

Consumer Value Considerations: Impact of Remanufactured Products in The Supply Chain Industry

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Abstract

The success of closed-loop supply chains depends on consumer acceptance of remanufactured products. However, little is known about research on how consumers value such remanufactured products. Thus, the objective of this study is to examine the consumer value considerations of remanufactured products and to determine the most critical consumer value considerations that impact the adoption of remanufactured products in the supply chain industry. Consumer consideration of the value of remanufactured products was measured in terms of perceived benefits (environmental benefits and price advantages) and perceived sacrifice (perceived risks). Next, quantitative methods have been used in carrying out this research. Data were collected on a five-point Likert scale through a questionnaire in an online Google Form and distributed physically to respondents. The data was gathered from 196 respondents located in Malacca. Statistical Packages for Social Sciences (SPSS) and SmartPLS were used to analyze the data. According to the results of this study, there are moderately significant links between perceived benefits and perceived sacrifice with the adoption of remanufactured products. since the perceived benefit on price advantage has the highest correlation value, which is 0.647 and that means it is the most significant and moderate positive relationship between the independent variable and dependent variable. Meanwhile, the third independent variable is perceived sacrifice on perceived risks with the lowest value of 0.574 compared to the other two independent variables. In sum, according to the table above, all three independent variables have a positive and moderate relationship with the dependent variable as the results show a correlation coefficient (r). For future reference, this study is considered a significant contribution to researchers' and practitioners' better understanding of the role of consumers in closed-loop supply chains concerning the acceptance of remanufactured products.

Keywords: Consumer Value, Remanufactured Products, Supply Chain.

Introduction

According to Wang et al (2020), Closed Loop Supply Chain Management (CLSCM) is an important contribution to achieving sustainable performance in the supply chain industry. Beside from the management awareness, the one of the difficulties with the closed loop supply chain (CLSC) originates from a lack of public awareness (Panigrahi et al., 2018). This means consumers have a better understanding of how and why remanufacturing can be an eco-friendlier decision.

The closed supply chain addresses sustainability by collecting used or end-of-life items returned for recovery, refurbishment, remanufacturing, reuse and recycling (Islam and Huda, 2018). According to Mishra et al (2018), to establish a unique system, closed loop combines information flows, financial and physical connecting downstream organizations with upstream organizations along the supply chain. CLSC complements direct flow with reverse flow, which covers a larger range of operations and, in most cases, more parties than a typical supply chain.

The economic potential of closed-loop supply chains is considerable. From Mahmoud Gonbadi et al (2021), the closed-loop supply chain (CLSC) has received a great deal of attention from a sustainability perspective as one of the key components of the circular economy. Closed-loop supply chains (CLSCs) are particularly crucial for a business since they allow the company to profit by returning things to customers and reimbursing the remaining additional value Shekarian and Flapper (2021), such as remanufacturing allows enterprises to participate in pro-environmental actions (Singhal et al., 2019a). As a result, methods to prolong a product's life cycle have attracted growing attention in both theory and practice. Product returns are also becoming a growing worry for the industry (Panigrahi et al., 2018). Furthermore, CLSCs have several good impacts on the environment, including the conservation of primary resources, the reduction of landfill space, and the reduction of the impact of potentially harmful substances (Gonbadi et al., 2021). From Shabbir et al (2021), one of the aims of creating a closed-loop supply chain (CLSC) is to create a network with the aid of using launching and running the material flow across chain centers such that the beneficiaries' economic, environmental, and social goals are all optimized on the equal time.

Moreover, a closed-loop supply chain (CLSC) performs the following primary activities which are reverse logistics, product acquisition, possibly product disposal, product inspection, remanufacturing and reselling products that have been remanufactured to original functions and quality (De Giovanni and Zaccour, 2022). Remanufacturing is a closed-loop manufacturing activity that recycles components that are still in good working to restore the residual value of discarded items (Wang et al., 2018a). Remanufacturing is excellent for the environment since it saves energy and materials while also producing products at a lesser price (Jiang et al., 2019). Before being reassembled and quality-tested, the products that have been returned is disassembled, the parts are properly cleaned, sorted, and reconditioned, and new parts may be manufactured (Singhal et al., 2019a). There is a vast range of remanufactured products across the world, including laptops, bicycles, machine tools, electric or electronic products, photocopiers, cellular phones, and computers (Testa et al., 2021).

In the supply chain industry, Muranko et al (2019) emphasise the need to analyse consumer behaviour. This is because many behavioural barriers hinder the development of a circular

economy, but appropriate behavioural change interventions can help overcome these barriers. As a result, knowing consumers' value considerations toward remanufactured goods is essential for the remanufacturing industry's successful adoption. This research aims to contribute to consumer research on CLSC by assessing Malaysian citizens' consumer value considerations for remanufactured products. Research objectives derived from the formulation of problem statement are to examine the consumer value considerations of remanufactured products and to determine the most critical consumer value considerations which impact the adoption of remanufactured products in supply chain industry. By studying on several value perceptions and risk perceptions, this research will be beneficial to the remanufactured products as well as increase the consumers' acceptance of the remanufactured products to enhance value output across a product's life cycle. Briefly, the research objectives in this study are stated as below:

(RO1) To examine the consumer value considerations of remanufactured products.

