

Switching intention towards the purchase of remanufactured cellphones: development of a scale in the mexican context

Intención de cambio hacia la compra de teléfonos celulares remanufacturados: desarrollo de una escala en el contexto mexicano

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Abstract

The adoption of a circular economy requires the change of some systemic characteristics. One specific change is the regular purchase of remanufactured products. Therefore, the aim of this study is to offer a framework that could help in future studies to determine the purchase intention rate of remanufactured products in the Mexican context. After a pilot test starting with 80 items, three purification stages were performed to obtain a 20-item scale measuring value, government incentives, environmental benefits, attitude and purchase intention.

key words: circular economy, switching intention, remanufactured products, consumer behavior

Resumen

La adopción de una economía circular requiere el cambio de algunas características sistémicas tales como la compra regular de productos remanufacturados. El objetivo de este estudio es ofrecer un instrumento que pueda contribuir con futuros estudios para determinar la intención de compra de productos remanufacturados en el contexto mexicano. Tras cuatro etapas de pruebas de campo y purificación se obtuvo una escala de 20 ítems que miden valor, incentivos de gobierno, beneficios ambientales, actitud e intención de compra.

Palabras clave: economía circular, intención de cambio, productos remanufacturados, comportamiento del consumidor

1. Introduction

The remanufacturing of products “is an environmental and sustainable approach that, in the circular economy, can deliver lower eco-costs of materials depletion and pollution” (Vogtlander, Scheepens, Bocken, & Peck, 2017). According to these authors, remanufacturing can be defined as “an industrial process whereby products, referred

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to as cores, are restored to useful life" (p. 2). In other words, remanufacturing is the strategy to maintaining the value of a material at the highest level possible for the longest possible time.

To achieve remanufacturing production processes, several activities must be well handled, including product recycling, disassembling and reverse logistics (Tavares Thome, Scavarda, Santos Ceryno, & Remmen, 2016). Additionally, one of the key factors that would allow remanufacturing production is the consumption of the products that will be generated in this industrial scheme. Therefore, it is important to study the factors that would facilitate consumers' willingness to switch from new products to remanufactured products (Hazen, Mollenkopf, & Wang, 2017).

The consumption of remanufactured products is a recent trend mainly in developed countries (Khor & Hazen, 2016). In our research, we could not find any academic articles that explain the purchase intention of remanufactured products in developing countries. In this sense, this work joins this line of research with the aim to explain consumer intention to buy remanufactured products (instead of new products) in developing countries.

Therefore, the purpose of this paper is to adapt and validate a scale to measure the purchase intention of remanufactured products in Mexico. This document presents the methodology that informs the development of the scale that considers the variables of value, attitude, environmental consciousness and government incentives as antecedents to the consumer's intention to switch. First, we present a conceptual framework for circular economy, the switching intention theory, and the variables involved. Thereafter, we describe the validation process. The main findings include the reliability and validity of the variables *value*, *government incentives*, *environmental benefits*, *attitude* and *intention to purchase* remanufactured products in the Mexican context.

1.1. Conceptual framework

Circular Economy: The Role of the Consumer

The circular economy is increasingly gaining traction within academia, industry and with policymakers (Geissdoerfer, Savaget, Bocken, & Hultink, 2017; Kirchherr, Reike, & Hekkert, 2017) because it represents an alternative to solve problems that threaten sustainability. The circular economy is defined as "an economic model wherein planning, resourcing, procurement, production and reprocessing are designed and managed, as both process and output, to maximize ecosystem functioning and human well-being" (Murray, Skene, & Haynes, 2015). According to Kirchherr *et al.* (2017), the implementation of this new model, which is restorative by design, requires a shift of how we think about many things, including consumption, because if we do not change the way we use and dispose of our waste, then health and economic problems will tend to remain and increase.

