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

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Abstract

In this paper, we investigated the factors that influence Indonesian customers in buying refurbished smartphone. The decision model is constructed using Analytical Hierarchy Process (AHP). There are four main factors considered, they are: Price, Performance, Benefit and Risk with sub-criteria for each factor. Three smartphone alternatives are determined for comparison, they are the flagship, refurbished and mid-range smartphones. We then surveyed 54 respondents, segmented by age, gender, job, knowledge, and experience in using refurbished smartphone. However, only age and experience in using refurbished turned out to be the significant factors that influence a customer in buying a refurbished smartphone. Younger people consider performance as the most important factor that influences them in buying a smartphone, while the older respondents consider benefit. As for the performance, both hardware and software are the most important 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.

Keywords: Refurbished, Analytical Hierarchical Process, Group Decision.

1. Introduction

Smartphones have become important devices in this modern world, especially during the covid-19 pandemic where most activities are conducted by means of information technology. We are facing 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 in the world and the world's tenth largest economy in terms of 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 quite high: 69.6% of the urban population and 53.6% of the rural population is in possession of 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 the recent decades, the study of extending mobile phones' lifespans has increased significantly, as an attempt to address the sustainability issues. There are several alternatives to extend smart phones' 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 is understandable since there is no governmental 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, from the manufacturers' perspective, refurbishing smartphones is not quite desirable since it could cannibalize the new products' demands.

This research explores the factors that influence customers' interest in buying refurbished smartphones, which is categorized under several segments based on age. We also make an attempt to compare customers' interest to buy refurbished smartphones and mid-range new smartphones. The identified factors can be used to help manufacturers to better understand the customers' needs, and further improve the market of refurbished smartphones to establish a circular economy in Indonesia.

2. Research Design and Methods

2.1 Recovery Process

Recovery process is a process that aim to restore or to add the product lifespan. There are several options in the recovery process, i.e., reuse, repair, remanufacture, and refurbished [10]. Every option has different process as well as output. The reuse process is the simplest in the recovery process. In the case of a smartphone in Indonesian context, reuse can be easily found within family. When the first owner would like 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, 11]. According to King et al. [10], 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 such that it will have the same performance specification as the one from the original equipment manufacturer (OEM), from the customer's perspective [12]. 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.

There are several papers studied the potential of mobile phone reuse and remanufacturing or refurbishment. The process of performing remanufacturing process on a mobile phone was studied by Kang et al. [13]. They developed simulation models and were able to identify the bottleneck processes and further propose an extended model to improve it. Seliger [14] 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 phone [15] and the social impacts across the life cycle of mobile phones with improvement opportunities on those impacts [16] were presented to support the initiatives on mobile phone recovery processes.

Consumer behavior and market aspect are very important for the success of mobile phone reuse and remanufacturing or refurbishment. The prospects and opportunities to adopt remanufactured mobile phone has been studied based on the influence of product design, end-of-life scenario, and recovery options [17]. The customer acceptance is studied in several countries, such as in India [3], in the Netherlands [18], and in Germany [19].

2.2 Analytic Hierarchy Process

The analytic hierarchy process (AHP) is one of the decision-making tools that was developed by Saaty [20]. In the AHP the judgements between one option to the others are made by comparing many criteria reciprocal pairwise. The fundamental scale used in AHP is depicted in Table 1.

Table 3. 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 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 for example normalized principal eigen vector of matrix A . The consistency index of pairwise comparison matrix is given by $C.I = (\lambda_{max} - n)/(n - 1)$, λ_{max} is the max eigen value of the respective matrix (for the detail see [21]). In this work we use the Super Decision v3 software [22], we also consider AHP for group decision making [23].

2.3 Model Construction

The AHP model was constructed using the van Weelden et al. model [18]. In their model van Weelden et al. explored the consumer acceptance of refurbished smartphone in the Dutch market, by considering several factors. Those factors are initial response, barriers, benefits, risks, influencing personal factors, influencing contextual factors and influencing product-related factors. This model was then adapted to the Indonesian characteristics in buying a smartphone. We also interviewed thirteen respondents aged between 21-59, who own either flagship, refurbished, or mid-range smartphones. We asked what factors influenced them in buying their current smartphones. We also adapt the Saaty's AHP Benefit Opportunity Cost Risk model [24, 25], by considering Price as Cost and Performance as Opportunity.

