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Reimagining Sustainability: Examining Consumer Awareness and Behavior towards Purchasing Remanufactured Products

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Remanufacturing and utilizing remanufactured products are key indicators of a country's sustainability efforts due to their significant potential to reduce carbon emissions. The Kingdom of Saudi Arabia has prioritized this area as part of its Vision 2030 goals. While studies have examined consumer behavior toward remanufactured products in countries such as China and India, limited research has explored awareness and behavior in emerging markets pursuing strategic sustainability visions. This study investigates consumer awareness and purchasing behavior toward remanufactured products in Saudi Arabia, an emerging market committed to sustainability under Vision 2030. It introduces a new construct, consumer-suggested facilitators, capturing strategies proposed by consumers to enhance acceptance of remanufactured products—extending prior research in this field. A structured survey with a comprehensive questionnaire was conducted to assess factors influencing awareness, trust, and behavior toward remanufactured products. Findings show a significant correlation between consumer awareness and trust ($r = 0.335$, $p < 0.001$) and between perceived cost-benefits and knowledge of product channels ($r = 0.465$, $p < 0.001$). The results highlight the need for strategic marketing initiatives, educational campaigns, and supportive policies to accelerate remanufactured product adoption. Insights from this research help optimize supply chain strategies and consumer engagement approaches in the remanufacturing industry.

Keywords: Correlation analysis, Industrial engineers, Kingdom of Saudi Arabia, Remanufacturing, Sustainability

Introduction

For the past few decades, the ongoing discussion about sustainability has been prominent and growing. The beginning of the 21st century has been recorded as the start of the significant acceleration of this topic. This is due to the increase in awareness of the threats that might impact future generations from several aspects[1], which encompass the economy, environment, and society, see Fig. 1. According to a United Nations report, it is essential to ensure long-term environmental balance and economic resilience by following Sustainable Development Goals.[2] Therefore, researchers and governments have focused on finding solutions that would assure sustainability.

Remanufacturing, which is an industrial process, involves the conversion of worn-out products to remanufactured products that are considered to be in like-new conditions.[3,4] The common steps involved in remanufacturing are collecting end-of-life products, disassembly, sorting and cleaning, replacement of worn-out parts, inspection, and reassembly. The process flow of remanufacturing is demonstrated in Fig. 2, where the term 'core' refers to used products—a definition that aligns with prior interpretations in the literature.[5] Remanufactured products and their industry are promising solutions that align with the idea of sustainability. The growing interest is largely driven by the considerable value these products offer across economic, ecological, and societal dimensions. Economically, the European market is estimated to generate between $ 84 – 120 billion from remanufactured products by 2030. This is beside the social benefits, as 600,000 job opportunities will be created.[6] Environmentally, it is estimated that the

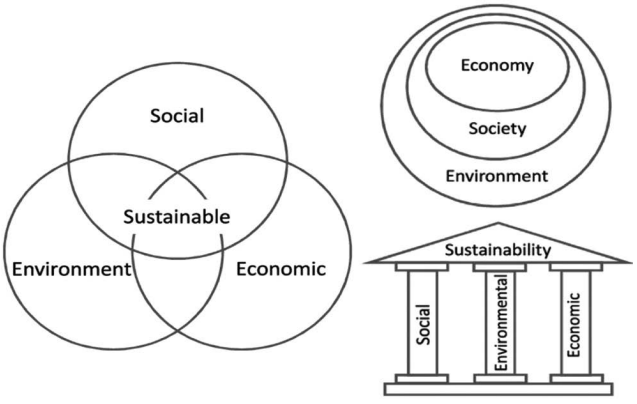

Fig. 1 — Sustainability aspects and pillars[1]

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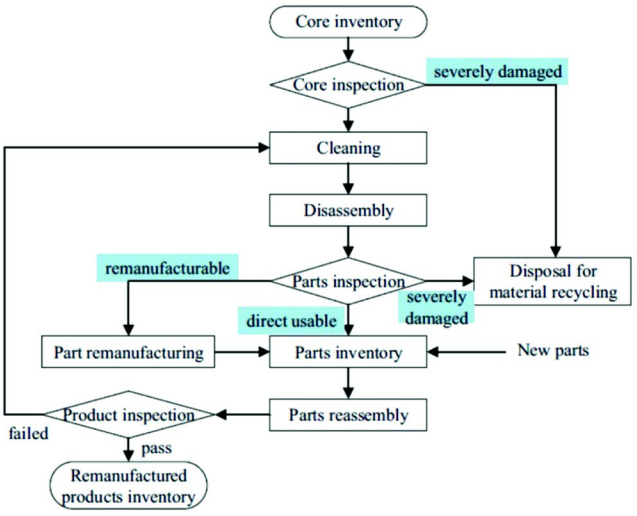

Fig. 2 — Remanufacturing process for a cell phone[5]

contribution to reducing the potential of global warming by remanufacturing mechanical products is at least 50%. Xerox Corporation reported that around $ 200 million was saved due to remanufacturing photocopying machines. In the same way, Caterpillar Inc. generated about $ 2 billion from practicing remanufacturing of several products, including but not limited to engines, transmissions, and hydraulic parts.[7]

In the same context, the Kingdom of Saudi Arabia (KSA) is also one of the nations that is committed to integrating remanufacturing into their industry. This is due to the realization of its importance in the transition to more sustainable practices, which would guarantee a greener future for their generation. As we have witnessed, many programs have been promoted for this purpose, such as the National Industrial Development and Logistics Program as part of the Saudi Vision 2030. The kingdom has shown interest in starting and developing its remanufacturing capabilities in different sectors, for example, remanufacturing automotive products, including engines, transmissions, and braking systems. Remanufacturing industrial equipment and electronics is another example of where the kingdom aims to excel in the near future.