(RO2) To determine the most critical consumer value considerations which impact the adoption of remanufactured products in supply chain industry.

Scope of Study

The scope of this study focuses on examining consumer value considerations of remanufactured products and how the perceived benefits and perceived sacrifice affecting the adoption of remanufactured products in supply chain industry. Firstly, researcher is going to identify several types of consumers value considerations when trying to adopt the remanufactured products. Additionally, the researcher is going to determine the most critical consumer value considerations influencing the adoption of remanufactured products in supply chain industry. The case study of research is conducted through online google form and physically distributed to the respondents. The respondents of this research include consumers who are intent to use and purchase the remanufactured products, such as small electric or large electric. This study enables the researcher to understanding consumers' value considerations as related to remanufactured products. Furthermore, this research can help practitioners and researchers better understand the consumer's participation in the closed loop supply chain, particularly in terms of remanufactured product acceptance. Furthermore, this research contributes for academic purpose such as publication on academic and reference.

Significant of the Study

This study discusses the consumers value consideration of remanufactured products and determine how the consumers perceived value affect the remanufactured products in supply chain industry. The findings help to gain insights into the remanufactured products and understand various consumers value considerations that need to be determined when the consumers try to adopt for the remanufactured products. By determining consumers value considerations with the value perceived and risk perceived that have to be well-thought beforehand when developing the future market for the remanufactured products, this research is beneficial towards not only for both the researcher and the remanufactured industry on closed-loop supply chain in order to better understanding the consumers' value concerns for remanufactured products to engage more people in closed-loop supply chain to minimize the e-waste.

In brief, this research is aimed to examine the consumer value considerations of remanufactured products. Moreover, it is also designed to determine the most critical consumer value considerations which impact the adoption of remanufactured products in supply chain industry. The scopes of this research are to identify the consumer value considerations and how value perceptions and risk perceptions affect remanufactured products in supply chain industry. This research is being conducted under a limitation. First, the respondents' understanding of remanufactured products may be poor, leaving them unable to make adequate and formal responses to the research questions on the Google form. In addition, the respondents are assumed to be honest and knowledgeable while answering the questions prepared in the Google form.

To collect accurate data and information, 196 respondents were randomly involved in Malacca to conduct the questionnaire for this research. This research helps to better understanding the consumer value considerations on the remanufactured products in the supply chain industry. Finally, this chapter introduces a review of the study. The problem statement and research objectives indicate the consumer value considerations and the impact of consumer value considerations on the remanufactured products are the focus area of this research. The case study is designed and conducted to Malaysia citizens who live in Malacca to address the problem statement along with to accomplish the objectives of the research.

Problem Statement

Many countries are grappling with a growing waste problem. One of the reasons for the increase in waste generation is the rapidly growing electrical and electronic waste (Jayaraman et al., 2019). Because of quicker technological clock speed, there were total of 2,283.7 tonnes of electrical and electronic waste (e-waste) collected by the Department of Environment (DoE) as of November 2021. Moreover, the quantity of e-waste collected exceeds the department's objective of 800 tonnes for the entire year 2021 (Malaymail, 2021). However, the current strategies of depositing e-waste in landfills or incinerating it are not sustainable (Shekarian and Flapper, 2021). It turns into an increasing number of critical withinside the destiny to control e-waste in one's life. Recently, the 'throwaway' tradition has attracted a superb deal of interest from many institutional businesses that sell sustainable manufacturing and consumption (Wang et al., 2018a). However, electric powered and digital waste may be each a very good enterprise prospect and a rising international environmental crisis. Monitors, TVs, and mobile telephones are several of the not unusual place digital gadgets that contribute to e-waste.

Despite numerous e-waste legislation being introduced and put into law, the disposal of electronic waste (e-waste) in Southeast Asian countries is still relatively slow (Doan et al., 2019). All electronic products have a usable life, however after a particular period, they reach the end of their residual value (Jayaraman et al., 2019). Thus, the process of disposing various types of electrical and electronic equipment that is no longer functional to its owners is known as electronic garbage (e-waste) (Jayaraman et al., 2019). Electronic devices such as cell phones, refrigerators, consumer electronics, air conditioners, and laptops are common components of e-waste (Jayaraman et al., 2019). Moreover, in a closed-loop supply chain, the reverse manufacturing process is also referred to as e-waste by remanufacturing and refurbishing the waste product to new finished good for future use (Doan et al., 2019). Hence,

the consumer acceptance of remanufactured products is very significant in reducing the e-waste (Sari et al., 2021).

Consumer acceptance of remanufactured goods is a fundamental difficulty to realising the full potential advantage of product recovery activities, according to several organisations. However, consumer engagement of remanufactured products is necessary for the success of the entire closed-loop supply chain (Panigrahi et al., 2018). Consumers' acceptability of remanufactured products is crucial to the CLSC's success (Singhal et al., 2019). While people in the manufacturing industry are familiar with the concept of remanufacturing, consumers are frequently unaware of how remanufactured products differ from new, used, or even repaired products in terms of product quality (Wang et al., 2018a). Admittedly, the remanufacturing sector's expansion is challenged by the lack of recognition and acceptability of consumers (Singhal et al., 2019).

