastic packaging contributes greatly to large amounts of waste [8]. Packaging includes all products that function to wrap, protect, transfer, and display raw materials and final products from producers to consumers [9]. Plastic is a suitable and inexpensive material for packaging [10]. This property is very important for the industry to market their products from producers to consumers widely. Currently there are many eco-friendly packaging alternatives especially for ready to consumed food, because ready to consumed food does not require long distribution, it is directly picked up or
delivered to the consumer, and is direct for consumption, and does not require a long shelf life. However, even though alternative packaging materials that more eco-friendly are available, there are still many food industries that use plastic packaging which difficult to recyclable, even though people already know that plastic is a serious environmental problem [11].

Previous research has been conducted on plastics packaging that harm environment, namely research on the correlation between a person’s economic status and their behaviour in handling waste [12], redesign plastic that is more environmental friendly, inexpensive, and can be reused to help dealing with plastic problems [13], waste sorting process by households in Jakarta [14], discrepancies between consumer opinions and their behaviour towards reducing the use of plastic packaging [15], also the impact of plastic packaging toward environmental damage [16]. However, no research discusses about the basic considerations and level of importance of food industry who continue to use of non-eco-friendly packaging, even though there are other packaging alternatives that are more environmental friendly. By knowing the basic considerations and level of importance of the food industry in choosing food packaging, a solution can be formulated for the food industry to shift from non-eco-friendly packaging to more environmental friendly packaging. The concept of Analytical Hierarchy Process (AHP) was initially developed by Satty [17]. This method is a multi-criteria decision analysis tool that assists to determine level of importance of each criteria [17]. The implementation of Analytical Hierarchy Process (AHP) has been applied and successfully help determine the level of importance of each criteria in many industries [17] [18][19], but has not been used to determine level of importance in food industry. Therefore, AHP method will be used to determine level of importance of each sub criteria of this research.

This study focus are limited to one of the food industry located in Jakarta named “The food industry” (Initial name), because Jakarta has a population density of more than 2,500 people/km2 that produces large amount of waste [5]. The objective is to implement Analytical Hierarchy Process (AHP) method to determine the importance of each consideration criteria in selecting food packaging and strategic actions by implementing assessment model that can be taken to encourage the food industry to shift to eco-friendly packaging.

2. Methodology

![Figure 1. Research methodology](attachment:image.png)
Phase 1: Analytical Hierarchy Process (AHP)

The application of the AHP Method is used to determine decision making process and the level of importance that causes the food industry to continue to use non-eco-friendly packaging rather than eco-friendly packaging. At the end of analysis, comparison of several food packaging is conducted to find the best packaging for the food industry. All phases in research methodology are summarized in figure 1.

2.1. AHP hierarchy model

The purpose of making this hierarchy is to provide a big picture of the purpose of decision making, factors in decision making and the best alternative for each decision making factor [20]. At this stage, the process of pairing the decision-making process is conducted, all hierarchy are made at several levels. At the highest level the point discussed is ”the focus or purpose of the research is determined”, and the purpose of this research is to find the best food packaging for the food industry which environmental friendly aspect is become one of consideration in assessment process. At the next level, the steps taken are determining the criteria and sub-criteria for the research objectives. Factors that cause the food industry to prefer non-eco-friendly packaging over other eco-friendly packaging are determined by conducting interview process [21] and based on previous research that has been conducted before [22, 23]. At the last level, alternative solutions are provided. All purpose, criteria, sub criteria and solution are summarized into AHP hierarchy model in Figure 2.

![Figure 2. AHP Hierarchy [24]](image)

2.2. Pair wise comparison and judgemental matrix

At this stage, a comparison of the level of importance for each criterion or sub-criteria that has been determined in point 2.1 is conducted. At this stage, the respondents determine the level of importance of each criterion. There are 2 respondents involved in determining weight scores. The first respondent comes from purchasing manager who understand the flow process in purchasing division and the other respondent is general manager as the representative of top management from the food industry. The scale of the level of importance is selected referring to Table 1 with reference to the judgmental matrix, where A compares one criterion with another (see Equation 1).