While the broader recognition of remanufacturing and remanufactured products across various regions is well acknowledged, adopting and accepting remanufactured products is a very crucial aspect that needs further investigation in the nascent marketplace.[8] Most of the studies have been devoted to understanding and study the purchasing behavior of remanufactured products in countries such as China, India, and members of the European Union, which are mature remanufacturing markets. This motivates us to delve into and explore the consumer behavior toward purchasing and trusting the remanufactured products in the KSA. The remanufacturing market in the KSA is a rapidly developing market with growing sustainability ambitions under Vision 2030**.** In this paper, we conducted a study to test awareness, trust levels and purchasing behavior of remanufactured products in the KSA. Our study also examines factors consumers believe could increase the popularity and acceptance, which few studies have considered, if any. Therefore, the research question of our paper is "What is the current level of consumer awareness, trust, and purchasing behavior toward remanufactured products in Saudi Arabia, and what factors are associated with these behaviors?".

Understanding consumer behavior toward these products is very important for all stakeholders. Industrial engineers, specifically, would benefit as it contributes to understanding more details about the demand, which would help in optimizing the supply chain. Additionally, it would generate concepts that would also help in optimizing the pricing strategies.

The paper proceeds with a review of the literature, followed by the research methodology, results and their analysis, a critical discussion, and a concluding section that highlights limitations and proposes avenues for future investigation.

Literature Review

Since the late last century, the terminology of remanufacturing has been defined as a controlled industrial process that renews used products to a state equivalent to new, ensuring similar performance standards, quality, and warranty coverage.[9,10] Remanufactured products have vast benefits, promoting a sustainable solution that supports both the economy and the environment. Economically, the incurred cost of remanufactured products is typically 40%–65% less than that of new products.[11,12] Andrew-Munot, Ibrahim, and Junaidi claimed that this reduction is due to using, retrieving, or recovering components, which is generally less costly than producing new ones.[13] Their findings were supported by the All-Party Parliamentary Sustainable Resource Group, which compared input costs, labour costs, and gross profit between remanufactured and new products (from virgin resources) (Fig. 3). As

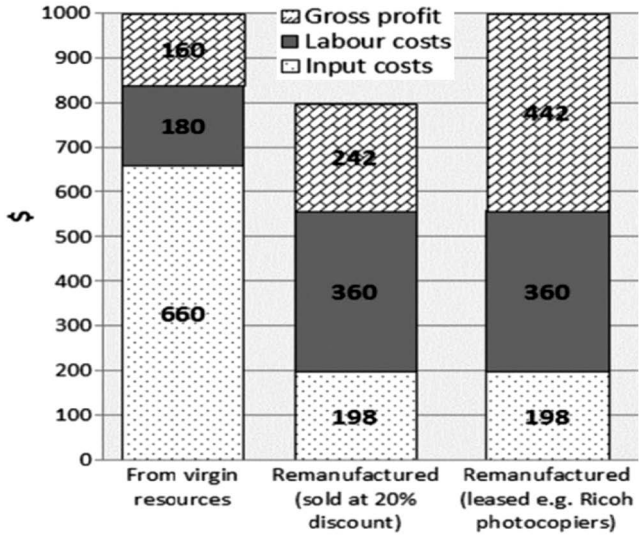

Fig. 3 — Input cost, labour cost, and gross profit comparison between new and remanufactured product

demonstrated in Fig. 3, remanufactured products incur significantly lower input costs and, at the same time, generate more profit due to reduced material and energy requirements. Similarly, Lu *et al*. reported that it is economically beneficial for remanufacturers to sell these products with the same warranty and quality level.[14] Heydari & Ghasemi indicated that new products would have 40%–80% more cost than remanufactured products due to lower material and labor requirements[15], while Hunka *et al*. reported that the production cost of remanufactured products is about 50% less than that of new ones.[16]

From an environmental perspective, remanufacturing reduces material and energy use, which has a direct positive effect on the environment.[17] Feng *et al*. and Zheng noted that it also enables compliance with environmental legislation.[18,9] Numerous studies have demonstrated its impact on reducing gas emissions, waste, and energy consumption.[20–24] For instance, Hunka *et al*. found that remanufactured products produce 80% lower emissions compared with new products[16], while Ma *et al*. highlighted their contribution to reducing greenhouse gas emissions.[17] Researchers have also emphasized social benefits such as job creation, employment opportunities, and consumer affordability.[25,26]