Literature Review

The emergence of Industry 4.0 and its application in manufacturing, has ushered in a new era for business entities (Sharma et al., 2020). It not only expands sustainable operating practices, but also promises to improve operational efficiency. There are some sustainability dimensions in Industry 4.0 which includes the sustainable design in manufacturing such as product recycling, reusing and remanufacturing. Remanufacturing offers great opportunities for a sustainable future and comprehensive sustainability benefits at the time of product design (Reimann et al., 2019). This is because the effective innovation process can reduce the cost of remanufacturing (Reimann et al., 2019). However, pioneers who have achieved great success in remanufacturing often invest heavily in new product designs to reduce remanufacturing costs (Reimann et al., 2019).

Moreover, remanufacturing is a production approach that aims to recover a used product's residual value by reusing, repairing or replacing components, recovering the finished product to a state that is equivalent to new (Saidani et al., 2020). From research of Saidani et al. (2020), techno-economic and organizational lessons of heavy-duty vehicles from industrial pilot studies are learned. This industrial pilot project looks at the whole end-of-life management of a heavy vehicle, from disassembly through used part recycling and remanufacturing. It shows a variety of factors to consider while completing the loop for heavy trucks, including technical and organisational expertise as well as cost concerns. Infrastructure, tooling, the disassembly process, and remanufacturing viability are examples of technical and organisational knowledge, while economic considerations include optimising solutions by identifying prospective recycling routes and the value of recycling according to market demand.

In logistics and supply chain management, reverse logistics is a relatively new and inseparable concept, and it is critical as a successful and long-term business strategy (Panjehfouladgaran et al., 2020). Reverse logistics, according to Panjehfouladgaran et al. (2020), not only offers financial advantages like cost savings and the accomplishment of social responsibility goals, but also recovers product value. Therefore, the benefits of reverse logistics become a strategic driver that motivates companies to adopt RL practices.

Furthermore, recognizing and controlling relevant risk factors is essential. Since supply chain management includes RL, RL risk management should be investigated, in order to produce control and minimise risk factors in order to achieve effective RL deployment

(Panjehfouladgaran et al., 2020). Using a combination of supply chain and risk management research, Panjehfouladgaran et al (2020) employed risk management theory to identify and cluster RL risk variables and provide risk mitigation approaches to limit the negative impact of risk on RL deployment. The risk factors for RL may be divided into three categories, which are tactical, strategic, and operational. For starters, clusters of strategic risk variables can have a direct impact on an organization's long-term strategic operations and top management decisions. Second, groups of tactical possible risks will have an impact on an organization's mid-term tactical operations, mostly due to problems with supply and inventory management. Meanwhile, the operation cluster directly affects the daily operation and directly affects the operation, resulting in the inability to meet customer needs. However, there are some uncertainties in closed-loop supply chain. Shabbir et al (2021) developed a novel closed-loop supply chain with uncertainty by including resilience, sustainability, and dependability components. A risk criterion is presented to reduce overall cost, environmental damage, and energy consumption while increasing job chances as a social element to provide resilient solutions to uncertainty.

Furthermore, remanufactured products have certain marketing challenges (Govindan et al., 2019). Govindan et al. (2019) explored and analysed chances to enhance marketing techniques for remanufactured items by investigating various marketing tactics, customer behaviour, price and branding decisions, and green transportation optimization. Lack of customer engagement for remanufactured products is a significant impediment to remanufactured product marketing. The authors explored numerous contributing aspects to remanufactured product marketing challenges, including a lack of customer interest for remanufactured goods, which is a major hurdle to remanufactured product marketing. Remanufactured products are items that have been restored, reused, or replaced with new parts to restore the function of an old, used, or worn-out product (Singhal et al., 2019). With remanufacturing process, recycles components that are still in good working were being restored the residual value of discarded items (Wang et al., 2020). According to Khara et al. (2020), some products in the commercial sector cannot be recycled more than once. Most plastics, such as plastic tubs, can only be recycled once or twice before they must be downcycled.

In the field of environmental construction, Sartipi (2020) utilised the concept of innovation diffusion, innovators in the construction field are encouraged to familiarize themselves with the adoption process. This is because despite numerous productive and novel technological advancements, the construction industry has faced the burden of environmental initiatives over the past few decades. The implementation of the technologies has proven to stem from the behavioural characteristics of individuals and organizations in the supply chain. Therefore, this paper takes the diffusion of innovation theory as a benchmark. The Diffusion of Innovation (DOI) theory, one of the first in social science, was created by E.M. Rogers in 1983. It explains how an idea or product gets patched over time and spreads within a group of people or social system and has its foundations in communication. In other words, the rate at which new concepts and technology spread can be explained by the diffusion of innovation. Marketers frequently employ the diffusion of innovation theory to measure how quickly consumers will accept new goods or services (Dearing and Cox, 2018). There are five main factors that influence innovation adoption, each of which plays a different degree of role in each of the five adopter categories. Since remanufacturing and its adaptations are still "new,"

many customers are unaware of them. Hence, the remanufactured products meet their interpretation of the diffusion of innovation definition, which describes the process of adoption and acceptance of innovations, such as new products or services (Halton, 2021). Therefore, diffusion of innovation theory provides a useful perspective to structure this study.

