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**Submission Confirmation for Identifying Factors that Influence Customers' Interest in Buying Refurbished Smartphones: An Indonesian Context - [EMID:ee79c5ab03f10b76]**

1 message

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**APST** <em@editorialmanager.com>  
Reply-To: APST <apst.kku@gmail.com>  
To: Siana Halim <halim@petra.ac.id>

Wed, Jun 9, 2021 at 12:32 PM

Dear Dr. Halim,

Your submission entitled "Identifying Factors that Influence Customers' Interest in Buying Refurbished Smartphones: An Indonesian Context" has been received by journal Asia-Pacific Journal of Science and Technology

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Siana Halim &lt;halim@petra.ac.id&gt;

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**Your Submission - [EMID:da623341151337d8]**

1 message

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APST <em@editorialmanager.com>  
Reply-To: APST <apst.kku@gmail.com>  
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Fri, Jul 16, 2021 at 11:25 AM

Ref.: Ms. No. APST-D-21-00324

Article Title: **"Identifying Factors that Influence Customers' Interest in Buying Refurbished Smartphones: An Indonesian Context"**

Asia-Pacific Journal of Science and Technology

Dear *Dr. Halim*,

Reviewers have now commented on your paper. You will see that they are advising that you revise your manuscript. If you are prepared to undertake the work required, I would be pleased to reconsider my decision.

For your guidance, reviewers' comments are appended below.

If you decide to revise the work, please submit a list of changes or a rebuttal against each point which is being raised when you submit the revised manuscript.

Your revision is due by **2021-08-15 23:59:59**.

To submit a revision, go to <https://www.editorialmanager.com/apst/> and log in as an Author. You will see a menu item call Submission Needing Revision. You will find your submission record there.

Yours sincerely

Surachai Chancharat  
Editor  
Asia-Pacific Journal of Science and Technology

**Comments from the Editor and Reviewers :**

Reviewer 1: - Abstract needs to revise, add more information related to methodology process such as interview process.

- Research design 2.1 recovery process mentioned a lot about remanufacturing, not refurbishment which is the main objective of this study.

- The number of respondent for survey is quite low. Is that possible to collect more data? If no, could you please find supportive reference to support about that?

-Please explain in more detail about questionnaire development process.

Reviewer 2: Overall, this paper delivers an interesting topic that contributes to recycle businesses. However, there are a number of points that need to be improved, as summarized below.

1. Following the heading of Section 2 (Research Design and Methods), the authors should provide a few statements to introduce what would be given by this section in order to explain the whole picture of this section.

2. Section 2.2 (AHP) should provide theoretical justification of why AHP is the most appropriate method for the objective of this study, as well as limitations of AHP that practitioners should be aware of. I suggest the authors to read the following paper to see an example of the justification of the chosen method. This recommended paper also mentions the limitations of AHP that the authors can use as one of the references.

"Resilient Supplier Selection in Electronic Components Procurement: An Integration of Evidence Theory and Rule-Based Transformation into TOPSIS to Tackle Uncertain and Incomplete Information, Symmetry, 2020, 12, 1109.

doi:10.3390/sym12071109"

3. The total number of pairwise comparisons that each participant must complete in the questionnaire should be declared.

4. Information in Section 3.1 should be put into a table.

5. In Table 2, the name of the first alternative is changed from "Premium" in Row 4 to "Flagship" in Row 5. They should be consistent with each other.
6. The sentences "However, we can see that for the participant between 15-55 years, the decision weight for Refurbish and Mid-Range is not significantly different. In contrast it is significantly different for senior citizens. In this case, we can conclude, young Indonesian consider Refurbish smartphones compared to Mid-Range." is not consistent with the results presented in Table 4 (Table 3 is missing from the paper). From Table 4, I can't see that the gap between Refurbish and Mid-Range in ">55" group is significantly larger than the gaps in the other groups, as claimed by the paper. Please re-analyze the results carefully.
7. This paper lacks statements to declare theoretical contributions and managerial implications to attract academic and business readers. These two points are very important for international publication.

Reviewer 3: Peer Reviewer finish reading this paper and has comments as below:

- Author should add one paragraph to explain more about the analysis process in section 2.5 (page 4)
  - Data set have only 54 sets. Author have to explain why that number is enough for showing as the sample size.
  - Author should show the accuracy index of the decision in each age group, such as CI:RI ratio or etc.
  - Check Benefit Criteria of 15-24 years old group. (page 6 line 9)
  - Make sure Figure 2 to show full number in price and risk attributes.
- 
- 

#### Reviewer's Responses to Questions

Does the title of this paper clearly and sufficiently reflect its contents?

Reviewer #1: Yes

Reviewer #2: Yes

Reviewer #3: Yes

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Are the keywords and abstracts/summary informative?

Reviewer #1: Yes

Reviewer #2: Yes

Reviewer #3: Yes

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Are the references relevant and up-to-date?

Reviewer #1: **No**: 13 out of 27 published older than 2015.

Reviewer #2: Yes

Reviewer #3: Yes

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Please rate the overall academic value and contribution of this manuscript.

Reviewer #1: fair

Reviewer #2: fair

Reviewer #3: good

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**Asia-Pacific Journal of Science and Technology**  
**Identifying Factors that Influence Customers' Interest in Buying Refurbished Smartphones: An Indonesian Context**  
 --Manuscript Draft--

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<b>Abstract:</b>	In this paper, we investigated the factors that influence Indonesian customers in buying a refurbished smartphone. The decision model is constructed using Analytical Hierarchy Process (AHP). There are four main factors: Price, Performance, Benefit and Risk, with sub-criteria for each factor. Three smartphone alternatives are determined for comparison, are flagship, refurbished, and mid-range smartphones. We then surveyed 54 respondents, segmented by age, gender, job, knowledge, and experience using a refurbished smartphone. However, only age and experience using refurbished turned out to be the significant factors influencing a customer in buying a refurbished smartphone. Younger people consider performance the most critical factor influencing them in buying a smartphone, while the older respondents consider it a benefit. As for performance, both hardware and software are the most critical factors. In all aspects, the flagship smartphone outperforms the refurbished and mid-range smartphones, except in the environmental aspect. In conclusion, people with concerns for the environment will buy the refurbished smartphones. Younger people consider buying refurbished smartphones than mid-range ones if they are concerned about the hardware more than the software.

Dear respected Sir/Madam,

We submitted a research paper entitled:

“Identifying Factors that Influence Customers’ Interest in Buying Refurbished Smartphones: An Indonesian Context”.