Psychologically, consumer-related constructs provide a promising way to study purchasing behavior[9], as they are defined in the consumer-related constructs sub-section. These include willingness to purchase[27,28], willingness to pay[29,30], and consumer awareness, which stems from product knowledge. Awareness influences purchasing intention by shaping perceptions of cost, quality, and environmental attributes.[31] Wang & Hazen, for example, found that knowledge of cost, quality, and green attributes affected Chinese consumers' decisions, while advertising and product experience served as main sources of knowledge. Similar studies have been conducted across Asia[32–34], with Wang & Kuah surveying eight countries to test purchasing intention, awareness, perceived quality, and environmental consciousness.[35] De Silva, Wang, and Kuah extended these variables to the UK and China, focusing on remanufactured electronics.[36] Chen, Wang and Jia compared remanufactured, refurbished, and new products in China[29], while Chen, Wang, and Yu used hierarchical regression to analyze Chinese consumers' willingness to pay.[37] Other works examined Indonesian[38] and Indian[39] consumers, showing that factors such as attitude, benefits, and risk perception significantly influence acceptance. Abbey *et al*. recommended price reduction as an incentive to improve purchasing behavior.[40]

A limited number of studies discussed purchase behaviors and trust directly.[41–47] For example, Khor & Hazen analyzed consumer intentions in Malaysia, while Wang *et al*. studied familiarity and ambiguity tolerance in China. In Saudi Arabia, Aldoukhi conducted a descriptive study on awareness of remanufactured products.[48] To the best of authors knowledge, no previous study has comprehensively examined consumer-related constructs such as awareness, purchasing behavior, and trust within the Saudi context. Moreover, few studies have considered consumer perspectives on factors that could increase acceptance. This study addresses that gap by designing a structured questionnaire that captures awareness and green knowledge (in Awareness and Knowledge section), purchasing behavior and trust (in Purchasing Behavior and Trust section), factors influencing decisions (in Factors Influencing Purchasing Decision section), and a new variable on consumer-suggested facilitators (in Facilitate the Popularity and Development of Remanufactured Products section).

Methodology

To conduct our study, an online survey was distributed targeting university communities in Saudi Arabia. This is due to the benefit of such a community involving a diverse range of characteristics, their

accessibility, as well as relatively high awareness of environmental and sustainability topics, which is relevant when studying perceptions of remanufactured products.

We developed a questionnaire to measure variables that are associated with demographic and consumer-related constructs, as illustrated in the consumer-related constructs subsections. The developed questionnaire is generated based on the studies conducted by Cao *et al*., Chen, Wang & YU, Wang & Kuah, as well as Chinen & Matsumoto.[35,37,38,49]

One of the most effective methods for verifying a survey's content is face and content validity, where the questionnaire is reviewed by three subject-matter experts for assessment.[50,51] These experts include two academics specializing in sustainability and one industry marketing and sales expert. Then a pilot study was performed on a sample of the targeted population, which included 30 subjects. Based on this pilot, minor wording adjustments were made to improve item comprehension and layout. The final version incorporated all expert and pilot feedback to enhance overall validity. Also, to ensure that the study clarifies what a remanufactured product is, a statement was introduced giving a clear explanation of what a remanufactured product is.

The participants in this study were selected using a convenience sample, a non-probability sampling method. Given that no eligibility criteria were established for participation, all respondents to the questionnaire were retained for analysis. Nevertheless, the utilization analysis only included participants who were aware.

Formal sample size calculations were not feasible because the survey is targeted at university communities generally in the KSA. Rather, the sample size in this investigation was chosen using a guideline promoted by Comery and Lee.[52] According to the "rule of thumb", 100 = fair, 200 = good, 500 = very good, and >100 is excellent.

The questionnaire was created via the SurveyMonkey platform in English and distributed in February 2024. After collecting the responses, IBM SPSS Statistics for Windows Version 29.0.2.0. is used to analyze the data. Descriptive analysis is first conducted of the demographic characteristics, and then followed by convergent validity. After that, the Chi-Square test between gender and other construct variables is performed, and then the correlation between the construct variables is conducted. Lastly, the correlation between the responses to selected questions is tested. The flow chart summarizing the methodology followed in this research is summarized in Fig. 4.

The authors also adhere to the practiced ethics in which participation in this study is anonymous, confidential, and entirely voluntary. None of the questionnaire responses will be visible or audible to anyone other than the researchers. Although this study is considered low risk due to its anonymous nature and absence of sensitive topics, all participants were informed about the purpose of the study and were made aware that their responses would be used for research purposes, with full freedom to complete the survey. Additionally, ethical approval for the study was granted by the Ethics Committee of Al Yamamah University.

Demographical Characteristics

It refers to the statistical characteristics of the participants of the study. It is very important in our study to understand these characteristics, as there are many insights that can be obtained such as the age of the participants. Here, it includes the gender, age, education level, major of study, occupation, and the major of study of the participants in the study.

Consumer-Related Constructs

They are theoretical concepts that study the psychological perspective of the consumer towards an object. In this study, the focus is on the following constructs related to remanufactured products: awareness and knowledge, purchasing behavior and trust, and factors influencing purchasing decisions.