Method

Quantitative research is the process of collecting and analyzing numerical data. Quantitative methods are research oriented towards understanding the objective world, testing hypotheses generated in theory through experimental design, and leading to statistical generalizations applicable to large populations (Creswell and Creswell, 2018). It can also be used to find patterns and averages, make predictions, and test for causality. (Bhandari, 2021). Moreover, quantitative research also shows post-positivist assumptions that represent traditional forms of research. In short, quantitative methods were used in conducting this research. In the quantitative study, a survey-based questionnaire was administered to the respondents to collect data and respondents' views. In addition, the researcher needed to identify consumer value considerations for remanufactured products in the supply chain industry and to examine the impact of consumer value considerations on the adoption of remanufactured products. This is because for consumers to successfully adopt remanufactured products, the researcher must have an in-depth understanding of remanufacturing topics that are relevant to consumers.

Materials

This study will examine consumer value considerations for remanufactured products and determine the impact of consumer value considerations on the adoption of remanufactured products. An interpretive research design will be used, first collecting quantitative data and then providing in-depth data interpretation of the quantitative results. In the first quantitative phase of this study, primary data will be collected from 196 respondents in Malacca to assess whether the adoption of remanufactured products is related to consumer value considerations using diffusion of innovation theory (DOI). To get the appropriate data needed, the researcher will have questionnaires with three sections. Section A will ask for the demographic information of the respondents. It will determine the age, gender, education level, employment status and income level. Section B is the tool to determine the consumer value consideration for the remanufactured products by using Linkert Scale. Section C is the tool that will be used to examine the impact of consumer value consideration on the adoption of remanufactured products.

Moreover, the second phase of research instrument will follow the primary data collected to help interpret the quantitative results. In this explanatory follow-up, the tentative plan is to explore the consumer value consideration of remanufactured products in supply chain industry.

Samples

As researcher will be conducting this research in Malacca, Malaysia. Additionally, the number of populations was 400 respondents in Malacca state. Therefore, researcher has determined the number of 400 respondents to answer a questionnaire that was distributed. In this research, total sample of 196 respondents who live in Malacca, Malaysia was selected based on the (Krejcie and Morgan, 1970). For this research, researchers will use probability sampling

based on the objectives of this study and some limitations of the study. Simple random sampling is the most suitable method for this study because its results are accurate and easily accessible. Moreover, it is useful for researchers who are interested in associations that apply to the entire population in Malacca.

Site

The researcher has chosen Malacca city as the research location for this study. The main reason is because Malacca has been declared as a UNESCO world heritage city in year 2008 with outstanding historical value. Additionally, according to Department of Statistics Malaysia Official Portal (2021), stated that the population of people in Malacca has an estimated population of 0.94 million of people. Furthermore, the Melaka government formulates a comprehensive strategic plan and manages Melaka City as an urban development to be resilient in the future. The concept of resilience is one of the most important drivers in achieving sustainability either in a city or in the supply chain industry (Jamaliidin and Sulaiman, 2018). Additionally, green design features have been adopted in parts of Melaka to suit the city's heritage image and support sustainable urban development. Hence, Malacca city is suitable to conduct the research about remanufactured products in supply chain industry. The researcher believed that Melaka is an appropriate location for the research, as it is a World Heritage Site in Malaysia and a resilient city of the future. Therefore, the researchers chose to collect the data required for this research. The data collected based on this study will allow researchers to make accurate analyses and achieve research goals.

Procedures

Data was gathered using accessible sampling, and the sample size was limited by the industry's time constraints resulting from their scheduling and working hours of required travel for logistical tasks. As a result, responses to the questionnaire were sent via email, WhatsApp, Telegram, and Google Forms. Factor analysis and reliability tests were utilized in the quantitative research designs to validate the findings and support or refute a hypothesis.

Measurement

This study used a pilot test, and based on the respondent's response rate, a valuable means from the testing procedures for this research measurement was established. A total of 400 people were asked to participate in the survey, which was conducted in Malacca, Malaysia. Of those, 196 respondents have returned in each state, covering the manufacturing of food products, beverages, machinery, electrical and electronic goods, transport equipment, engineering support, building materials, textiles, chemicals and pharmaceuticals.

Data Analysis

Data the results of the research conducted using quantitative approach were discussed. The data collected by questionnaires involving general customers as respondent which consist of Malacca central area in Malacca state. This will examine the consumer value considerations of remanufactured products, and then determine the most critical consumer value considerations which impact the adoption of remanufactured products in the supply chain industry. After that, the findings are then being analysed and studied with quantitative method such as hypothesis testing, Pearson Correlation and Multiple Regression Testing. Considering the focus of this research study is to examine the consumer value considerations of remanufactured products, the result is presented in a total of three main sections. The

three sections of questionnaire are Section A for demographic of respondents, Section B for the consumer value considerations towards adoption of remanufactured products in supply chain industry, Section C for the adoption of remanufactured products. The data analysis is then tested based on 196 respondents at Malacca. The statistical package for the social sciences (SPSS) version 27 software and SmartPLS version 3 will use coding and keying of all results received from the questionnaire.