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

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

In the Price (Cost) criteria, in model does not have sub-criteria.

In the Risk criteria, we proposed three sub-criteria, that is, obsolesce, service and warranty and endurance. Since smartphone can be seen as a fashion product after sometimes it can be obsolesced. Therefore, we proposed obsolesced as a sub-criterion in the risk criteria. In the service and warranty, we concern about the easiness to find 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 [26]. While endurance sub-criterion means is the gadgets water and heat resistance and not 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.

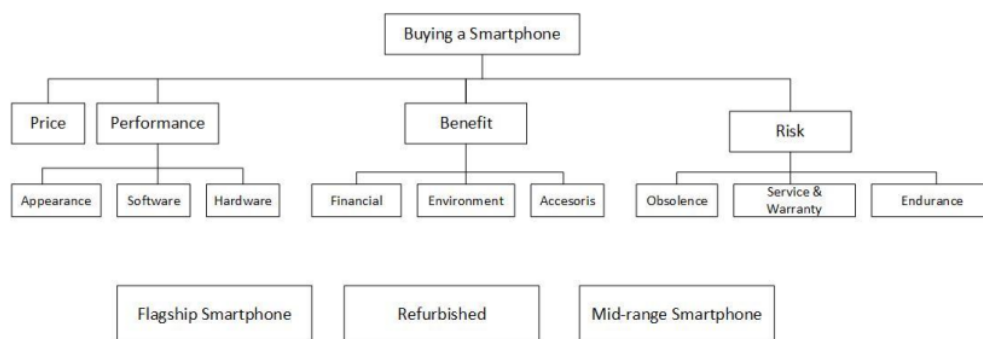


Figure 1. Model for buying a flagship, mid-range or refurbished smartphone.

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 background such as, gender, age, education, at what age they had their smartphone at the first time and what was that smartphone's brand. The last question of section one is about their knowledge of refurbished smartphone. Section two is the comparative judgment of each criterion: Benefit, Performance, Price and Risk. Section 4 to Section 6 is about pairwise comparative judgment for each sub-criterion with respect to the alternatives, which are flagship, refurbished and mid-range smartphone.

2.5 Data collection and analysis

The participants in this study were voluntary. Due to covid-19 pandemic, which is started in 2019, 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.

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%), 24-45 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 (52%) does not know about refurbish, and 47% of them know about refurbish smartphone. However, only 11% of them have refurbish smartphone, and the rest (89%) never have it. The participants have graduated from university (53%), and high school (47%). They have smartphone at the age 13-18 years (41%), 6-12 years (22%), the rest (37%) have smartphone at the age more than 19 years old. At the time they answer this questionnaire, 55.6% of the participants have mid-range smartphone, and 44.4% have flagship smartphone. Additionally, 11% of them have use refurbish smartphone.

In this study, only 48% of the participants have knowledge of refurbish smartphone. Therefore, before the participants, participated in this study, we explained the refurbish terminology to them. After they know about refurbish smartphone, 35% of participants, at the age in between 15-45 years are interested to have it as their gadget, 33% of participants, at the age in between 46-55 years, are also interested to have a refurbish smartphone and 40% of the senior participant (more 55 years) are interested to have a refurbish smartphone.

By this background we conclude that the participants of this study are a representative sample.

3.2. Priorities based on age segmentation.

We used super decision as software to analysis the decision, as an example we summarize the criteria weight for participants at the age in between 25-45 years (see Table 1). We can see, Participant 1 priorities 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 [27]. We conclude that for junior

worker in the range of age between 25-45 years, they put Performance over Risk, Price and Benefit as their priority when they buy a smartphone.

Table 1. Weight of criteria decided by participants at the age between 25-45 years.

Participant	Benefit	Performance	Price	Risk
1	0.064	0.160	0.337	0.438
2	0.313	0.387	0.250	0.049
3	0.135	0.549	0.232	0.083
4	0.276	0.391	0.138	0.195
5	0.183	0.576	0.088	0.153
6	0.048	0.102	0.326	0.524
7	0.120	0.401	0.040	0.439
8	0.052	0.294	0.099	0.555
9	0.052	0.235	0.126	0.587
10	0.348	0.425	0.145	0.081
11	0.233	0.561	0.072	0.134
Average	0.166	0.371	0.169	0.294
Percentage	17%	37%	17%	29%

Table 2 summarizing the weighted priorities for each criteria and sub-criteria, which are calculated for segmented age in between 25-45 years. We can see that for 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 important than Warranty and Obsolesce for them. As a group, the junior worker tends to choose flagship smartphone over the Mid-range and Refurbished smartphone. However, we can see that the weight between the Mid-range and Refurbished is significantly different. So, we can say, Junior worker still considering having refurbished smartphone as their gadgets (see Table 2).