Previous works exploring the potential development of circular economies have identified key issues for this model to be successful. One of these issues is the understanding of the dynamics of the potential markets for remanufactured products and the need to build a genuine business approach for this sector (Guide & Wassenhove, 2009). Understanding consumer perception of circular economy products is a key element in defining proper strategies directed to the promotion of this type of business model.

If the objective is to develop alternative ways of production and supply chain management with profitable results, we need not only to gather information about the right channels to recover the products after their use but also to develop the right market for the remanufactured products. If this is not possible, the potential value of the circular economy will not be accomplished (Guide & Wassenhove, 2009). Therefore, the more that information regarding the consumer's perspective (particularly their willingness to switch to consumption of these types of products) is made available, the closer circular economies will be to successful development.

Switching Behavior and Remanufactured Products

The relevance of understanding market dynamics resides in the fact that a lack of understanding may constitute an important barrier to operational designs for circular economies (Guide & Wassenhove, 2009). Switching behavior to choose a different product has been studied in the marketing field in different contexts. Wathne *et al.* (2001) proposed a model in which switching intention is dependent on switching barriers (relationship with current suppliers), switching cost and marketing variables (price and product superiority). Thaichon and Quach (2016) proposed a model in which switching behavior was the result of the effect of the consumer's switching cost, satisfaction and commitment with their current choice. Because remanufactured products constitute a recently developed market, little research has been done on this matter (Hazen *et al.*, 2017). The model proposed by Hazen *et al.* (2017) constitutes a starting point for this study. This model is based on the push-pull-mooring (PPM) theory of migration and is discussed in the following section.

Push–Pull–Mooring Theory of Migration Framework

According to Hazen *et al.* (2017), the push-pull-mooring theory of migration suggests that people are pushed and/or pulled by macrolevel factors to migrate to different locations, considering both powerful and parsimonious factors. In this sense, microlevel mooring factors serve to heighten the effects of the push and pull factors. In this section, we differentiate between push, pull and mooring factors.

Stimson & Minnery (1998) define the 'push' factors as macrolevel factors that motivate people to change their existing location and are typically negative in nature. In terms of consumer behavior, they are the "factors that might motivate the migration of a supply chain's end-consumers to alternative products or services; such factors might include high prices, poor service or poor quality" (Hazen *et al.*, 2017). For example, if the price of a new cellphone is elevated, this can "push" consumers to prefer remanufactured cellphones.

On the other hand, the term 'pull' "refers to macrolevel factors that are typically positive and serve to draw people to new locations that are more appealing than their current one (Moon, 1995). Hazen *et al.* (2017), in the context of a supply chain's end-consumer, "pull factors might include superior product performance, groundbreaking technology or government incentives and tax breaks such as those for alternative-powered vehicles". If the purchase of a remanufactured cellphone provides a benefit to the environment and this benefit can be perceived and validated by the consumer, then this benefit can facilitate the consumer's switching intention.

One of the criticisms of conventional push-pull models is that they do not include microlevel factors (Boyle, Helfacree, & Robinson, 1998). In this sense, mooring factors must be considered. These mooring factors are referred to as the "microlevel factors consisting of personal, social and cultural values that play intervening roles in one's intention to migrate" (Moon, 1995). Mooring factors might include personal connections, attitudes, or feelings of anxiety or excitement (Hazen *et al.*, 2017). For example, if a person is more sensitive about the potential environmental impacts that the production of brand new products causes, it is possible that his or her preferences will change to purchasing remanufactured products.

In summary, according to the push-pull-mooring theory of migration, push factors are assumed to be negative factors, pull factors are considered positive, and mooring factors are internal (Hazen *et al.*, 2017). In this context, if we want to explain the switching intention of a person, we have to analyze the variables that can be included in each factor. Having exposed the differences between the push, pull and mooring factors, we analyze here the variables that have been considered relevant in the purchase intention of remanufactured products.

1.2. Variable definitions

According to the theoretical model proposed by Hazen *et al.* (2017) five variables are considered to affect the switching intention of a person. These variables can be divided into three sets. The first factor contains the variables that “push” the behavioral change in the consumer (value). The second group includes the “positive” influencers of the change (government incentives and environmental benefits). The factors that work on a personal level are the mooring factors (attitude towards remanufactured product).