This paper has never been submitted to any conferences nor journal. At this time, this paper only submitted to APST.

We hope the scope and journal content are suitable for publication in APST.

Surabaya, 9<sup>th</sup> June 2021

Sincerely yours

Siana Halim

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## Identifying Factors that Influence Customers' Interest in Buying Refurbished Smartphones: An Indonesian Context

### Abstract

In this paper, we investigated the factors that influence Indonesian customers in buying a refurbished smartphone. The decision model is constructed using Analytical Hierarchy Process (AHP). There are four main factors: Price, Performance, Benefit and Risk, with sub-criteria for each factor. Three smartphone alternatives are determined for comparison, are flagship, refurbished, and mid-range smartphones. **The model was constructed based on the van Weelden model and by interviewing 13 respondents. Those respondents have smartphones either flagship, refurbished or mid-range. Their age is from 21 to 59 years old. First, the in-depth interview was conducted to know their experience, reasons, and factors in choosing a smartphone. After that, a small survey of 10 respondents was conducted to check the model and check the questioners' inconsistency. We then surveyed 54 respondents using the final questioners, segmented by age, gender, job, knowledge, and experience using a refurbished smartphone.** The results show that age and experience using refurbished are the significant factors influencing a customer in buying a refurbished smartphone. Moreover, younger people consider performance the most critical factor influencing them in buying a smartphone, while older respondents consider it a benefit. As for performance, both hardware and software are the most critical factors. In all aspects, the flagship smartphone outperforms the refurbished and mid-range smartphones, except in the environmental aspect. In conclusion, only people with concerns for the environment will buy the refurbished smartphones. However, increasing the benefit and hardware performance of refurbished smartphones would drive the younger age groups to switch from buying mid-range to refurbished smartphones, while an increase in risk factors would lower customers' priority of buying refurbished smartphones.

**Keywords:** Refurbished, Analytical Hierarchical Process, Group Decision.

### 1. Introduction

Smartphones have become essential devices in this modern world, especially during the covid-19 pandemic, where most activities are conducted through of information technology. We face an era where people work from home, students' study from home, and even social and religious activities are carried out remotely. For many people, especially ones with limited access to computers, the next best option is to use smartphones. Hence, the role of smartphones has expanded significantly, not only as a communication device but also as the enabler of remote activities.

Today, Indonesia is the fourth most populated country globally and the world's tenth-largest economy in purchasing power parity. The number of mobile phone and Internet users is also increasing. According to Badan Pusat Statistik [1], the number of mobile phone owners is relatively high: 69.6% of the urban population and 53.6% of the rural population has a mobile phone. However, due to smartphones' short life cycle, the increased number of disposed phones could lead to landfill insufficiency. Also, the increased demand for smartphones would exhaust the natural resources due to the increased manufacturing processes [2]. In recent decades, the study of extending mobile phones' lifespans has increased significantly to address sustainability issues. Several alternatives extend smartphones' lifespans, such as direct reuse, repair-and-reuse, refurbish or remanufacturing. The marketing of such smartphones is considered in several studies, such as in [3-5].

The availability of refurbished smartphones is very limited in Indonesia. This situation is understandable since there is no government program to promote it, and customers are not used to recycling their smartphones when they have reached the end-of-use stage [6-8]. The most common approaches are keeping the phones at home, giving them to relatives, or selling the phones on the secondhand market [7,9]. Furthermore, refurbishing smartphones is not entirely desirable from the manufacturers' perspective since it could cannibalize the new products' demands.

This research explores the factors that influence customers' interest in buying refurbished smartphones, categorized under several segments based on age. We also attempt to compare customers' interest to buy

refurbished smartphones and mid-range new smartphones. The identified factors can help manufacturers better understand the customers' needs, and further improve the market of refurbished smartphones to establish a circular economy in Indonesia. In this paper, we use the terms remanufacturing and refurbishing interchangeably because there are plentiful cases of remanufacturing (e.g., upgrading RAM) and refurbishing (e.g., replacing the battery) in smartphones. In the smartphone market, the terms are also used loosely. For example, Apple uses the term "Certified Refurbished Products" for its like-new product with a one-year warranty.

## 2. Research Design and Methods

This work aims to investigate the factors that influence Indonesian customers in buying a refurbished smartphone. We started with understanding the recovery process and its options to argue the potential of smartphone refurbishment and its market. Additionally, buying a smartphone is a decision process. People must consider many aspects before deciding on one smartphone which suitable for them in those aspects. There are many tools in the decision analysis that can be used to help a decision-maker decides. For example, some of them are using TOPSIS for selecting electronics components suppliers [10]. DEMATEL is also used to analyze the remanufacturing of mobile phones [11]. This study used the analytical hierarchy process (AHP) since the AHP helps find decisions to a problem with hierarchy [12]. Buying a smartphone can be thought of as a hierarchy in thinking. Moreover, we can check the consistency of the decision-maker in comparing one aspect to the others.

### 2.1 Recovery Process

The recovery process is a process that aims to restore or to add the product lifespan. There are several options in the recovery process, i.e., reuse, repair, remanufacture, and refurbished [13]. Every option has a different process as well as output. The reuse process is the simplest in the recovery process. In the case of a smartphone in the Indonesian context, reuse can be easily found within the family. When the first owner wants to buy a new one, it is common to pass on the old smartphone to the other family member [6]; hence this reuse process extends the lifespan of that old smartphone. Another common reuse practice in Indonesia is selling the old smartphone to the secondhand market [8, 9, 14]. According to King et al. [13], the repair process implies fixing or replacing the broken parts of a product, such that the product can be used properly. The remanufacturing process is the process where used products are reproduced. They will have the exact performance specification from the original equipment manufacturer (OEM), from the customer's perspective [15]. Rathore et al. [3] stated refurbishment is a process in which a professional company collects and restores used products to a functional and satisfactory state. After that process, the refurbished products can be sold to customers.

Several papers studied the potential of mobile phone reuse and remanufacturing or refurbishment. The process of performing a remanufacturing process on a mobile phone was studied by Kang et al. [16]. They developed simulation models and were able to identify the bottleneck processes and further propose an extended model to improve them. Seliger [17] proposed a process and facility planning for mobile phone remanufacturing using a simulation model that allows the adaptation towards quick changes in product, process, and market constraints. The analysis of eco-efficiency of remanufactured mobile phones [18] and the social impacts across the life cycle of mobile phones with improvement opportunities on those impacts [19] was presented to support the initiatives on mobile phone recovery processes.