\[
A = (a_{ij}) (i, j = 1; 2, ...., the number of criteria)
\]
Table 1. AHP scale [16]

| Intensity of Importance | Definition | Description |
|-------------------------|------------|-------------|
| 1                       | Equal Importance | Element Ai and Aj are equally important |
| 3                       | Weak Importance of Ai over Aj | Experience and Judgement Slightly favour Ai over Aj |
| 5                       | Essential or strong Importance | Experience and Judgement Strongly favour Ai over Aj |
| 7                       | Demonstrated Importance | Aj is very strongly favoured over Aj |
| 9                       | Absolute Importance | The Evidence favouring Ai over Aj is of the highest possible order of affirmation |
| 2,4,6,8                 | Intermediate | When compromise is needed, values between two adjacent judgements are used |

Reciprocals of the above judgements to it when compared with Aj, then Aj has the reciprocal value when compared with Ai

2.3. Determine local priority and consistency of comparison
At this stage, local priority determination and consistency tests are conducted by calculating the consistency ratio, referring to Equation 2, 3, and 4 [20].

\[
\lambda_{\text{max}} = \frac{\text{Consistency vector}}{n} \quad (2)
\]

\[
CI = \frac{(\lambda_{\text{max}} \cdot n)}{(n - 1)} \quad (3)
\]

\[
CR = \frac{CI}{RI} \quad (4)
\]

Where:
- CI = Consistency Index
- RI = Random Index (where RI value is obtained by referring to Table 2)
- n = Number of category/subcategory

The acceptable CR value is in the range of 0-0.1. If CR value is more than the specified value, the results of the questionnaire conducted are inconsistent and unreliable therefore must be repeated [20].

Table 2. RI value index [20]

| Size | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------|---|---|---|---|---|---|---|---|---|----|
| RI   | 0 | 0 | 0.58 | 0.9 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 |

2.4. Determination of consideration factor weight
After the consistency ratio test shows a consistent value, all the weight of each assessment criterion and sub-criteria are valid, and it can determine the main contribution of the food industry choosing non-eco-friendly packaging rather than eco-friendly packaging, referring to the weight values obtained previously.
Phase 2: Assessment model
After the consideration factors are weighed, the next step is to create an Assessment model, so there is a new guidance to assess the food industry consideration to choose non eco-friendly food packaging. After assessment model is made, the next step is selection process between four products of eco-friendly food packaging and the existing non-eco-friendly food packaging to determine the best food packaging for the food industry. It is important to measure the score of all the food packaging alternatives. Currently there is no measurable measurement to determine which packaging is most suitable for the food industry. All measurements are implemented by subjective judgment of manager of the food industry. Therefore it is expected that this score measurement can provide an overview of the score of each packaging to determine which packaging is the best for the food industry.

3. Result and discussion
3.1. Phase 1
In this phase, data collection is conducted to understand stages and consideration factor of the process of purchasing food packaging in the food industry. After consideration factor has been determined, the next process is selection of packaging materials that best meet the criteria set by the food industry. All process in phase 1 is summarized in Figure 3.

![Figure 3. The Food Industry AHP Hierarchy](image)

3.2. Determine local priority and consistency of comparison and consideration factor weight
In this section, all criteria and sub criteria are analyzed, pair wise comparison and judgmental matrix are conducted. Based on the data processing that has been done, all weight from each criteria and sub-criteria are explained in Table 3.
Table 3. Weight Score

| Criteria       | Subcriteria              | Weight Score |
|----------------|--------------------------|--------------|
| Cost           | Price                    | 31%          |
| Quality        | Product Quality          | 13%          |
|                | Product Visual           | 3%           |
| Order          | Order Lead time          | 8%           |
|                | Minimum order quantity   | 5%           |
|                | Product Specification    | 20%          |
| Consumer       | Brand Image              | 20%          |

After all weight score is determined, local priority determination and consistency tests are conducted by calculating the consistency ratio to ensure all test is consistent. All calculation is explained from Equation 5, 6 and 7. It is found that CR value is in the range of 0-0.1, therefore it can be concluded that all test is consistent.