Table 1
Push-Pull-Mooring variables and definitions

Factor type	Variable	Variable definition
Push	Value	The effect of the price in the purchase intention of new and remanufactured products
Pull	Government incentives	Importance perceived by the consumer regarding the promotion of remanufactured products
	Environmental benefits	Consumers' intention to purchase remanufactured products compared to the positive or negative impact on the environment
Mooring	Attitude	The propensity toward purchasing remanufactured products

Even though other variables may affect the consumer's intention to switch to remanufactured products, this set of variables was chosen as a first attempt in the Mexican context to apply a scale to that has already been proven adequate elsewhere. This study does not aim to establish the presence of a trend for favorable attitude towards remanufactured products; rather, it seeks to identify the potentially different effects of diverse variables on intentions to switch to these kinds of products, in a context distinct from that of the earlier study. Table 1 lists the variables based on Hansen *et al.* (2017) and incorporated into our analysis, along with brief definitions for each.

Value. According to Dekhili & Achabou (2013), the price variable is at the forefront of many consumer decisions, and with little exception, consumers will consider price when weighing purchase options. Furthermore, Zhang *et al.* (2014) found that consumers are more likely to change the purchase decision if they perceive the prices of their current election to be high. In this sense, if the prices of brand new products rise, the consumer can be pushed to look for alternatives, and in remanufactured products, they can find a viable alternative. In this study, we considered evaluating this variable to analyze consumers' perceptions of brand new products, as they can be expensive and therefore not be reasonably priced. Thus, these products provide less value compared with the lower-priced remanufactured product.

Governmental incentives. According to Mishal *et al.* (2017), laws, regulations and standards to make the purchase of remanufactured products more feasible and attractive have been enacted worldwide, thus increasing the attractiveness for remanufactured products. Scholl *et al.* (2010) operationalized this variable by asking if the consumer considers relevant topics such as price ceilings, purchase subsidies, availability and labeling statements that may favor remanufactured products.

Environmental benefits. According to Mishal *et al.* (2017), an attractive element of remanufactured products is that they can provide environmental benefits. Some of the environmental benefits of remanufactured products are the use of fewer finite resources, the reduction of landfill waste, the reduction of atmospheric emissions and the reduction of negative effects on ecosystems (Collins, Steg, & Koning, 2007).

Attitude towards remanufactured products. Attitude towards switching has been associated with consumers' switching intentions (P. Bansal & DesJardine, 2014). According to Mishal *et al.* (2017), in the context of remanufactured products, attitude has been found to be a significant predictor of consumer adoption, as well as an important intervening variable. Taylor & Todd (1995) operationalized this variable by measuring the attitude towards choosing a new product, how much a person likes the idea of using a different alternative, and how much that person agrees with new or innovative proposals. When the consumer shows a favorable attitude towards difference and innovation, this could turn out to be a highly relevant and significant element in causing him to make the final decision to buy a remanufactured product rather than a product that may give superior performance or break ground technologically.

Switching intention. Finally, switching intention can be defined as the rational decision-making perspective based on the likelihood of a person to adopt an innovation or change to a different purchasing behavior. Therefore, we define switching intention in this context as the intention to change from purchasing new products to purchasing remanufactured products. When operationalizing the variable, we can define it as the likelihood of switching, determination to switch or consideration of switching to a new product (Hsu, 2014; Ping, 1995; Shin & Kim, 2008).

2. Methodology

2.1. Scale development process

The present section describes the process used to generate the scale and how it was validated. Hanzel *et al.*'s (2017) items were translated and adapted to Spanish. The final items in Spanish can be consulted in Annex A. The scale uses five variables: value, government incentives, environmental benefits, attitude and switching intention. The definitions of these variables have been provided in the previous section of this work. The number of items used in each variable ranges from 3 to 6.