Consumer behavior and market aspect are essential for the success of mobile phone reuse and remanufacturing or refurbishment. The prospects and opportunities to adopt remanufactured mobile phones have been studied based on the influence of product design, end-of-life scenarios, and recovery options [20]. Customer acceptance is studied in several countries, such as India [3], the Netherlands [21], and Germany [22].

### 2.2 Analytic Hierarchy Process

The analytic hierarchy process (AHP) is one of the decision-making tools that was developed by Saaty [23]. In the AHP, the judgments between one option to the others are made by comparing many reciprocal criteria pairwise. The fundamental scale used in AHP is depicted in Table 1.

Table 1. Fundamental scale of AHP



1	equal importance
3	moderate importance of one over another
5	strong or essential importance
7	very strong or demonstrated importance
9	extreme importance
2,4,6,8	Intermediate values
Use reciprocals for inverse comparisons	

The reciprocal pairwise scale is then transferred into what we called as a reciprocal matrix. In this matrix, the lower triangular of the matrix is reciprocal to the upper triangular, and the diagonal matrix equal to one. Let  $a_{kl}$  is the element of matrix  $A$

$$A = \begin{pmatrix} 1 & a_{12} & \dots & a_{1n} \\ 1/a_{12} & 1 & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \dots & 1 \end{pmatrix}$$

Once a pairwise comparison matrix is completed, we can derive the priority vector  $w = (w_1, w_2, \dots, w_n)$  using the normalized principal eigenvector of matrix  $A$ . The consistency index of pairwise comparison matrix is given by  $C.I = (\lambda_{max} - n)/(n - 1)$ ,  $\lambda_{max}$  is the max eigen value of the respective matrix (for the detail, see [24]). In this work, we use the Super Decision v3 software [25], we also consider AHP for group decision making [26].

### 2.3 Model Construction

The AHP model was constructed using the van Weelden et al. model [21]. In their model, van Weelden et al. explored the consumer acceptance of refurbished smartphones in the Dutch market by considering several factors. Those factors are initial response, barriers, benefits, risks, influencing personal factors, contextual factors and product-related factors. This model was then adapted to the Indonesian characteristics of buying a smartphone. We also interviewed thirteen respondents aged between 21-59 who own flagship, refurbished, or mid-range smartphones. We asked what factors influenced them to buy their current smartphones. We also adapt Saaty's AHP Benefit Opportunity Cost Risk model [27] by considering Price as Cost and Performance as Opportunity.

In the Benefit criteria, we consider financial, environmental, and accessories. Financial in the Benefit criteria means the easiness to get installment, bonus, and discount. While, for the environment, after some interviews, we found that some people who are very concerned with an environmental issue consider the refurbished smartphone as their gadget. The Indonesians, who are willing to pay a mid-range or flagship smartphone, are concern about the additional accessories given to the smartphone. It is also identified that upgraded specification, affordable price, and product warranty can driver customers to purchase a refurbished mobile phone [5].

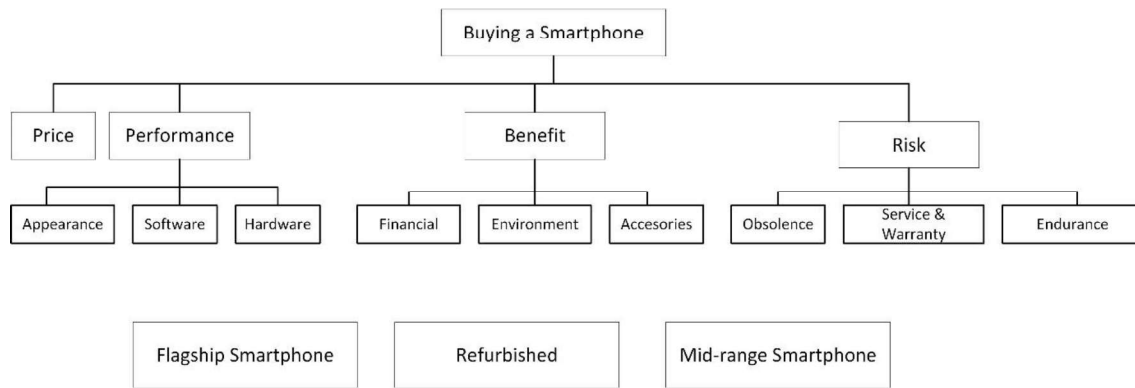
In the Performance (Opportunity) criteria, we proposed three sub-criteria: appearance, software, and hardware. In Indonesia, appearance is crucial for the one who wants to buy a smartphone. People will consider, for example, the body material of the smartphone, screen type, screen resolution, sim card slots. The ones who buy mid-range or flagship also concern the software, such as the processor, picture and video quality, sound, security and wi-fi connection features. Moreover, they can be aware of ram, internal memory, battery lifetime and charging time in the hardware.

The Price (Cost) criteria in the model do not have sub-criteria.

In the Risk criteria, we proposed three sub-criteria: obsolesce, service and warranty, and endurance. Smartphones can be seen as a fashion product after sometimes they can be obsolesced. Therefore, we proposed obsolesced as a sub-criterion in the risk criteria. In the service and warranty, we are concerned about the easiness of finding a service center to claim the warranty if the gadget is broken in the warranty term. Since warranty is also a signal to product reliability, offering a product warranty could increase customer's perceived quality of a refurbished smartphone [28]. At the same time, endurance sub-criterion means the gadgets water and heat resistance and not

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easily broken if it is fell down. The proposed decision model for buying a refurbished vs. flagship or mid-range smartphone is depicted in Figure. 1.



**Figure 1.** Model for buying a flagship, mid-range or refurbished smartphone.

#### 2.4 Questionnaire

A questionnaire was designed based on the proposed model depicted in Figure 1. It consists of six sections. Section one is about the respondent's background, such as gender, age, education, at what age they had their smartphone at the first time, and smartphone's brand. The last question of section one is about their knowledge of refurbished smartphones. Section two is the comparative judgment of each criterion: Benefit, Performance, Price and Risk. To do the comparative judgment, first, we ask which factor is more important for the respondents and how essential the chosen factor is to the others. For example, we ask the respondents to compare pair wisely Price, Performance, Benefit, and Risk in the first level. We ask them to compare Price to Performance at the first step, which is more important to them with a scale of 1 to 9 (see Table 1). Then Price to Benefit, Price to Risk, Performance to Benefit, Performance to Risk, and Benefit to Risk. In total, there will be  $3 \times 2 \times 1 = 6$  pairwise comparisons in Section 2. While Section 3 is also comparative judgment in the sub-criteria level. In the Performance, we asked the respondents to compare pair wisely the Appearance, Software, and Hardware. We explained what factors to consider in each sub-criteria, so each respondent has the same perspective (see Table 2). In total, there are nine pairwise comparisons in Section 3.