Table 2. The weighted of the AHP for segmented age in between 25-45 years

Goal	Buying a Smartphone										
Criteria	Benefit			Performance			Price	Risk			
Weight	0.166			0.371			0.169	0.294			
Sub-Criteria	Financial	Environment	Accessories	Appearance	Software	Hardware		Obsolesce	Warranty	Endurance	
	0.468	0.301	0.231	0.201	0.431	0.368		0.151	0.412	0.437	
Sub-Criteria X	0.078	0.050	0.038	0.074	0.160	0.137	0.169	0.045	0.121	0.129	
Criteria											
Alternative	Premium	0.541	0.362	0.681	0.563	0.569	0.583	0.336	0.521	0.511	0.564
	Refurbish	0.299	0.342	0.185	0.119	0.215	0.162	0.292	0.264	0.184	0.143
	Mid-range	0.160	0.296	0.133	0.318	0.216	0.255	0.371	0.215	0.305	0.293
	Decision										
Flagship	0.513										
Refurbish	0.214										
Mid-Range	0.277										

In overall, the priority in buying a smartphone is summarized in Table 3. All participants decide to buy Flagship smartphone over Refurbish and Mid-Range smartphone. However, we can see that for participant in between 15-55 years, the decision weight for Refurbish and Mid-Range is not significantly different. While it is significantly different for the senior citizen. In this case, we can conclude, young Indonesian consider Refurbish smartphone compared to Mid-Range.

Table 4. The priorities in buying a smartphone by age.

	15-24 years	25-45 years	46-55 years	>55 years
Criteria	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	0.563	0.513	0.582	0.481
Refurbish	0.208	0.214	0.204	0.253
Mid-Range	0.229	0.277	0.214	0.266

3.2. Priorities based on knowledge of refurbish.

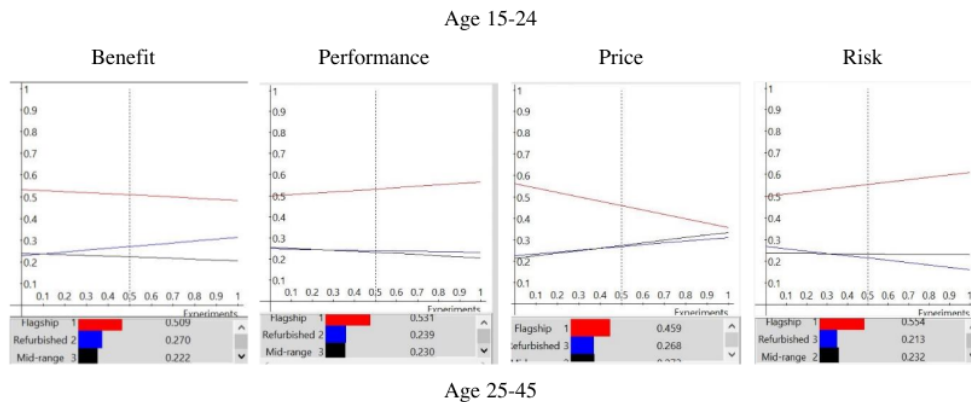
The knowledge of refurbish does not change the priority of the Indonesian respondents in buying a smartphone. Even though, they had an experience in using refurbished smartphone, they prefer to buy a flagship smartphone. Performance, financial, software and endurance are the criteria that they priorities more in buying a flagship smartphone than the mid-range nor refurbished smartphone (see Table 5).

Table 5 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
Buying a Smartphone			
Flagship	0.535	0.513	0.574
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 age more than 55 years are consistent in their decisions. They prefer to buy a flagship smartphone than the mid-range or refurbished regardless any alteration in the benefit, performance, price, and risk criteria. Junior respondents with age between 15-24 years, can be switch from buying a mid-range smartphone to refurbished. A small weight alteration in the benefit criteria from 0.16 to 0.2 (or more) influence their decision from buying a mid-range smartphone to a refurbished one. Respondents in productive age (25-55 years) are sensitive respondents. They consider to buy a refurbished smartphone than the mid-range if the benefit of refurbished smartphone is altered from 0.4 (for age 25-45) and from 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).