In the original scale, Hanzel *et al.* (2017) used personal computers as the reference product. However, we needed a reference product that is widely used by young people because it is probable that efforts to promote remanufactured products will be directed to this segment because of their greater probability to change purchasing behaviors. Therefore, we decided to use cellphones because they are commonly used among undergraduate students in rural and urban contexts in Mexico.

To begin, we decided to homogenize the number of items in each variable so that each variable would have six items. The validity and reliability of these six items were evaluated during the following stages. Table 2 shows the initial set of 30 items, along with the code, sentence, and source of the items.

Table 2
Items in the Mexican context: initial phase

Item code	Initial items	Source
Variable 1: Value (Push) Disagree/agree Likert scale, from 1–7.		
Val1	Brand new cellphones are expensive	Bansal <i>et al.</i> (H. S. Bansal, Taylor, & St. James, 2005)
Val2	Brand new cellphones are not reasonably priced	Chen & Dubinsky (2003)
Val3	Brand new cellphones are not a good product for the price	Sweeney & Soutar (Sweeney & Soutar, 2001)
Val4	Brand new cellphones are not an economical purchase	
Val5	Remanufactured cellphones offer more value for my money than new ones.	Original contribution
Val6	The price of remanufactured cellphones is better.	
Variable 2: Government incentive (Pull) Unimportant/important Likert scale, from 1–7.		
Gov1	Price ceilings for remanufactured products (i.e., set at a % of the new product cost)	Scholl <i>et al.</i> (2010)

Item code	Initial items	Source
Gov2	One-time purchase subsidies to encourage purchase of remanufactured products	
Gov3	Availability of remanufactured products	
Gov4	Identical warranties for new and remanufactured products	
Gov5	Tax incentives in the purchase of remanufactured products.	Original contribution
Gov6	Labeling that favors the purchase of remanufactured products.	
Variable 3. Environmental benefits (Pull) Disagree/agree Likert scale, from 1–7.		
Ben1	Purchasing a remanufactured cellphone will help use fewer finite resources.	Collins <i>et al.</i> (2007)
Ben2	Purchasing a remanufactured cellphone will help use more recyclable resources.	
Ben3	Purchasing a remanufactured cellphone will help minimize landfill waste.	
Ben4	Purchasing a remanufactured cellphone will help minimize harmful atmospheric emissions.	
Ben5	Purchasing a remanufactured cellphone will help minimize negative effects on natural ecosystems.	
Ben6	Buying a remanufactured cellphone will help reduce the negative effects on the ecosystem due to mining.	
Variable 4. Attitude (Mooring) Disagree/agree Likert scale, from 1–7.		
Att1	I like the idea of buying remanufactured cellphones.	Taylor & Todd (1995)
Att2	Purchasing remanufactured cellphones is a good idea.	
Att3	I have a good attitude towards using remanufactured cellphones.	
Att4	Using remanufactured cellphones is a smart decision.	Original contribution
Att5	The advantages of remanufactured cellphones overcome their disadvantages.	
Att6	The use of remanufactured cellphones is compatible with my lifestyle.	
Variable 5: Switching intention Disagree/agree Likert scale, from 1–7.		
Swi1	...I'm considering switching from a new cellphone to a remanufactured cellphone.	Hsu (2014) Ping (1995), Shin & Kim (Shin & Kim, 2008)
Swi2	...The likelihood of switching to remanufactured cellphones is high.	
Swi3	...I'm determined to switch to a remanufactured cellphone.	
Swi4	The next time I need a cellphone I will buy a remanufactured one.	Original contribution
Swi5	I will not buy a brand new cellphone again.	
Swi6	I want to stop buying brand new cellphones.	