$$\lambda_{max} = \frac{\text{Consistency vector}}{n}$$

$$\lambda_{max} = \frac{50.5}{7} = 7.26$$

$$CI = \frac{\lambda_{max} - n}{(n - 1)}$$

$$CI = \frac{(7.26 - 7)}{(7 - 1)} = 0.44$$

$$CR = \frac{CI}{RI}$$

$$CR = \frac{0.44}{1.32} = 0.03$$

3.3. Phase 2 Assessment model
In this phase, assessment model is conducted in order to measure and select the most appropriate type of packaging for the food industry. In the measurement and selection process, non-eco-friendly products such as the existing food packaging of the food industry and 4 items of eco-friendly packaging were selected as the object of assessment. The criteria for selecting eco-friendly products are based on packaging products that have material structures such as biodegradability and recyclability[10]. All assessment model and all packaging score are explained in Table 4 and Table 5.
Table 4. Assessment Model

| Subcriteria                     | Price vs Budget | MOQ (Pack) |
|--------------------------------|-----------------|------------|
|                                | Score           | Range      | Score           | Range      |
| Price                          | 100             | (x ≤ -3%)  | 100             | (x ≤ 30)  |
|                               | 75              | (-5% < x ≤ 0%) | 75              | (30 < x ≤ 60) |
|                               | 50              | (0% < x ≤ 3%) | 50              | (60 < x ≤ 90) |
|                               | 0               | 3% < x     | 0               | 90 < x     |
| Durability                     | Score           | Range      | Score           | Range      |
| Product Quality                | 100             | 100%       | 100             | High Contribution |
|                               | 75              | 90% ≤ x < 100% | 75              | Medium Contribution |
|                               | 50              | 80% ≤ x < 90% | 50              | Low Contribution |
| Number of Colour               | Score           | Range      | Score           | Range      |
| Product Visual                 | 100             | >3         | 100             | High Contribution |
|                               | 75              | 2          | 75              | Medium Contribution |
|                               | 50              | 1          | 50              | Low Contribution |
|                               | 0               | 0          | 0               | No Contribution |
| Material Requirement           | Score           | Limitation | Score           | Limitation |
| Product Specification         | 100             | As Determined | 100             | High Contribution |
|                               | 0               | Inappropriate | 0               | No Contribution |

Table 5. Eco-Friendly Packaging Score

| Subcriteria          | Eco 1 | Eco 2 | Eco 3 | Eco 4 | Non Eco |
|----------------------|-------|-------|-------|-------|---------|
| Price                | 7.74  | 15.47 | 23.21 | 15.47 | 30.95   |
| Product Quality      | 9.83  | 9.83  | 6.55  | 9.83  | 9.83    |
| Product Visual       | 2.30  | 1.53  | 1.53  | 1.53  | 0.77    |
| Order Lead time      | 5.73  | 3.82  | 3.82  | 5.73  | 5.73    |
| Minimum order quantity | 3.65 | 3.65  | 1.22  | 2.43  | 3.65    |
| Product Specification | 10.10 | 10.10 | 20.19 | 10.10 | 20.19   |
| Brand Image         | 10.10 | 20.19 | 20.19 | 20.19 | 5.05    |
| Total Score         | 49.43 | 64.59 | 76.71 | 65.28 | 76.16   |

After implementation packaging score assessment, it is shown that Eco 3 can outperform the rating from the existing non-eco-friendly food packaging and other eco-friendly food packaging. Therefore, Eco 3 can be selected as food packaging for the food industry. Eco 3 can outperform other packaging alternatives because the score of Eco 3 has more advantages in price, product specification and brand image which are the essential attributes to be considered in this assessment system. This result is supported by previous research which explained the price of packaging as one of the important
considerations in the food industry worldwide [25]. Food packaging can also affect brand image which contributes to the purchase intention. Brand image is important because it helps the brand to be distinguished from others and stimulate the purchase intention [26].

4. Conclusion
Based on implementation of Analytical Hierarchy Process (AHP) by analysing all considered factors and determining weighted score, it is shown that there is a new perspective and a new solution for the food industry in order to select the best food packaging, where Eco 3 can be selected as new alternative for the food industry. Therefore the food industry can shift from non-eco-friendly food packaging into more eco-friendly packaging. In further research, implementation of new attributes such as consumer behaviour in order to align customer’s perspective with packaging selection and design. However, further research could be implemented to check whether all the sub-criteria are also applied in other food industries.

Acknowledgments
Authors wishing to acknowledge assistance and encouragement from colleagues, special work by technical staff and financial support from Binus University

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