Table 2. Factors to consider in comparing the sub-criteria.

Performance			Benefit			Risk		
Appearance	Software	Hardware	Financial	Environment	Accessories	Obsolescence	Service & Warranty	Endurance
Body, number of sim card slot, size of screen, screen type, screen resolution, screen coating	Processor, Picture, sound, video quality, security, wifi,	RAM, ROM, Battery, Chipset	The easiness to get loan, trade-ins, good secondhand price	Awareness of environment waste	Screen guard, headset,	The technology obsolesces of the smartphone	The easiness to claim warranty and find official service counter	Water resistance, fall down resistance.

Section 4 to Section 5 concerns pairwise comparative judgment for each sub-criterion to the alternatives: Flagship, refurbished, and mid-range smartphones. In Section 4, we asked the respondent to compare pair wisely, the Price, Performance, Benefit and Risk to the alternatives. In Section 4, we asked the respondent to compare the pair wisely, the Price, Performance, Benefits, and Risk to the alternatives. For example, for Price, which alternative they will choose, flagship, refurbished, or mid-range smartphones. Moreover, they also decide the scale for the chosen alternative to the unchosen one. So, with respect to Price, there will be 3 pairwise comparison to for the flagship, refurbished and mid-range alternatives. In total, there are 12 pairwise comparisons in Section 4. Similarly, there will be 27 pairwise comparisons in Section 5. Section 6 is the final section in this questioner. In the closing statement, we asked about their experience to use flagship, refurbished, or mid-range smartphones. We also asked about their preferences if they want to buy a smartphone after this survey.

To validate the questioner, we distributed the first version of the questioner to 10 respondents. We then tested the consistency ratio of those small samples. If a question is inconsistent, we rephrase that question and test again to small samples until the questioner is valid.

## 2.5 Data collection and analysis

The participants in this study were voluntary. Due to the covid-19 pandemic, the questionnaire was spread out online through google form from April - June 2020. There are 54 valid questionnaires. Since this questionnaire follows the AHP rule, valid questionnaires mean the respondents' answers are consistent. Data were analyzed by descriptive statistics and AHP using super decision software. **It is well known that AHP is designed for individual decision-makers and group decision-makers. Therefore, the number of participants in the AHP surveys is not the main issue. In a group decision-maker, the critical issue is how to assemble the group [29]. In our study, the decision-makers, i.e., the surveys participant, consist of people who have/had either a flagship, mid-range, or refurbished smartphone. Moreover, they also represent young and old, men and women, and students to retirement.**

## 3. Results and discussion

### 3.1 Participants

The participants of this study are 54% women and 46% men. Their age is in between 15-24 years (56%), 25-45 years (20%), 46-55 years (15%), and more than 55 years (9%). The age segmentation represents students (15-24 years), junior workers (24-45 years), senior workers (46-55 years), and retired (> 55 years). Half of them are students, and the rest are workers. Most of them (53%) do not know about refurbish, and 47% know about refurbishing smartphones. However, only 11% have refurbished smartphones, and the rest (89%) never have them. The participants have graduated from university (53%) and high school (47%). They have a smartphone at the age 13-18 years (41%), 6-12 years (22%), the rest (37%) have a smartphone at the age more than 19 years old. When they answer this questionnaire, 54.6% of the participants have mid-range smartphones, and 34.4% have flagship smartphones. Additionally, 11% of them have use refurbish smartphones.

In this study, only 48% of the participants know of refurbish smartphones. Therefore, before the participants participated in this study, we explained the refurbish terminology to them. After they learned about refurbishing smartphones, 35% of participants, at the age in between 15-45 years; 33% of participants, at the age between 46-55 years, and 40% of the senior participant are interested in having a refurbished smartphone.

From this background (Table 3), we conclude that the participants of this study are a representative sample.

**Table 3. Profile of the participants**

<b>Gender</b>		<b>Knowledge of refurbished</b>	
Women	54%	Know	47%
Men	46%	Do not know	53%
<b>Age</b>		<b>Current smartphone</b>	
15-24 (students)	56%	Mid-range	54.6%
25-45 (junior worker)	20%	Flagship	34.4%
46-55 (senior worker)	15%	Refurbish	11%
>55 (retired)	9%	<b>Interest to have refurbished</b>	
<b>Education</b>		Age 15-45	35%
Graduated from university	53%	46-55	33%
High school	47%	>55	40%
<b>First time having a smartphone</b>			
6-12 year	22%		
13-18 year	41%		
>18 year	37%		

### 3.2. Priorities based on age segmentation.

We used the super decision as software to analyze the decision; as an example, we summarize the criteria weight for participants aged 25-45 years (see Table 4). We can see, Participant 1 prioritizes Risk over Price, Performance, and Benefit when he/she wants to buy a smartphone. For the group priorities, we are averaging the weight of each criterion. We do not use the geometric mean as it is suggested in [30]. We conclude that junior workers between 25-45 years put Performance over Risk, Price, and Benefit as their priority when buying a smartphone. **The consistency ratio of all participants is less than 10%, so we can conclude that the decision is consistent. In this survey, if the pairwise comparisons are not consistent, we will contact the participants who have inconsistent answers. We will explain that their answers are not consistent and then ask them to rethink the answers. In Table 4, since the number of criteria is four, then the random consistency index (RI) is equal to 0.91 [23, 25].**

Table 4. Weight of criteria decided by participants at the age between 25-45 years.