Validity and Reliability

Cronbach's alpha was used to estimate the reliability of the questionnaire. The total variables of this research have an overall alpha of 0.885. A total of 38 respondents were participated to assess the reliability of the questionnaire. For the reliability test, the researcher used a simple random sampling method and distributed the questionnaires through Google Form.

Results and Discussion

Perceived Benefit in Exploratory Reliability

The pilot test’s result in terms of Cronbach’s Alpha is 0.880. Throughout this test, a perceived benefit on environmental benefits is selected as a factor on the questionnaire. The pilot testing was deemed acceptable and created questions when the reliability level of the survey results exceeded 0.7. Hence, the pilot test is considered logical and acceptable with the question created. The pilot test’s result in terms of Cronbach’s Alpha is 0.891. Throughout this test, perceived benefit on price advantages is selected as a factor on the questionnaire. The pilot testing was deemed acceptable and created questions when the reliability level of the survey results exceeded 0.7. Hence, the pilot test is considered logical and acceptable with the question created. The pilot test’s result in terms of Cronbach’s Alpha is 0.929. Throughout this test, perceived sacrifice on perceived risks is selected as a factor on the questionnaire. The pilot testing was deemed acceptable and created questions when the reliability level of the survey results exceeded 0.7. Hence, the pilot test is considered logical and acceptable with the question created. The pilot test’s result in terms of Cronbach’s Alpha is 0.879. Throughout this test, the adoption of remanufactured products is selected as a factor on the questionnaire. The pilot testing was deemed acceptable and created questions when the reliability level of the survey results exceeded 0.7. Hence, the pilot test is considered logical and acceptable with the question created. The pilot test’s result in terms of Cronbach’s Alpha is 0.885. Throughout this test, total variables are selected as factors on the questionnaire. The pilot testing was deemed acceptable and created questions when the reliability level of the survey results exceeded 0.7. Hence, the pilot test is considered logical and acceptable with the question created.

Table 1.0
Reliability Statistics Result for Total Variables

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.885	.894	20

Reliability Statistics

Table 2.0 had pointed out that Cronbach alpha values of 0.7 or higher indicate acceptable internal consistency. In this research, all the Cronbach’s Alpha results are greater than the acceptable values of 0.7. Thus, all variables can be concluded that the items have relatively internal consistency. The Cronbach’s Alpha for the Perceived Benefit on Environmentally Benefits (E) is 0.880 measured by 5 factors. Then, the Cronbach’s Alpha for the Perceived Benefit on Price Advantages (P) is 0.891 measured by 5 factors. Moreover, the Cronbach’s Alpha for the Perceived Sacrifice on Perceived Risks (R) is 0.929 measured by 5 factors. Lastly, the Cronbach’s Alpha for the Adoption of Remanufactured Products (Q) is 0.879 measured by 5 items.

Table 2.0
Summarized Reliability Statistics Result

Variables	Cronbach's Alpha	N of Items	Result
Independent Variables			
Perceived Benefit on Environmentally Benefits (E)	0.880	5	Good
Perceived Benefit on Price Advantages (P)	0.891	5	Good
Perceived Sacrifice on Perceived Risks (R)	0.929	5	Good
Dependent Variable			
The Adoption of Remanufactured Products (Q)	0.879	5	Good