This study draws on the Theory of Planned Behavior (TPB)[53] as an overarching framework to explain the relationships among consumer-related constructs. According to TPB, awareness contributes to shaping consumer attitudes toward products, which in turn influence behavioral intentions. In the context of remanufactured products, greater awareness provides the knowledge base that fosters positive attitudes, while trust reduces perceived risk and uncertainty, thereby strengthening intention to purchase. Purchasing behavior reflects the outcome of these processes, linking awareness and trust with actual decisions. By structuring our constructs within this behavioral framework, the study conceptually integrates awareness, trust, and behavior, highlighting their interdependence in shaping consumer adoption of remanufactured products. A framework to structure the relationships among constructs used in our study is presented in Fig. 5

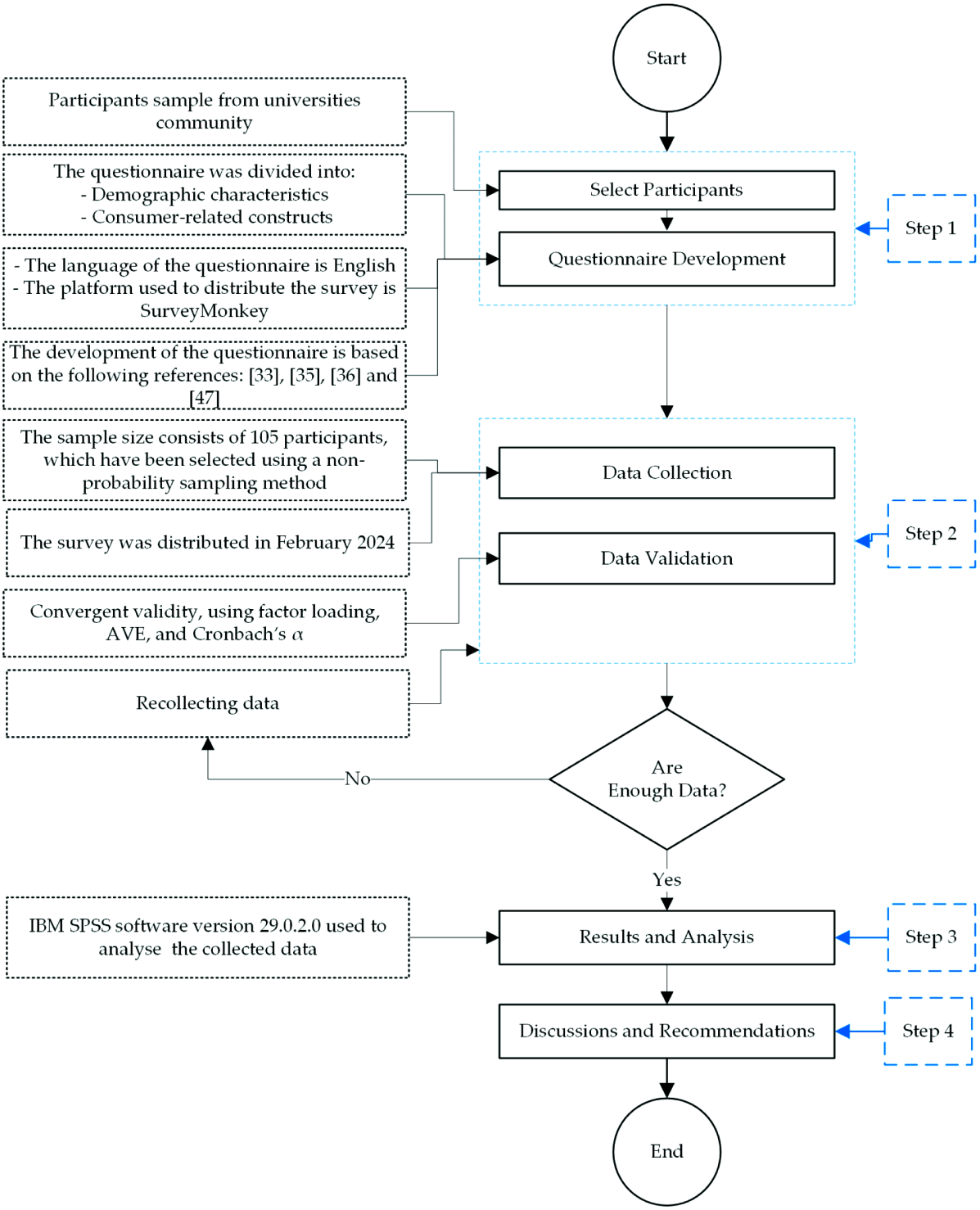

Fig. 4 — Research methodology

Awareness and Knowledge

It is a construct that aims to test the level of awareness and knowledge of the participants of the study via different construct variables. The variables to test this construct are if they have heard about remanufactured products before, and which channels helped them to learn about these products.

Purchasing Behavior and Trust

This tests the behavior towards purchasing these products, such as whether the consumer purchased these products before, as well as where they intend, or trust, to purchase these products from. Two construct variables are used to test legitimately the behavior and trust toward purchasing remanufactured products; directly asking if they purchased a remanufactured product before, as well as the channels that offer remanufactured products that you trust.

Factors Influencing Purchasing Decision

This is to test the factors that consumers might take into account when purchasing the remanufactured products. To evaluate this construct, construct variables are determined by asking the following questions: what factors prevent consumers as well as, what makes it the first choice to purchase these products, whether the remanufactured products are cheaper than the new products, and by what percentage.