Participant	Benefit	Performance	Price	Risk	CI	CR = CI/0.91
1	0.064	0.160	0.337	<b>0.438</b>	<b>0.076</b>	<b>0.083</b>
2	0.313	<b>0.387</b>	0.250	0.049	<b>0.069</b>	<b>0.076</b>
3	0.135	<b>0.549</b>	0.232	0.083	<b>0.061</b>	<b>0.067</b>
4	0.276	<b>0.391</b>	0.138	0.195	<b>0.084</b>	<b>0.092</b>
5	0.183	<b>0.576</b>	0.088	0.153	<b>0.078</b>	<b>0.086</b>
6	0.048	0.102	0.326	<b>0.524</b>	<b>0.079</b>	<b>0.087</b>
7	0.120	0.401	0.040	<b>0.439</b>	<b>0.071</b>	<b>0.078</b>
8	0.052	0.294	0.099	<b>0.555</b>	<b>0.089</b>	<b>0.098</b>
9	0.052	0.235	0.126	<b>0.587</b>	<b>0.074</b>	<b>0.081</b>
10	0.348	<b>0.425</b>	0.145	0.081	<b>0.070</b>	<b>0.077</b>
11	0.233	<b>0.561</b>	0.072	0.134	<b>0.086</b>	<b>0.094</b>
Average	0.166	0.371	0.169	0.294	<b>0.076</b>	<b>0.084</b>
Percentage	17%	37%	17%	29%		

Table 5. summarizing the weighted priorities for each criterion and sub-criteria, which are calculated for segmented age between 25-45 years. We can see that for the junior worker, in the Benefit criteria, Financial is the most important for them; it follows by environment and accessories. While for Performance criteria, they are prioritizing Software over hardware and appearance. In the Risk criteria, Endurance is more critical than Warranty and Obsolesce for them. The junior workers tend to choose the flagship smartphone over the Mid-range and Refurbished smartphone, as a group. However, we can see that the weight between the Mid-range and Refurbished is not significantly different. So, we can say, Junior workers are still considering having refurbished smartphone as their gadgets (see Table 5).

Table 5. The weighted of the AHP for segmented age in between 25-45 years

Goal Criteria Weight	Buying a Smartphone										
	Benefit 0.166			Performance 0.371			Price 0.169	Risk 0.294			
Sub-Criteria	Financial	Environment	Accessories	Appearance	Software	Hardware		Obsolesce	Warranty	Endurance	
Sub-Criteria X	0.078	0.050	0.038	0.074	0.160	0.137	0.169	0.045	0.121	0.129	
Alternative	<b>Flagship</b>	0.541	0.362	<b>0.681</b>	0.563	<b>0.569</b>	<b>0.583</b>	0.336	0.521	0.511	<b>0.564</b>
	Refurbish	0.299	<b>0.342</b>	0.185	0.119	<b>0.215</b>	0.162	0.292	<b>0.264</b>	0.184	0.143
	Mid-range	0.160	<b>0.296</b>	0.133	0.318	0.216	<b>0.255</b>	0.371	0.215	<b>0.305</b>	0.293
Flagship	Decision	<b>Group index</b>									
Refurbish	<b>0.513</b>	n = 3									
Mid-Range	0.214	RI = 0.58									
	0.277	CI = 0.052									
		CR = 0.089									

Overall, the priority in buying a smartphone is summarized in Table 6. All participants decide to buy Flagship smartphones over Refurbish and Mid-Range smartphones. However, we can see that for the participant between 25-45 (junior workers), the decision weight for Refurbish and Mid-Range is significantly different (based on t-test). In contrast, for the other segmented ages, those weights are not significantly different. Therefore, we can conclude that Indonesian students, senior workers, and retirements consider Refurbish smartphones and Mid-Range smartphones their smartphones.

Table 6. The priorities in buying a smartphone by age.

Criteria	15-24 years	25-45 years	46-55 years	>55 years
	Performance	Performance	Performance	Benefit
Sub-criteria				
Benefit	Financial	Financial	Financial	Financial
Performance	Hardware	Software	Software	Hardware
Risk	Endurance	Endurance	Endurance	Endurance
	Buying a Smartphone			
Flagship	<b>0.563</b>	<b>0.513</b>	<b>0.582</b>	<b>0.481</b>
Refurbish	0.208	0.214	0.204	0.253
Mid-Range	0.229	0.277	0.214	0.266
	Group index			
n	3	3	3	3
RI	0.58	0.58	0.58	0.58
CI	0.055	0.052	0.049	0.054
CR	0.094	0.089	0.084	0.093

### 3.2. Priorities based on knowledge of refurbish.

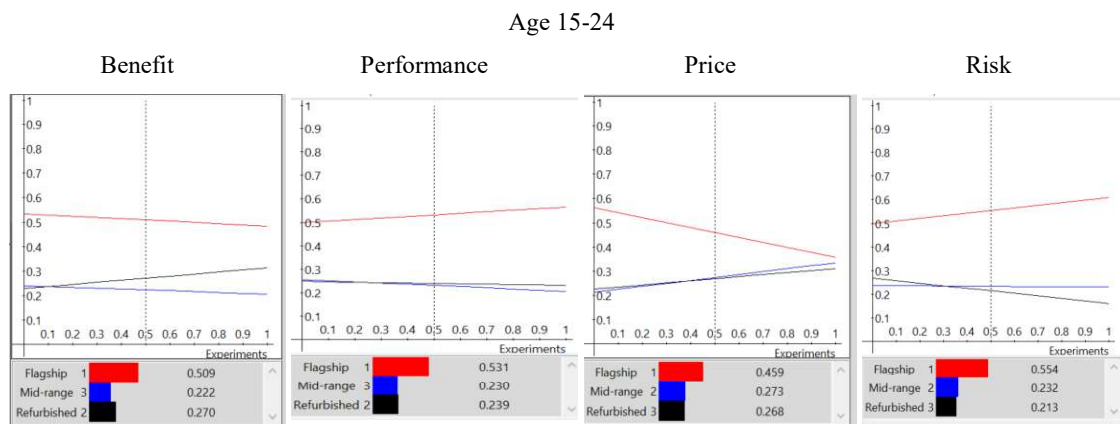
The knowledge of refurbishing does not change the priority of the Indonesian respondents in buying a smartphone. Even though they had experience in using a refurbished smartphone, they prefer to buy a flagship smartphone. Performance, financial, software, and endurance are the criteria for buying a flagship smartphone more than the mid-range or refurbished smartphone (see Table 7).

Table 7 The priorities in buying a smartphone by knowledge of smartphone refurbished.