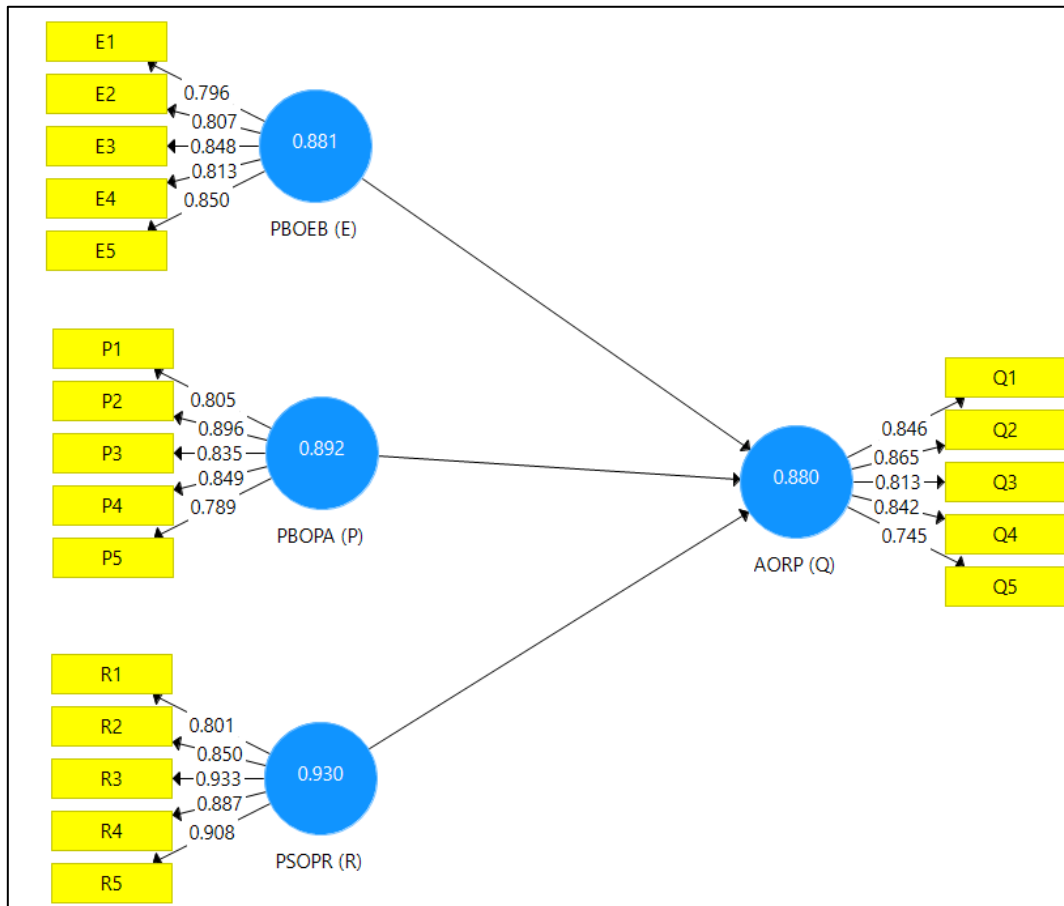


Figure 1.0: Summarized Reliability Statistics Result in Factor Loading for 20 Items and Cronbach's Alpha

Thus, figure 2.0 presents the convergent validity of the constructs. The factor loadings for all measurement items are ranging from 0.789 to 0.933. Composite reliability values range from 0.913 to 0.943. Average variances extracted (AVE) are ranging from 0.678 to 0.769. Cronbach's Alpha values range from 0.880 to 0.930. All three criteria have fulfilled the threshold required for the robustness of the structural relationship before further analysis is conducted.

Reliability Test: Exploratory Factor Analysis

To evaluate reflective measurement models, the reliability of indicators and constructs, as well as convergent and discriminant validity, should be assessed. To confirm the reliability of the indicator, each item should have a load higher than 0.50 on its associated latent variable. Table 4.20 shows the factor loadings for all measures ranged from 0.681 to 0.823.

Table 3.0

Factor Loadings of All Items

	AORP (Q)	PBOEB (E)	PBOPA (P)	PSOPR (R)
E1		0.757		
E2		0.803		
E3		0.697		
E4		0.735		
E5		0.786		
P1			0.710	
P2			0.681	
P3			0.683	
P4			0.735	
P5			0.739	
Q1	0.738			
Q2	0.760			
Q3	0.808			
Q4	0.776			
Q5	0.800			
R1				0.750
R2				0.731
R3				0.810
R4				0.823
R5				0.802

Validity Test: Pearson's Correlation Coefficient

The first independent variable was perceived benefit on environmental benefits with a correlation coefficient (r) value of 0.644. Moreover, since the perceived benefit on price advantage has the highest correlation value, which is 0.647 and that means it is the most significant and moderate positive relationship between the independent variable and dependent variable. Meanwhile, the third independent variable is perceived sacrifice on perceived risks with the lowest value of 0.574 compared to the other two independent variables. In sum, according to the table above, all three independent variables have a positive and moderate relationship with the dependent variable as the results show correlation coefficient (r) values are between 0.5 to 0.7. It showed that all the independent variables were associated with the dependent variable of the adoption of remanufactured products (Table 4.0).

Table 4.0

Pearson Correlation Coefficient Analysis

Correlations					
		IV1	IV2	IV3	DV
IV1	Pearson Correlation	1	.682**	.617**	.644**
	Sig. (2-tailed)		.000	.000	.000
	N	196	196	196	196
IV2	Pearson Correlation	.682**	1	.575**	.647**
	Sig. (2-tailed)	.000		.000	.000
	N	196	196	196	196
IV3	Pearson Correlation	.617**	.575**	1	.574**
	Sig. (2-tailed)	.000	.000		.000
	N	196	196	196	196
DV	Pearson Correlation	.644**	.647**	.574**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	196	196	196	196

** . Correlation is significant at the 0.01 level (2-tailed).

Multiple Regression Analysis

This study employed multiple regression analysis to assess and determine the relationship between the consumer value consideration and the adoption of remanufactured products. Multiple regression analysis was performed to test these three hypotheses. The results of the multiple regression analysis are shown in Table 5.0.

Table 5.0

Multiple Regression Analysis

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
PBOEB (E) -> AORP (Q)	0.293	0.29	0.102	2.866	0.004
PBOPA (P) -> AORP (Q)	0.33	0.326	0.094	3.515	0
PSOPR (R) -> AORP (Q)	0.206	0.215	0.091	2.273	0.023

Based on the finding, the p-value of the perceived benefit on environmental benefits ($p = 0.004$) is less than the alpha value of 0.05. Therefore, the research concludes that perceived benefit on environmental benefits is positively related to the adoption of remanufactured products. Hypothesis 1 is supported. In addition, the result indicated that the p-value for the perceived benefit on price advantage ($p = 0.000$) is also less than the alpha value of 0.05. Therefore, it can be suggested that environmental attitude is positively related to the adoption of remanufactured products. Hypothesis 2 is therefore supported. Nevertheless, the last hypothesis 3 is supported. The p-value of the perceived sacrifice on perceived risks ($p = 0.023$) is less than the alpha value of 0.05. Therefore, it may be concluded that the perceived sacrifice on perceived risks is positively related to the adoption of remanufactured products. Hypothesis 3 is supported.