Facilitate the Popularity and Development of Remanufactured Products

This is an independent variable that is used to check what can make the remanufactured products more popular in the KSA.

Results

As shown in Table 1, the demographic characteristics are demonstrated for our study, where the number of participants in the questionnaire is 105. Around 63% of the participants' gender is male, and the rest of 37% are female. In terms of the participant's age, the majority of participants are aged 18-24 years old, with about 49%. It is found that around 37% of those aged 18-24 years old are male and 63% are female. An undergraduate degree is the education level of most of the participants in our study with 51%. This would align and support the internal consistency and correctness of our study since

Table 1 — Demographic characteristics

Demographic characteristics (N = 105)

Variable	Variable groups	%
Gander	Male	62.9%
	Female	37.1%
Age	18–24	49.5%
	25–34	19.0%
	35–44	20.0%
	45–54	7.6%
	55–64	3.8%
Education Level	High school graduate	14.3%
	Postgraduates	34.3%
	Undergraduate degree	51.4%
Major	Arts and Humanities	1.9%
	Business	8.6%
	Health and Medicine	19.0%
	Science, Technology, Engineering, and Math (STEM)	61.0%
	Others	9.5%
Income	Below 5,000	43.8%
	10,000–15000	7.6%
	15,000–20,000	7.6%
	5,000–10,000	19.0%
	Above SR 20,000	21.9%

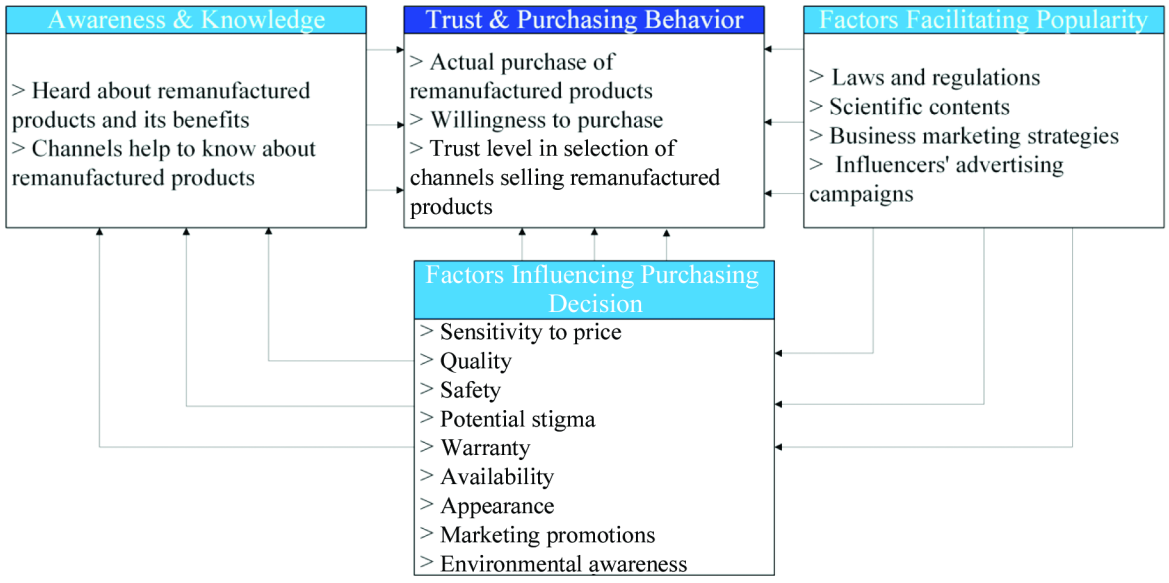

Fig. 5 — A structured framework of the relationships among constructs

the majority of the study participants are aged 18-24 years old. At the same time, the education level of the majority of participants is an undergraduate degree. About 62% of the participants in the study are Science, Technology, Engineering and Math (STEM) majors, which is considered the majority major compared to other majors. Most of the participants are still students, and they account for 40% versus other occupations.

To test the degree of different measures or questions that test a certain construct variable, convergent validity is used. Here, three indicators are utilized, which are Factor Loading, Average Variance Extracted (AVE), and Cronbach's α. Factor Loading is a measurement to assess how strongly a question assesses or is associated with a construct variable. Additionally, AVE measures the variance captured by the construct variable relative to the measurement error, while Cronbach's α measures the internal consistency reliability of a construct variable. For more information about Factor Loading, AVE, and Cronbach's α, we refer the reader to Podsakoff & Organ.[54] As shown in Table 2, all the questions scored above 0.5 for the factor loading, which means they have an acceptable association with the construct variable they assess. Additionally, scoring 0.6 for the AVE of the awareness and knowledge construct variable indicates that the variance captured by the measurement error is acceptable. However, the questions asked to evaluate purchasing behavior and trust, and factors influencing purchasing decisions they are almost acceptable since the AVE score is 0.4. While this value is marginally acceptable in exploratory research, it may indicate that the items explain less variance in the underlying construct than ideal. Regarding Cronbach's α, all the construct variables scored 0.7, except the 0.6 score for purchasing behavior and trust construct variable, which demonstrates that measuring the internal consistency reliability is acceptable or almost acceptable.