	Using Refurbish	Know Refurbish	Do not know about Refurbish
Criteria	Performance	Performance	Performance
Sub-criteria			
Benefit	Financial	Financial	Financial
Performance	Software	Software	Hardware
Risk	Endurance	Endurance	Endurance
<b>Buying a Smartphone</b>			
Flagship	<b>0.535</b>	<b>0.513</b>	<b>0.574</b>
Refurbish	0.236	0.214	0.202
Mid-Range	0.239	0.277	0.228

### 3.3 Sensitivity Analysis

The age segmentation is sensitive in deciding to buy a smartphone. Senior respondents with an age of more than 55 years are consistent in their decisions. They prefer to buy a flagship smartphone than a mid-range or refurbished one regardless of any alteration in the benefit, performance, price, and risk criteria. Junior respondents aged between 15-24 years can switch from buying a mid-range smartphone to refurbished. A slight weight alteration in the benefit criteria from 0.16 to 0.2 (or more) influences their decision from buying a mid-range smartphone to a refurbished one. Respondents of productive age (25-55 years) are sensitive respondents. They consider buying a refurbished smartphone than the mid-range if the benefit of a refurbished smartphone is altered from 0.4 (for age 25-45) and 0.5 (for age 46-55). They consider buying a mid-range than the flagship if they consider the smartphone price (see Figure 2 in detail).



Age 25-45

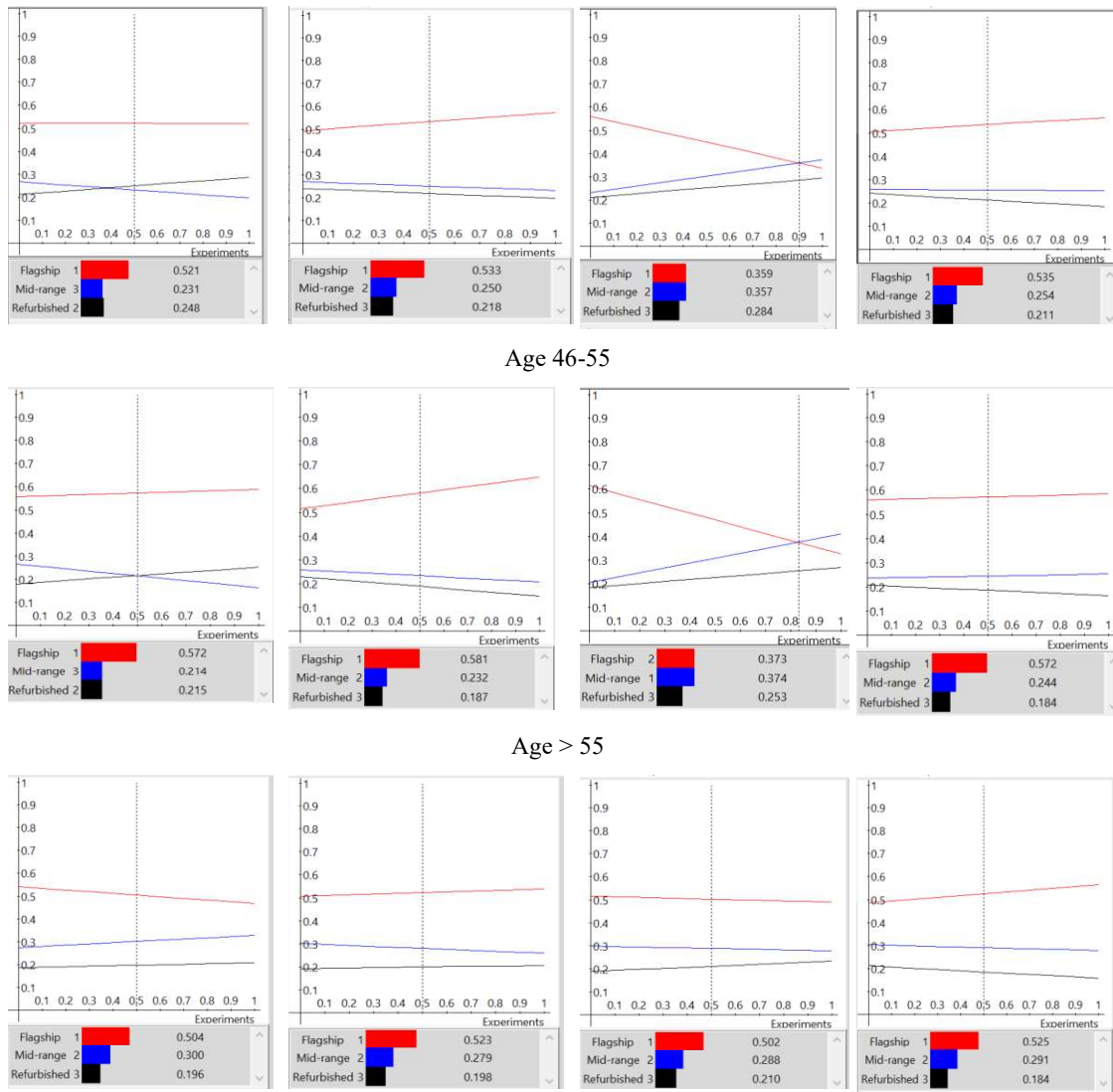


Figure 2. Sensitivity analysis on buying a smartphone based on age of the respondents with respect to Benefit, Performance, Price and Risk

The results from the decision of priorities in buying a smartphone and sensitivity analysis contributed to the following findings:

- Financial benefit and endurance are the most critical factors in the decision of buying smartphones, regardless of the age group
- Increasing the benefit and hardware performance of refurbished smartphones would drive the younger age groups to switch from buying mid-range to refurbished smartphones
- An increase in risk factor would lower customers' priority of buying refurbished smartphones

Therefore, to increase the priority of Indonesian customers in buying refurbished smartphones, the companies should add financial benefits such as offering bonuses, discounts, or installment programs. Furthermore, upgrading the hardware, such as RAM, ROM, and replacing the battery, would also increase the attractiveness of the refurbished smartphone. A collaboration with financial firms and mobile phone operators could bring attractive offers that serve as financial benefits. Also, to reduce the risk perception of refurbished smartphones, the companies could provide service centers and offering extended warranty packages.

#### 4. Conclusion

This paper investigated the factors influencing Indonesian customers in buying refurbished smartphones using Analytical Hierarchy Process (AHP). We considered four criteria, namely benefit, performance, price, and risk. The results show that a refurbished smartphone is not a popular product, 47% of the respondents know about refurbish smartphones, but only 11% of them have experience buying a refurbished smartphone. Even though they have had owned a refurbished smartphone, they prefer to buy a flagship than the refurbished one. The knowledge of refurbishment does not change the priority of the Indonesian respondents in buying a smartphone. They prioritize performance, finances, software, and endurance in buying a smartphone. The age segmentation is sensitive in deciding to buy a smartphone. Senior respondents aged more than 55 years are consistent in their decisions. In contrast younger respondents may alter from buying a mid-range to refurbish smartphone, if the refurbished smartphone gives more benefit to them. When they decided to purchase refurbished smartphones, the influencing factors are financial and hardware. It is cheaper than the flagship, but the hardware is more updated than the mid-range smartphone. However, they have concern with the risk in terms of the endurance of the refurbished smartphones. Hardware is the main concerned for the buyer who wants to buy a refurbished smartphone. Buyers, who care about the environment, also prioritizing refurbished smartphones as their gadget. This study can be extended by exploring additional factors that could increase customers' preference in buying refurbished smartphones, such as product-service system, environmental communication benefits, and narrow the market segmentations.