Discussion

The researcher achieved the first research purpose through the Pearson correlation coefficient analysis of SPSS software. The findings showed that all independent variables (perceived benefit on environmentally benefits, perceived benefit on price advantages, and perceived sacrifice on perceived risks) were positively correlated with the dependent variable (the adoption of remanufactured products). According to the correlation coefficient values, all factors fall into the category of moderately positive correlations, between 0.50 and 0.70 and all variables have a significance level of 0.000. Meantime, all variables had p-values less than 0.05. According to Eggert et al (2019), consumer value plays a vital role at the heart of all marketing activity. Moreover, real customer value is the set of benefits that customers expect from a particular product (Bungatang and Reynel, 2021). Drawing upon this definition, the researcher affirmed that consumer value consideration plays a crucial part in the adoption of remanufactured products. From Fahy and Jobber (2019), there were four core forms of consumer value have been identified, which were price value, performance value, emotional value and relational value. The consumer values examined in this research were perceived benefit and perceived sacrifice. The the Pearson correlation coefficient towards the adoption of remanufactured products in related to perceived benefit on price advantages has a moderate positive which achieved a value of 0.647. Remanufacturing is also a cost-effective method due to reduced material consumption and effort. Refer to the paper of Lv et al. (2021), the higher the similarity between remanufactured products and new products, the more consistent their ability to meet consumer demand, and the more consumers will choose to buy remanufactured products with more favorable prices and give up buying new products. Similar to the findings of this research, the perceived benefit of price advantage would be positively and moderately related to the adoption of remanufactured products. To sum up, usually the lower price of remanufactured products will attract consumers to buy and use remanufactured products instead of new products, forming a substitution effect. Thus, the researcher believed that the consumers would consider adopting the remanufactured products, due to its perceived benefits to the environmentally benefits and price advantages.

Based on the discussion of the quantitative research findings in the previous chapter, it can be concluded that the consumers often seek a comprehensive assessment of value and risk when making adopting decisions, and it turns out that the same is true for remanufactured products. Moreover, according to the result of this study, consumers care more about the perceived benefit of price advantage, than the perceived benefit of environmental benefit and perceived sacrifice on perceived risks. The second research objective has been met by using SmartPLS software tools to further evaluate using multiple linear regression. Thus, reveals that the original sample, or it can stand for unstandardized beta showed that perceived benefit on price advantages has turned out to be the most significant factor, which the $\beta = 0.33$ was higher as compared to other independent variables. This showed that this factor is the most critical consumer value consideration that would influence the adoption of remanufactured products in the supply chain industry. In addition, the finding was supported because the significant value for perceived benefit on price advantages, which it is 0.000 where the p-value is less than 0.05. As in this study, perceived risk had the least positive impact on the adoption of remanufactured products compared to perceived benefit. Perceived risk factor, while slightly positive, does not appear to be statistically significant, so it has less impact on consumer adoption of remanufactured products. Such negligible positive correlation results for the perceived risk index have not been widely observed in the research,

as most existing studies show that perceived risk is negatively correlated with the adoption or purchase of remanufactured products.

Contribution of Study

Over the last decade, researchers have given increased attention to remanufacturing. While many operational difficulties have been properly researched, research into predicting customer demand for, and market development of, remanufactured products is still in its infancy (Van Nguyen et al., 2020). Researchers claim that practitioners are surprisingly ignorant of how and why consumers value remanufactured goods. Therefore, instead of more particular information regarding how and why consumers value remanufactured products, industry has long relied on conventional wisdom.

The first implication of this study is to emphasize the importance of consumer value management in building and sustaining profitability of the closed-loop supply chain (CLSC). It also reveals important aspects of how customers perceive the value of remanufactured products and how perceived value relates to consumers' adoption and buying intentions. Therefore, this study increases consumer acceptance and value of remanufactured products in marketing strategies. Moreover, supply chain managers can use this finding to help model specific sources of variation, improving customer orientation by focusing on customer orientation to reduce demand risk. This practice will have an impact on providing the most effective means of recapturing value through remanufacturing and remarketing processes. Additionally, for remanufacturing businesses to have a competitive advantage on the market, it is crucial to understand how consumers see remanufactured goods. This study's conclusions outline the elements that can be included into business operations, supply chain management, and marketing strategies to increase company competitiveness by developing better customer values.

Additionally, to avoid rejecting a product for recycling or reusing the products, two factors must be considered, which are people's attitudes toward environmental protection and the quality or safety of the product (Sun et al., 2018). Thus, the researcher was studied the consumer value consideration of remanufactured products in the aspect of perceived benefit on environmentally benefits and perceived sacrifice on perceived risks. At the same time, this research contributed to consumers' concerns and views when trying or adopting the remanufactured products. In addition, this study extends the line of research that attempts to understand and explain why the consumer rejects or does not try to adopt the remanufactured products in life.

