

# **Usage Awareness of Remanufactured Products: A Case Study from the Kingdom of Saudi Arabia**

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## **Abstract**

It is undeniable how remanufactured products provide a promising solution that would reduce the burden on the environment and enhance sustainability solutions. However, in countries like the Kingdom of Saudi Arabia, which are developing in a high-speed pattern, the usage of remanufactured products is still in its early stages. This study aims to assess the awareness and utilization of the remanufactured products as well as addressing the factors that prevent people in the kingdom from using these products. Studying remanufactured product awareness and utilization in Saudi Arabia can support sustainability, resource efficiency, economic growth, and policy formulation for sustainable consumption and production. Among university students, faculty members, engineers and non-engineers, a total of 57 participants completed a validated questionnaire survey. The survey contained two parts; questions aimed to collect demographic information about the participants and questions to test awareness, usage, and willingness to purchase remanufactured products, as well as factors that impact the decision to purchase remanufactured products. Descriptive analysis was used to describe and summarize the research dataset we obtained. Our analysis indicated that 31.58% purchased remanufactured products while 68.42% did not have the opportunity to buy a remanufactured product before. However, the remanufacturing industry and products will have a bright future in the Kingdom of Saudi Arabia as long as more promotions are shared on social media on these products and keep a large price difference compared with the new products.

## **Keywords**

Kingdom of Saudi Arabia, Questionnaire, Remanufacturing.

## **1. Introduction**

The burden on the environment has reached a level where creative solutions should be introduced to reduce it. Remanufacturing promotes a promising solution that would mitigate the impact on the environment as it extends the product life cycle. This is a true fact since it reduces the usage of resources, provides better control of waste as well as fewer production processes and chemical reactions. In remanufacturing, the products are completely disassembled and some parts are machined to like-new condition, which sometimes includes cosmetic operations as shown in Figure 1.

Globally, the popularity of the remanufactured product has increased over the last few years. This increase has created new potentials from a different perspective. In 2030, it is estimated that the European market would generate from the remanufacturing industry an annual value of \$84 billion-\$120 billion as well as it would create about 600,000 employment opportunities (Parker et al 2015) (Parker et al., 2015).

The Kingdom of Saudi Arabia is a great landscape for remanufacturing. The Saudi Vision 2030 promotes an opportunity for such an industry to grow as one of the top goals and potential of the National Industrial Development and Logistics Program is to develop existing industries and localize promising manufacturing industries. Thus, it is important to understand the awareness and perception of remanufactured products in the area, which can inform the development of this new industry. In this paper, we investigate the awareness of the remanufactured product in the Kingdom of Saudi Arabia.

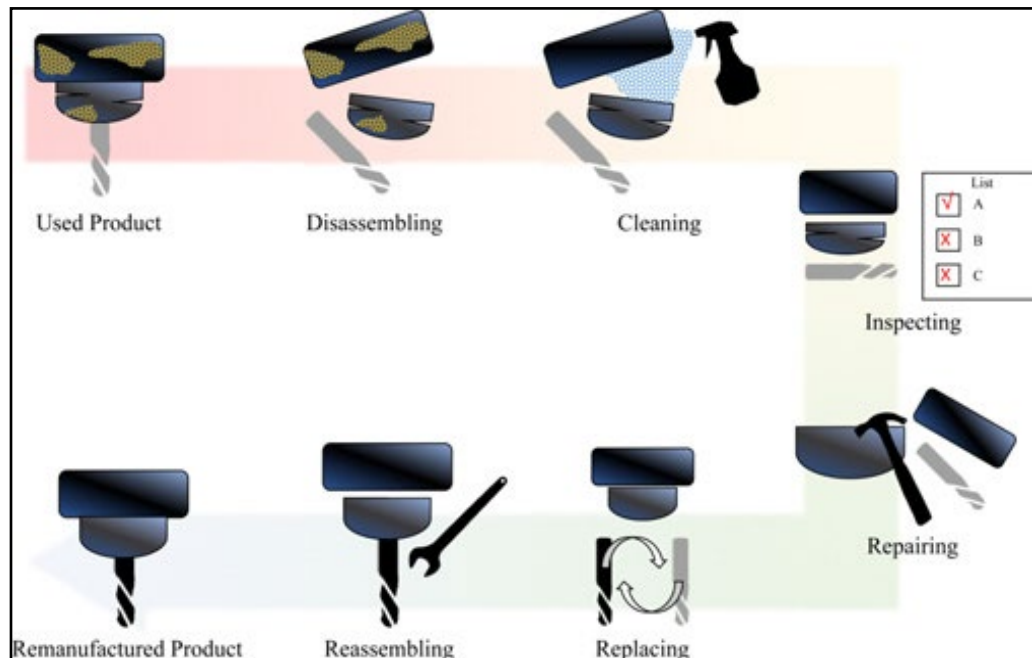


Figure 1. Remanufacturing process (Lee et al 2017) (C.-M. Lee, Woo, & Roh, 2017).