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Appendix 1. The weighted of the AHP based on age.

Buying a Smartphone (Age 15-24 years)											
Goal		Price	Performance (0.424)				Benefit (0.160)			Risk (0.24)	
Criteria	SubCriteria		Appearance	Software	Hardware	Financial	Environment	Accessories	Obsolesce	Warranty	Endurance
	SubCrit x Criteria	0.184	0.078	0.167	0.179	0.056	0.052	0.052	0.076	0.078	0.086
Alternative	Flagship	0.356	0.592	0.561	0.585	0.520	0.256	0.676	0.594	0.603	0.632
	Refurbish	0.310	0.198	0.237	0.196	0.235	0.515	0.190	0.149	0.178	0.154
	Mid-Range	0.334	0.210	0.202	0.219	0.245	0.230	0.134	0.257	0.219	0.214
	Decision										
	Flagship	0.535									
	Refurbish	0.236									
	Mid-range	0.239									

Buying a Smartphone (Age 25-45 years)											
Goal		Price	Performance (0.371)				Benefit (0.166)			Risk (0.94)	
Criteria	SubCriteria		Appearance	Software	Hardware	Financial	Environment	Accessories	Obsolesce	Warranty	Endurance
	SubCrit x Criteria	0.169	0.074	0.160	0.137	0.078	0.050	0.038	0.045	0.121	0.129
Alternative	Flagship	0.336	0.563	0.569	0.583	0.541	0.362	0.681	0.521	0.511	0.564
	Refurbish	0.292	0.119	0.215	0.162	0.299	0.342	0.185	0.264	0.184	0.143
	Mid-Range	0.371	0.318	0.216	0.255	0.160	0.296	0.133	0.215	0.305	0.293
	Decision										
	Flagship	0.513									
	Refurbish	0.214									
	Mid-range	0.272									

Buying a Smartphone (Age 46-55 years)											
Goal		Price	Performance (0.373)				Benefit (0.264)			Risk (0.191)	
Criteria	SubCriteria		Appearance	Software	Hardware	Financial	Environment	Accessories	Obsolesce	Warranty	Endurance
	SubCrit x Criteria	0.171	0.066	0.209	0.099	0.120	0.043	0.101	0.032	0.060	0.099
Alternative	Flagship	0.324	0.717	0.620	0.660	0.586	0.319	0.713	0.607	0.600	0.651
	Refurbish	0.267	0.122	0.151	0.151	0.282	0.454	0.145	0.183	0.221	0.151
	Mid-Range	0.409	0.161	0.229	0.188	0.131	0.324	0.142	0.209	0.179	0.198
	Decision										
	Flagship	0.574									
	Refurbish	0.202									
	Mid-range	0.228									

Buying a Smartphone (Age > 55 years)											
Goal		Price	Performance (0.137)				Benefit (0.402)			Risk (0.324)	
Criteria	SubCriteria		Appearance	Software	Hardware	Financial	Environment	Accessories	Obsolesce	Warranty	Endurance
	SubCrit x Criteria	0.138	0.034	0.050	0.053	0.208	0.081	0.113	0.045	0.113	0.165
Alternative	Flagship	0.490	0.614	0.570	0.458	0.400	0.354	0.672	0.672	0.396	0.579
	Refurbish	0.232	0.136	0.182	0.268	0.180	0.327	0.169	0.187	0.161	0.148
	Mid-Range	0.278	0.250	0.247	0.273	0.420	0.320	0.159	0.141	0.443	0.273
	Decision										
	Flagship	0.499									
	Refurbish	0.194									
	Mid-range	0.307									

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## Addendum

### Reviewer 1:

- Abstract needs to revise, add more information related to methodology process such as interview process.

Thank you, we have added the related methodology process in the abstract.

- Research design 2.1 recovery process mentioned a lot about remanufacturing, not refurbishment which is the main objective of this study.

Thank you for your valuable input. In this paper, we use the terms remanufacturing and refurbishing interchangeably because there are plentiful cases of remanufacturing (e.g. upgrading RAM) and refurbishing (e.g. replacing battery) in smartphones. Also, in the smartphone market, the terms are also used loosely. For example, Apple use the term "Certified Refurbished Products" for its like new product with one-year warranty. This approach is also used by many authors such in [4] Mugge et al. (2017), [15] Neto, J. and Bloemhof (2012), and [19] Gurita et al. (2018). We have added the explanation in the introduction section, as follows:

In this paper, we use the terms remanufacturing and refurbishing interchangeably because there are plentiful cases of remanufacturing (e.g., upgrading RAM) and refurbishing (e.g., replacing battery) in smartphones. Also, in the smartphone market, the terms are also used loosely. For example, Apple use the term "Certified Refurbished Products" for its like new product with one-year warranty

- The number of respondent for survey is quite low. Is that possible to collect more data? If no, could you please find supportive reference to support about that?

Thank you, we added some explanation concerning the number of respondents, as follows

It is well known that AHP is designed for individual decision-makers and group decision-makers. Therefore, the number of participants in the AHP surveys is not the main issue. In a group decision-maker, the critical issue is how to assemble the group [29]. In our study, the decision-makers, i.e., the surveys participant, consist of people who have/had either a flagship, mid-range, or refurbished smartphone. Moreover, they also represent young and old, men and women, and students to retirement.

-Please explain in more detail about questionnaire development process.

Thank you, we added the questionnaire development process in section 2.4

**Reviewer 2:** Overall, this paper delivers an interesting topic that contributes to recycle businesses. However, there are a number of points that need to be improved, as summarized below.

1. Following the heading of Section 2 (Research Design and Methods), the authors should provide a few statements to introduce what would be given by this section in order to explain the whole picture of this section.