Therefore, to ensure that the quality and safety of products using recycled materials are adequately understood, the legislation needs to collaborate with the industry. Education, taxes, subsidies, regulations, support for research, and public awareness campaigns are a few of the approaches to promote remanufactured products. For example, a public awareness program showing how remanufactured products are produced. At the same time, the government can advertise those recycled products are worthwhile and safe to use. This is due to the possibility that policies intended to promote products made from recycled or reused materials could be unsuccessful if actions are not taken to correct widespread misconceptions about products made from recycled or reused raw materials.

Limitation of Study

There are some limitations to the conduct of this study, such as time constraints and respondents' knowledge of remanufactured products. Firstly, the time it takes to collect data from all respondents does take some time. It took about a month to get respondents' answers. Secondly, respondents' knowledge of remanufactured products was one of the limitations of this study. Knowledge of the remanufacturing process may influence respondents when they fill out the questionnaires.

Recommendations for Future Research

Future research should examine other factors that may influence the adoption of remanufactured products, such as consumer perceived value with purchase intention to further develop the emerging mid-range theory. This is because the research may be improved by identify additional independent and original variables in the construction. Perceived sacrifice on perceived risks was newly discovered additional independent variables in this study. In the future, other pioneers should be encouraged to explore more. Secondly, to determine whether the research model can be applied to other markets or countries, external aspects such as market differences, economic differences, and even cultural differences in the remanufacturing industry should be investigated.

Thirdly, consumers' willingness to adopt the remanufactured products is also influenced by other factors, such as recycling knowledge. It may involve some marketing tactics, such as advertising. Although some researchers have incorporated such green advertising into remanufacturing studies (Zeng et al., 2022), but the researchers have focused on how consumers' purchasing preferences change, rather than their willingness to recycle. Hence, it's still interesting and important to integrate other operations related to recycling realization with consumers' intention to adopt the remanufactured products.

In addition, the researchers believe that there is still considerable room for future research, such as in-depth research on the relationship between online and offline word-of-mouth in social media and its impact on consumers' decision-making process for purchasing or adopting remanufactured products. Furthermore, referring to Zhang et al. (2022), trade old for remanufactured has become a marketing tool to promote product recycling. Extended Warranty Services are used to facilitate recycling of end-of-life products. Therefore, the relationship between the optimal extended warranty service strategy and the adoption of remanufactured products in the supply chain industry can be used as one of the directions for further research.

Conclusion

In this study, with the rapid development of technology, electronic products are updated faster compared to before, causing many countries to engage with the growing problem of e-waste. Therefore, to reduce environmental pollution and e-waste, remanufacturing plays an important role for the consumer value considerations of remanufactured products in supply chain industry (Jiang et al., 2019). Remanufacturing is one of the closed-loop manufacturing activities that recovers components that are still working properly to recover the residual value of discarded items (Wang et al., 2018a). In addition, there is many remanufactured products around the world, including laptops, machine tools, electrical or electronic products, mobile phones, and computers (Testa et al., 2021).

There were two research objectives derived from these formulation of problem statements, which are to examine the consumer value considerations of remanufactured products and to determine the most critical consumer value considerations which impact the adoption of remanufactured products in supply chain industry. Moreover, this study adopted a quantitative and explanatory research design. Moreover, the researcher used the diffusion of innovation (DOI) theory as a foundational framework to determine the impact of consumer value considerations on the remanufactured products using three independent variables, which were perceived benefit on environmental benefits, perceived benefit on price advantages, and perceived sacrifice on perceived risk. While the dependent variable of this study was the adoption of remanufactured products.

After data collection and data analysis, the results showed that all the three independent variables, the perceived benefit on environmental benefits, perceived benefit on price advantages, and perceived sacrifice on perceived risk will be positively related to the adoption of remanufactured products. However, the most critical consumer value considerations which impact the adoption of remanufactured products in supply chain industry was perceived benefit of price advantage, with significant value $0.000 < 0.05$ and $\beta = 0.33$. Based on the above results, the researcher can draw some insights. Firstly, the researcher believed that the concept of remanufactured products is often viewed as green, and consumers who use green products tend to be more concerned about their environmental benefits. Secondly, based on this finding result, because remanufactured products are more like new products, generally lower prices of remanufactured products will attract consumers to buy and use them rather than new products. Thirdly, although individuals are rarely willing to make sacrifices for the greater good. However, Hull et al (2022) reported that the issue of sustainability is becoming more pressing on the minds of consumers. Therefore, like the findings of this research, most respondents were willing to adopt remanufactured products, even though the perceived sacrifice of perceived risk on remanufactured products is higher.

In conclusion, this study reviewed the literature on the theory and practice of consumer relation on remanufactured products, which is critical to the success of closed-loop supply chains and achieving the goals of acceptability of remanufactured products. This research aims to examine consumer value considerations for remanufactured products and to determine the most critical consumer value considerations that influence the adoption of remanufactured products in supply chain industries. This research can be used as a foundation for theoretical development regarding the role of consumers in closed-loop supply chain (CLSC). In fact, consumer perceptions of value and intent to adopt remanufactured products derived from the CLSC process are current bottlenecks that need to be addressed. The interplay between diffusion of innovation (DOI) theory with perceived benefits and perceived sacrifice provide a unique perspective on this issue. Besides that, the theory developed in this paper provides a useful basis for additional and much-needed research in this area, especially to the supply chain field.

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