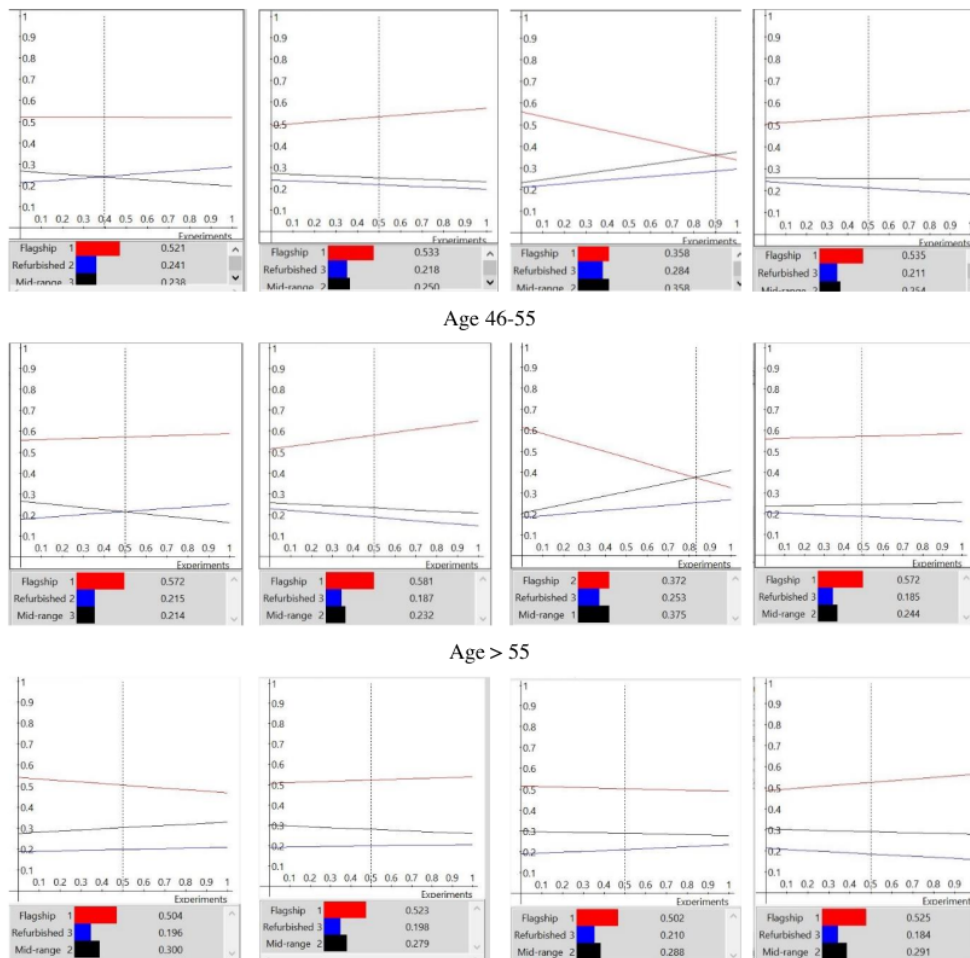


Figure 2. Sensitivity analysis on buying a smartphone based on age of the respondents with respect to Benefit, Performance, Price and Risk

4. Conclusion

In Indonesia a refurbish smartphone is not a popular product. In this study, only 47% of the respondents know about refurbish smartphone, but only 11% of them have experience in buying a refurbish smartphone. Even though they had a refurbish smartphone, the prefer to buy a flagship than the refurbish one. The knowledge of refurbish does not change the priority of the Indonesian respondents in buying a smartphone. People priorities performance, financial, software and endurance for buying a smartphone. The age segmentation is sensitive in deciding to buy a smartphone. Senior respondents with age more than 55 years are consistent in their decisions, while younger respondents may alter from buying a mid-range to refurbish smartphone, if the refurbished smartphone give more benefit for them.

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

Goal	Buying a Smartphone (Age 15-24 years)									
Criteria	Price	Performance (0.424)				Benefit (0.160)			Risk (0.24)	
SubCriteria		Appearance	Software	Hardware	Financial	Environment	Accessories	Obsolesce	Warranty	Endurance
	0.184	0.185	0.394	0.421	0.351	0.327	0.322	0.318	0.326	0.357

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