Table 2 — Convergent validity

Construct variable	Questions	Factor loading	AVE	Cronbach's α
Awareness and knowledge	AK1	0.6	0.6	0.7
	AK2	0.8		
Purchasing behavior and trust	PBT1	0.7	0.4	0.6
	PBT2	0.5		
Factors influencing purchasing decision	FIPD1	0.7	0.4	0.8
	FIPD2	0.6		
	FIPD3	0.7		
	FIPD4	0.7		

As presented in Table 3, the results of a Chi-square test examining the relationship between gender and several other construct variables (AK1, AK2, PBT1, PBT2, FIBD1, FIBD2, FIBD3, FIBD4, and F). The table shows the Chi-square statistic ("Value"), the degrees of freedom ("df"), and the p-value ("Asymp. Sig. (2-sided)") for each variable. A p-value less than 0.05 is typically considered statistically significant, indicating a likely association between gender and that specific variable. In this case, only PBT2 shows a statistically significant association with gender (p=0.002). This means people's perceptions of whether remanufactured goods are always less expensive than new ones are influenced by their gender. The other variables do not demonstrate a significant relationship with gender based on these Chi-square test results.

The Pearson's correlation coefficient (r) and the associated p-value (p) for each pair of variables are calculated. A correlation coefficient between +1 and +0.5 ($1 \geq r \geq 0.5$) indicates a strong positive correlation, between +0.5 and +0.3 ($0.5 > r \geq 0.3$) indicates a moderate positive correlation, and between +0.3 and +0.1 ($0.3 > r \geq 0.1$) indicates a weak positive correlation. Similarly, a correlation coefficient between −1 and −0.5 ($-1 \leq r \leq -0.5$) indicates a strong negative correlation, between −0.5 and -0.3 ($-0.5 < r \leq -0.3$) indicates a moderate negative correlation, and between −0.3 and −0.1 ($-0.3 < r \leq -0.1$) indicates a weak negative correlation. The asterisks denote statistical significance: ** indicates significance at the 0.01 level, and * indicates significance at the 0.05 level.

Table 3 — Chi-Square test between gender and variables

Variable	Value	df	Asymp. Sig. (2-sided)
AK1	0.147	1	0.702
AK2	21.109	18	0.274
PBT1	2.990	1	0.084
PBT2	41.177	19	0.002
FIBD1	10.728	10	0.379
FIBD2	1.144	1	0.285
FIBD3	21.880	16	0.147
FIBD4	1.370	3	0.713
F	9.107	10	0.522

AK1 & AK2 = Awareness and knowledge, PBT1 & PBT2 = Purchasing behavior and trust, FIBD1 – FIBD4 = Factors influencing purchasing decision, F = Popularity facilitation

Pearson's correlations, shown in Table 4, between several variables (AK1, AK2, PBT1, PBT2, FIPD1, FIPD2, FIPD3, FIPD4, and F). Here, AK1 has a statistically significant moderate positive correlation with AK2 ($r = 0.308$, $p = 0.001$), meaning that knowledge of remanufactured product channels (AK2) is higher among those who are aware of remanufactured items (AK1). PBT1 and AK1 are also statistically significantly correlated ($r = 0.301$, $p = 0.002$), in which the probability of buying remanufactured goods (AK1) is moderate positively correlated with awareness of them (PBT1). This implies that raising awareness might promote buying. Another statistically significant moderate correlation is observed between PBT2 and AK2 ($r = 0.335$, $p < 0.001$), where the increased trust in remanufactured items (PBT2) is linked to higher awareness about remanufactured product channels (AK2). Providing customers with information about reliable sources may increase confidence. FIPD1 has a statistically significant moderate positive correlation with AK2 ($r = 0.465$, $p < 0.001$), meaning that perceptions of cost-benefits (FIPD1) are significantly influenced by knowledge regarding remanufactured goods channels. It is essential to educate individuals about cost benefits. F and AK2 are significantly moderately positively correlated ($r = 0.353$, $p < 0.001$), in which opinions on how to promote the appeal of remanufactured products are favorably correlated with knowledge about their distribution channels. Initiatives to market remanufactured items are likely to be supported by knowledgeable individuals. The same thing also applies between F and PBT2, FIPD1, and FIPD3.

The correlation between the choices for the AK2 variable is demonstrated in Table 5. It is found that there is a significant weak positive correlation ($r = 0.278$, $p = 0.004$) between the choices Television/Broadcast Advertisement (AK2.2) and Original Manufacturer Platforms (AK2.4), which represents an indication that people are more likely to look at Original Manufacturer platforms for information on remanufactured products if they rely on broadcast or television ads. Thus, it is a potential strategy to increase the awareness of consumers about remanufactured goods is to combine direct manufacturer information with television commercials. Another significant weak positive correlation ($r = 0.264$, $p = 0.006$) is observed between Research Papers (AK2.6) & Expert Discussions (AK2.7). This suggests that looking for in-depth, technical information about remanufactured products may be especially pertinent through these channels.

The correlation between the choices of the PBT2 variable is illustrated in Table 6. Remanufacturing Enterprises (PBT 2.3) and Nationally Licensed Third Parties (PBT 2.4) have a significant moderate positive correlation ($r = 0.384$, $p < 0.001$). It suggests that those who trust in remanufacturing companies also trust in national government-licensed third parties.