## 2. Literature Review

Remanufacturing is an industrial process involving the conversion of worn-out products into like-new conditions (Aksoy and Gupta 2005), (Kim et al. 2006) (Aksoy & Gupta, 2005; Kim, Song, Kim, & Jeong, 2006). This indicates that remanufacturing consumes less energy and utilizes less material, which has a direct positive impact on the environment (Ma et al. 2020). Many review papers have been presented to discuss the current challenges and suggest future research opportunities in this area (Chakraborty 2021, Belbağ & Belbağ, 2023 & Zhang 2023). According to Hunka et al. (2021), environmental benefits are counted as the main motivation for customers to buy remanufactured products. However, the economic benefits of remanufacturing have been noticed since the first decade of 2000. Xerox Corporation saved around \$200 million by remanufacturing copiers returned at the expiration of their lease contracts (Ferguson 2009). Caterpillar Inc.'s remanufacturing division had over \$2 billion in sales and was the fastest-growing division out of all of its other divisions (Ferguson 2009). Additionally, Heydari and Ghasemi (2018) indicated that the cost of new products is higher by 40-80% than the remanufactured products since the remanufacturing products consume less material and labor. To study the public awareness of using remanufactured products, Cao et al. (2019) conducted a questionnaire survey on Chinese residents. They found that public awareness there of these products is not up to a satisfactory level. Additionally, about 30% of them purchased remanufactured products even though more than 70% of them express their desire to purchase these products. Lee and Kwak (2020) shared a survey with students of a Korean university. The purpose of their survey is to study the level of acceptance of the remanufactured product there according to different product categories and business models. They found that the product categories and business models have a significant impact on the consumer decision of accepting remanufactured products.

The discussed problem in this paper is although the popularity of remanufactured products has increased in the last few years around the world, the awareness of remanufactured products in the Kingdom of Saudi Arabia is still a question that has not been answered yet. Thus, the objective of this paper is to test the familiarity and popularity of remanufactured products with the resident of the kingdom as well as investigate factors that motivate or prevent them to buy remanufactured products.

## 3. Methods

The method utilized in this study is a questionnaire survey, which is a very useful tool to provide valuable insights into the awareness, perceptions, and behaviors related to remanufactured products. The first 6 questions are designed

to ensure a comprehensive understanding of the population's awareness of remanufactured products. It encompasses a diverse range of demographic characteristics, including age, gender, education level, income level, field of expertise and occupation. The remaining 10 questions are closed-ended questions with predefined response options which are designed to gather relevant information about the respondents' awareness, knowledge, and attitudes towards remanufactured products. A pilot test was conducted with experts in the field to test the questionnaire's clarity, comprehensibility, and overall effectiveness. The questionnaire survey was conducted online to ensure the accessibility of the targeted population and it was ensured that the identity of the participants as well as giving the option to withdraw from the study at any time without any consequences.

#### 4. Data Collection

The data were collected from 57 voluntarily valid residents participated in our online questionnaire survey. Table 1 summarizes the demographic characteristics of the collected sample.

Table 1. Demographical Characteristics of the Data Collected

Characteristics	Percentage (%)
N = 57	
Gender - Male	53.57
Gender - Female	46.43
Age range: 18-24 years old	48.21
Age range: 25-34 years old	21.43
Age range: 35-44 years old	23.21
Age range: 45-54 years old	5.36
Age range: 55-64 years old	1.75
Occupation: students	37.50
Occupation: job in the industry for a government sector	25
Occupation: academia and research	16.07
Occupation: job in the industry for a privet sector	14.29
Occupation: run their own business	3.57
Occupation: Others	3.57
Education level: high school	23.21
Education level: undergraduate degree	42.86
Education level: postgraduates	33.39
Major of studies: science, technology, engineering, and mathematics (STEM)	51.79
Major of studies: business and management	10.71
Major of studies: Health and medicine	25
Major of studies: others	12.5

#### 5. Results and Discussion

The results indicated that 67.27% of the participant have heard about remanufactured products while 32.73% have not yet. From those who have heard about the remanufactured products, 49% are male and 51% are female, as shown in Figure 2.