Thank you for your valuable comments. We have added the heading of Section 2 as follows:

This work aims to investigate the factors that influence Indonesian customers in buying a refurbished smartphone. We started with understanding the recovery process and its options to argue the potential of smartphone refurbishment and market. Additionally, buying a smartphone is a decision process. People must consider many aspects before deciding on one smartphone which suitable for them in those aspects. There are many tools in the decision analysis that can be used to help a decision-maker decides. For example, some of them are using TOPSIS for selecting electronics components suppliers [10]. DEMATEL is also used to analyze the remanufacturing of mobile phones [11]. This study used the analytical hierarchy process (AHP) since the AHP helps find decisions to a problem with hierarchy [12]. Buying a smartphone can be thought of as a hierarchy in thinking. Moreover, we can check the consistency of the decision-maker in comparing one aspect to the others.

2. Section 2.2 (AHP) should provide theoretical justification of why AHP is the most appropriate method for the objective of this study, as well as limitations of AHP that practitioners should be aware of. I suggest the authors to read the following paper to see an example of the justification of the chosen method. This recommended paper also mentions the limitations of AHP that the authors can use as one of the references.

"Resilient Supplier Selection in Electronic Components Procurement: An Integration of Evidence Theory and Rule-Based Transformation into TOPSIS to Tackle Uncertain and Incomplete Information, Symmetry, 2020, 12, 1109. doi:10.3390/sym12071109"

Thank you, we added one paragraph in section 2.2 to explain why we used AHP.

3. The total number of pairwise comparisons that each participant must complete in the questionnaire should be declared.

Thank you, we explain the number of pairwise comparison in Section 2.4.

4. Information in Section 3.1 should be put into a table.

Thank you, we put the information in section 3.1 into a table.

5. In Table 2, the name of the first alternative is changed from "Premium" in Row 4 to "Flagship" in Row 5. They should be consistent with each other.

Thank you so much... we corrected it.

6. The sentences "However, we can see that for the participant between 15-55 years, the decision weight for Refurbish and Mid-Range is not significantly different. In contrast it is significantly different for senior citizens. In this case, we can conclude, young Indonesian consider Refurbish smartphones compared to Mid-Range." is not consistent with the results presented in Table 4 (Table 3 is missing from the paper). From Table 4, I can't see that the gap between Refurbish and Mid-Range in ">55" group is significantly larger than the gaps in the other groups, as claimed by the paper. Please re-analyze the results carefully.

Thank you so much... we re-analyzed the dataset and using t-test to compare those two weights. Yes, you are right, and we change the conclusion as follows:

However, we can see that for the participant between 25-45 (junior workers), the decision weight for Refurbish and Mid-Range is significantly different (based on t-test). In contrast, for the other segmented ages,

those weights are not significantly different. In this case, we can conclude, Indonesian students, senior workers and retirements considering Refurbish smartphones as well as Mid-Range smartphone as their personal smartphone.

7. This paper lacks statements to declare theoretical contributions and managerial implications to attract academic and business readers. These two points are very important for international publication.

Thank you for your valuable inputs. We have added the theoretical contribution and managerial implication in the discussion section, as follows:

The results from the decision of priorities in buying a smartphone and sensitivity analysis contributed to the following results

- Financial benefit and endurance are the most important factors in the decision of buying smartphones, regardless of the age group
- Increasing the benefit of refurbished smartphones would drive the younger age groups to switch from buying mid-range to refurbished smartphones
- An increase in risk factor would lower customers' priority of buying refurbished smartphones

Therefore, to increase the priority of Indonesian customers in buying refurbished smartphones, the companies should add financial benefits such as offering bonuses, discounts, or installment programs. Furthermore, upgrading the hardware, such as RAM, ROM, and replacing the battery, would also increase the attractiveness of the refurbished smartphone. A collaboration with financial firms and mobile phone operators could bring attractive offers that serve as financial benefits. Also, to reduce the risk perception of refurbished smartphones, the companies could provide service centers and offering extended warranty packages.

### **Reviewer 3:**

Peer Reviewer finish reading this paper and has comments as below:

-Author should add one paragraph to explain more about the analysis process in section 2.5 (page 4)

Thank you, we added some explanation in that section.

-Data set have only 54 sets. Author have to explain why that number is enough for showing as the sample size.

Thank you, we added some explanation in that section.

-Author should show the accuracy index of the decision in each age group, such as CI:RI ratio or etc.

Thank you, we added the group consistency index in Table 4-6. We also explained how we dealt with inconsistency in the survey as follow:

In this survey, if the pairwise comparisons are not consistent, we will contact the participants which have the inconsistency answers. We will explain to them that their answers are not consistent and then ask them to rethink the answers. In Table 4, since the number of criteria is four, then the random consistency index (RI) is equal to 0.91 [20, 22].

-Check Benefit Criteria of 15-24 years old group. (page 6 line 9)

We are sorry, we don't understand your point in this question. In page 6 line 9 we explain the sensitivity analysis in the benefit criteria of 15-24 years old group. We found that this group is very sensitive in term of switching from buying a mid-range to refurbished smartphone.

-Make sure Figure 2 to show full number in price and risk attributes.

Thank you, we changed the figures so that all numbers are shown clearly.



Siana Halim &lt;halim@petra.ac.id&gt;

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**Your Submission - [EMID:7ac0ccdf109e1a3c]**

4 messages

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**APST** <em@editorialmanager.com>  
Reply-To: APST <apst.kku@gmail.com>  
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Wed, Aug 4, 2021 at 4:12 PM

Ref.: Ms. No. APST-D-21-00324R1  
Identifying Factors that Influence Customers' Interest in Buying Refurbished Smartphones: An Indonesian Context  
Asia-Pacific Journal of Science and Technology

Dear Dr. Halim,

I am pleased to tell you that your work has now been accepted for publication in Asia-Pacific Journal of Science and Technology.

It was accepted on August 4, 2021.

Please proofread the accepted manuscript by a native English speaker. Please send the proofread manuscript along with the Certificate of Proofreading to APST or the Letter from the English Editor to APST via [apst.kku@gmail.com](mailto:apst.kku@gmail.com) by August 25, 2021.

When you send the proofread manuscript, please indicate your manuscript number and also the acceptance date.

Thank you for submitting your work to this journal.

With kind regards

Alissara Reungsang  
Chief Editor  
Asia-Pacific Journal of Science and Technology

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Wed, Aug 4, 2021 at 4:56 PM

[Quoted text hidden]

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Mon, Aug 9, 2021 at 8:56 AM

Dear respected Prof Reungsang,

Many thanks for the good news. We sent our manuscript to the native proofreader, and hopefully we can submit the requirement in due time.

sincerely yours  
Siana Halim  
[Quoted text hidden]

---

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[Quoted text hidden]