Table 4 — Correlations between variables

		AK1	AK2	PBT1	PBT2	FIPD1	FIPD2	FIPD3	FIPD4	F
AK1	r	1								
	Sig.(2-tailed)									
AK2	r	0.308**	1							
	Sig.(2-tailed)	0.001								
PBT1	r	0.301**	0.100	1						
	Sig.(2-tailed)	0.002	0.309							
PBT2	r	0.003	0.335**	0.006	1					
	Sig.(2-tailed)	0.980	0.000	0.951						
FIBD1	r	0.054	0.465**	−0.080	0.203*	1				
	Sig.(2-tailed)	0.584	0.000	0.415	0.038					
FIBD2	r	0.124	−0.009	0.179	0.191	−0.102	1			
	Sig.(2-tailed)	0.207	0.929	0.068	0.051	0.298				
FIBD3	r	0.062	0.345**	−0.126	0.184	0.510**	−0.141	1		
	Sig.(2-tailed)	0.532	0.000	0.200	0.060	0.000	0.151			
FIBD4	r	0.095	0.060	−0.007	−0.023	0.037	−0.212*	0.047	1	
	Sig.(2-tailed)	0.333	0.542	0.944	0.815	0.704	0.030	0.635		
F	r	0.034	0.353**	−0.129	0.325**	0.315**	−0.037	0.368**	0.002	
	Sig.(2-tailed)	0.728	0.000	0.191	0.001	0.001	0.710	0.000	0.984	

**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed)

Table 5 — Correlations between AK2 options

		AK2.1	AK2.2	AK2.3	AK2.4	AK2.5	AK2.6	AK2.7
AK2.1	r	1						
	Sig.(2-tailed)							
AK2.2	r	−0.152	1					
	Sig.(2-tailed)	0.121						
AK2.3	r	0.065	−0.079	1				
	Sig.(2-tailed)	0.509	0.420					
AK2.4	r	−0.038	0.278**	0.159	1			
	Sig.(2-tailed)	0.704	0.004	0.106				
AK2.5	r	0.118	−0.013	0.115	0.088	1		
	Sig.(2-tailed)	0.230	0.893	0.242	0.370			
AK2.6	r	−0.169	0.045	0.014	0.075	0.098	1	
	Sig.(2-tailed)	0.084	0.649	0.885	0.448	0.322		
AK2.7	r	−0.147	−0.146	−0.032	0.018	0.115	0.264**	1
	Sig.(2-tailed)	0.135	0.138	0.744	0.855	0.242	0.006	

** Correlation is significant at the 0.01 level (2-tailed); AK2.1 = Friends and relatives, AK2.2 = Television or broadcast advertisement, AK2.3 = Retailer stores, AK2.4 = Original manufacturer platforms, AK2.5 = Other online or social media platforms than original manufacturer, AK2.6 = Research papers and scientific publications, AK2.7 = Discussion topics with experts inside or outside the university environment

Table 6 — Correlations between PBT2 options

		PBT 2.1	PBT 2.2	PBT 2.3	PBT 2.4	PBT 2.5	PBT 2.6	PBT 2.7
PBT 2.1	r	1						
	Sig.(2-tailed)							
PBT 2.2	r	−0.075	1					
	Sig.(2-tailed)	0.445						
PBT 2.3	r	−0.051	−0.043	1				
	Sig.(2-tailed)	0.609	0.666					
PBT 2.4	r	0.094	0.034	0.384**	1			
	Sig.(2-tailed)	0.342	0.727	0.000				
PBT 2.5	r	−0.150	0.080	0.154	0.016	1		
	Sig.(2-tailed)	0.126	0.419	0.116	0.872			
PBT2.6	r	0.000	0.026	−0.076	−0.007	−0.058	1	
	Sig.(2-tailed)	1.000	0.789	0.439	0.944	0.556		
PBT 2.7	r	0.018	−0.098	−0.026	0.101	−0.111	0.155	1
	Sig.(2-tailed)	0.853	0.320	0.793	0.303	0.258	0.113	

** Correlation is significant at the 0.01 level (2-tailed); PBT2.1 = Original manufacturer, PBT2.2 = Retailer stores, PBT2.3 = Remanufacturing enterprises, PBT2.4 = Third parties who get the national license of remanufacturing, PBT2.5 = Maintenance and repair stations, PBT2.6 = Online stores, PBT 2.7 = Friends and relatives

Government accreditation appears to strengthen confidence in remanufacturers.

The correlation between the choices of the FIPD variable is presented in Table 7. A significant weak negative correlation is found between Quality Concern (FIPD1.1) and Product availability (FIPD1.5) ($r = -0.240$, $p = 0.014$). It suggests that those who trust in remanufacturing companies also trust in national government-licensed third parties. Government accreditation appears to strengthen confidence in remanufacturers. This implies that people are less likely to view availability as a top concern if they believe that remanufactured products have quality problems. People may already reject remanufactured products if they think the quality is subpar, so availability isn't even a consideration for them.