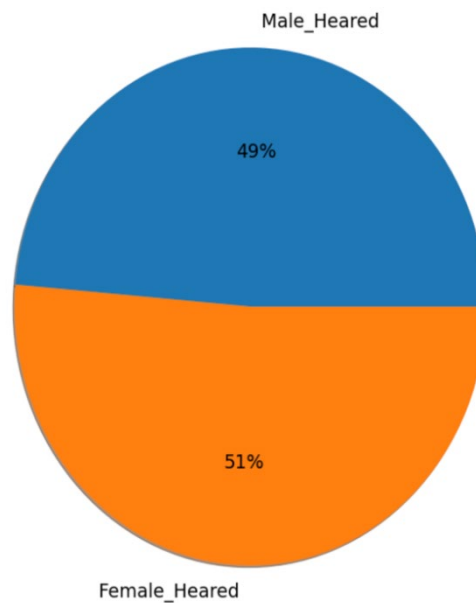


Figure 2. Male and female percentage of those who have heard about remanufactured products.

This indicates there is a recognizable work of these channels that help facilitate the popularity of remanufactured products more efforts are expected from the channels that help facilitate the popularity of remanufactured products. In the study, the channels that are considered are laws and regulations, advertisements of remanufacturing in the community and scientific content on remanufacturing in university courses. However, it would be better to adopt new creative ideas to attract attention to these products, especially for the male gender.

As demonstrated in Figure 3, 60% of who have heard about the remanufactured products and purchased them are male and the remaining 40% are female.

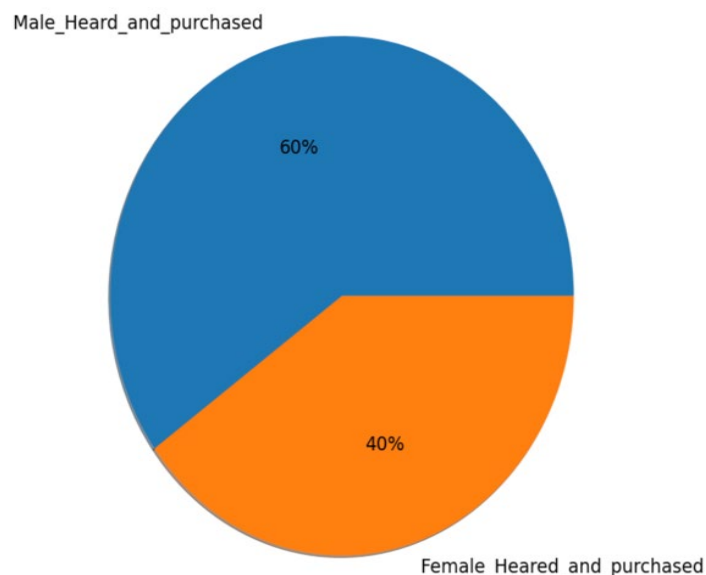


Figure 3. Male and female percentage of those who have heard and purchased remanufactured products.

This indicates that although of the small percentage of the male being aware of the remanufactured products, they are more willing to purchase them, compare with the female.

For those who have not purchased a remanufactured product before, almost 45% of the male and female agreed on the right pricing to convince them to buy a remanufactured product is when it is 30% – 40% less than the price of the new product as demonstrated in Figure 4.

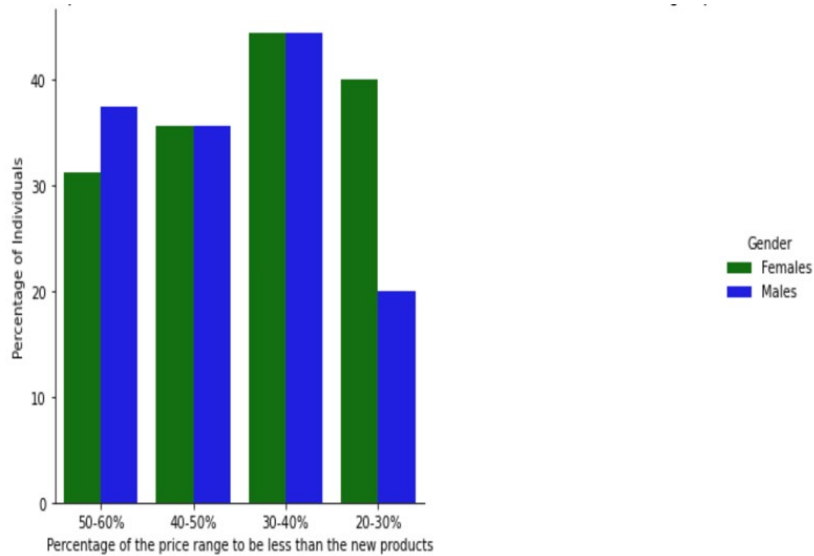


Figure 4. Price range preference of each gender to purchase remanufactured products.

Other than the price, the quality factor of these products was a concern for about 56% and 54% of the males and females, respectively, which prevented them from purchasing the remanufactured products, see Figure 5. Taking into consideration the quality factor of the remanufactured products during the advertisement period may result on a significant different on the purchasing behavior tendency of people in KSA as they already have the willingness to buy them.

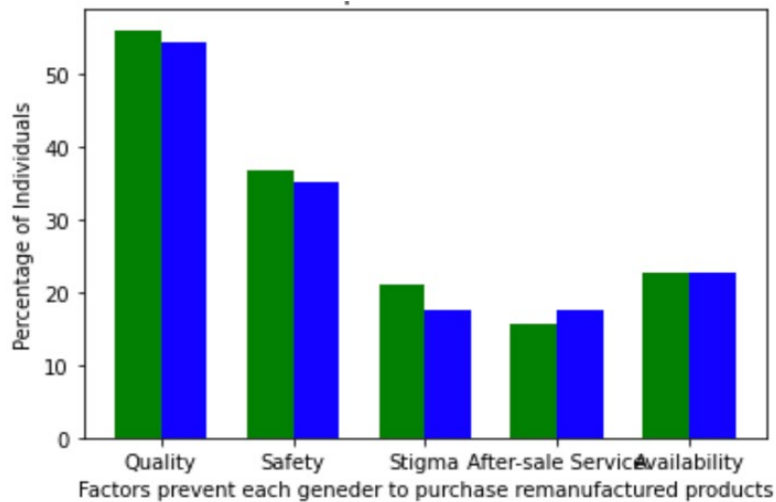


Figure 5. Factors, rather than price, prevent each gender from purchasing remanufactured products.

## 6. Conclusion

This study aimed to test the awareness and willingness to purchase remanufactured products in the Kingdom of Saudi Arabia as well as the factors prevent purchasing them. From the survey we conducted, the future of remanufactured products is very promising in the Kingdom of Saudi Arabia. The majority of the participant in the survey have an idea

about the remanufactured product although a small portion had the experience of purchasing this type of product. What also supports our prediction is the industrial revolution that has been taken in place since the launch of the Saudi Vision 2030 in 2016. To increase the popularity of remanufactured products, social media would play an important factor in this role. As expected, to increase the consumer willingness to purchase these products, the price would be the top motivation for both males and females in the Kingdom of Saudi Arabia. However, females tend to have the appearance of the products (e.g. color or shape) as another motivation to purchase the remanufactured products. on the other hand, besides the price, males would be also willing to purchase these products if a promotion is associated with their purchase. Even though both male and female in the Kingdom of Saudi Arabia trust the original manufacturer as a channel to purchase a remanufactured product, male shows a bit more flexibility to purchase these products from different channels (e.g. maintenance and repair stations) compared to female. To extend this work, it would be better to do further statistical analysis to statistically validate the obtained results.

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## Biography

**Dr. Murtadha Aldoukhi** received a BSc degree in Industrial and Systems Engineering from King Fahd University of Petroleum and Minerals, Saudi Arabia. He received a MSs degree in Engineering Management from California State University Northridge and a Ph.D. in Industrial Engineering from Northeastern University, United States. Dr. Murtadha has published several conference proceedings, book chapters and journal papers. Since January 2022, he has joined Al Yamamh University in Saudi Arabia as an assistant professor in the Department of Industrial

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