The correlation between the choices for the FIPD 3 variable is demonstrated in Table 8. It is found that there is a significant weak positive correlation ($r = 0.212$, $p = 0.030$) between the choices of Marketing promotions (FIPD3.3) and Appearance (FIPD3.2). This shows that those who place a high value on looks also react favorably to advertising campaigns. Thus, visual appeal in marketing campaigns or branding initiatives that emphasize a product's novel appearance may have an impact on consumers. Additionally, After-Sale Service (FIPD3.5) and Sales

Table 7 — Correlations between FIPD1 options

		FIPD1.1	FIPD1.2	FIPD1.3	FIPD1.4	FIPD1.5
FIPD1.1	r	1				
	Sig.(2-tailed)					
FIPD1.2	r	−0.093	1			
	Sig.(2-tailed)	0.347				
FIPD1.3	r	−0.058	−0.045	1		
	Sig.(2-tailed)	0.558	0.648			
FIPD1.4	r	−0.109	−0.032	0.157	1	
	Sig.(2-tailed)	0.267	0.743	0.111		
FIPD1.5	r	−0.240*	−0.163	−0.039	−0.033	1
	Sig.(2-tailed)	0.014	0.096	0.693	0.738	

*Correlation is significant at the 0.05 level (2-tailed); FIPD1.1 = The quality of remanufactured products is not the same as that of new products, FIPD 1.2 = The safety of remanufactured products, FIPD 1.3 = The potential stigma associated with buying a pre-owned or remanufactured product, FIPD1.4 = The after-sales service, FIPD 1.5 = It is not available

Table 8 —Correlations between FIPD3 options

		FIPD3.1	FIPD3.2	FIPD3.3	FIPD3.4	FIPD3.5	FIPD3.6	FIPD3.7
FIPD3.1	r	1						
	Sig.(2-tailed)							
FIPD3.2	r	−0.069	1					
	Sig.(2-tailed)	0.487						
FIPD3.3	r	0.043	0.212*	1				
	Sig.(2-tailed)	0.666	0.030					
FIPD3.4	r	−0.057	0.120	−0.128	1			
	Sig.(2-tailed)	0.563	0.223	0.194				
FIPD3.5	r	0.054	0.165	0.151	0.054	1		
	Sig.(2-tailed)	0.587	0.092	0.125	0.587			
FIPD3.6	r	0.023	0.173	0.176	0.115	0.197*	1	
	Sig.(2-tailed)	0.816	0.077	0.073	0.244	0.044		
FIPD3.7	r	0.130	0.095	0.006	0.016	0.187	0.064	1
	Sig.(2-tailed)	0.185	0.335	0.955	0.869	0.056	0.520	

*Correlation is significant at the 0.05 level (2-tailed); FIPD3.1 = Low price, FIPD3.2 = Appearance, FIPD3.3 = Marketing promotions, FIPD3.4 = Availability, FIPD3.5 = After-sale service, FIPD3.6 = Sale channel, FIDPD3.7 = Environmental awareness

Channel (FIPD3.6) are significantly weakly positively correlated (r = 0.197, p = 0.044), which indicates an association in the level of trust between the after-sales services support and where to buy these products from.For sale channels that experience issues selling remanufactured products, it might be helpful for them to improve their after-sale services.

Discussion

In this section, interpretations of the findings are presented and discussed at the construct level in light of previous studies.

The correlation analysis between the constructs reveals several noteworthy relationships. First, a moderate positive correlation was found between awareness/knowledge and purchasing behavior/trust (r = 0.41). This suggests that as consumers become more informed and aware of remanufactured products, their trust and likelihood to purchase also increase. This finding aligns with prior studies[34] that emphasize the importance of awareness in promoting environmentally conscious consumption.

Similarly, factors influencing purchasing decisions (such as quality, safety, price, and environmental concern) showed a moderate correlation with both AK (r = 0.37) and PBT (r = 0.45), indicating that consumers' perceived value and risk perceptions are central to both their understanding and trust in remanufactured goods. This supports prior literature suggesting that product-related attributes and consumer confidence are interlinked in forming behavioral intentions.[35,36]

The variable F, introduced in this study to capture consumer-identified facilitators for the adoption of remanufactured products (such as marketing, education, or policy support), demonstrated positive but slightly weaker correlations with AK (r = 0.29), PBT (r = 0.32), and FIPD (r = 0.39). While these are

still meaningful, they indicate that facilitating factors might play a supporting role, rather than a primary one, in shaping consumer behavior. This is a novel contribution of the study, as few works in the remanufacturing literature have explored consumer-proposed mechanisms to increase product acceptance.

Conclusions

This study explored key factors influencing consumer acceptance of remanufactured products in Saudi Arabia, focusing on awareness, trust, purchasing behavior, and consumer-suggested facilitators. The findings reveal that informed consumers are more likely to trust and purchase remanufactured goods, supporting the need for awareness-driven strategies. Quality concerns and lack of transparency were noted as barriers, yet manageable through policy support and clearer communication. A novel construct was introduced to capture consumer input on improving acceptance, offering practical insights for firms and policymakers in the circular economy space. Limitations include the use of convenience sampling, which limits demographic diversity and generalizability—especially to older or non-academic consumers. Additionally, one construct's AVE value fell slightly below the recommended threshold, affecting convergent validity. Future research should adopt broader sampling strategies, refine measurement tools, and explore evolving behaviors through longitudinal studies or product-specific analyses.

Declaration of Interest

The author declares that they have no conflict of interest.

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