After the development of an initial set of 30 items, four purification stages were undertaken. In the first stage, we administered a pilot test with 80 undergraduate students in a rural context. In the second stage, a panel of three judges, conformed by bilingual Marketing experts was formed to assess the content validity of the instrument. In the third stage, we administered 167 questionnaires distributed to students from three universities. Finally, in the fourth stage, we administered 155 questionnaires to students of one university. All the students who participated in the different stages of the study had the following profile: undergraduate students in the second half of their college education, between 18 and 27 years old, and having used a cellphone at least once in the last year.

2.2. First empirical test

Data collection

The first pilot test was performed with 80 undergraduate students with the profile mentioned above. All of them were studying in two universities located in the north of the state of Hidalgo, Mexico. These universities have the characteristic of being surrounded by a rural area. We decided to use a population more distant from urban

life because in this context, we could find a population with less knowledge of remanufactured products, which would allow us to evaluate the direct effect of the statements and the definitions established in the questionnaire. From the administration of this first pilot test, we obtained 64 useful questionnaires, which is a reasonable sample size for a pilot study (Hertzog, 2008). The results are presented below.

Reliability and validity of scale

To enable convergent, discriminant and criterion-related validity of the scale (Kerlinger, 1966), we performed two statistical tests. First, we conducted an exploratory factor analysis using principal component analysis as the extraction method with an *oblimin* rotation with Kaiser normalization to the 30 items. Next, we used Cronbach's alpha (Cronbach, 1951) to test internal reliability for the items of each variable. All statistical tests in this study were performed using Statistical Package for the Social Sciences (SPSS) software (IBM Corp, 2013).

The results of the factor analysis in this stage are presented in Table 3. We saw that the items of the variables: government incentives, switching intention and value were relatively well grouped in factors 2, 3 and 4, respectively. The items for environmental benefits and attitude were grouped in the first factor. Nevertheless, we obtained more factors than the hypothesized dimensions. We assumed that this happened because of the tiredness effect in the last two sections of the questionnaire and the wording of the statements. We used Cronbach's alpha to test reliability within each variable. In this initial pilot test, Cronbach's alpha values ranged from 0.893 to 0.96 among the different variables. In Table 7, the alpha coefficients can be consulted, not only for this stage but also for the subsequent ones.

Table 3
Convergent and Discriminant Validity. Stage one.

Item code	Factor Loadings*				
	1	2	3	4	5
Att2	0.951				
Att4	0.947				
Ben4	0.911				
Ben5	0.883				
Ben3	0.88				
Ben2	0.869				
Att1	0.868				
Ben1	0.856				
Att5	0.776				-0.406
Att3	0.654				
Att6	0.596				
Gov2	0.572				
Gov5		0.816			
Gov4		0.804			
Gov3		0.78			
Gov6		0.771			
Val6		0.729			
Gov1		0.627			
Swi3		0.573			
Swi1			-0.924		
Swi4			-0.91		
Swi5			-0.859		
Val2			-0.615		
Swi2			-0.443		
Val5			-0.42	-0.408	
Val4				-0.739	
Val1				-0.692	
Val3				-0.65	

* Extraction method: principal component analysis. Rotation method: Oblimin with Kaiser normalization (Kaiser, 1958). Rotation converged in 21 iterations.

Because of these results, we took three actions. First, we identified points to be corrected in the administration method; second, we determined that the variables in the questionnaire had to be distributed randomly; and third, we had to analyze and rewrite the items. For this last step, in the next step, we ask for the collaboration of a panel of expert judges

2.3. Construct Validity

Panel of expert judges

A widespread practice in consumer-related scale development research to verify construct validity is the use of a panel of expert judges (Hardesty & Bearden, 2004). A panel of three experts in consumer behavior and with research experience in the context of Mexico evaluated the items obtained from the previous stage. All the experts were doctoral professors at a management school in Mexico.

To assist, we gave each judge a document with the purpose of this study and a format that could help to evaluate the instrument under design. As in other construct validity processes (Sweeney & Soutar, 2001), we gave the judges a description of each of the five value dimensions evaluated, the literature references from where the items were built originally, the original wording of the item in English, the proposed translation/adaptation, the suggested added questions and the results obtained in the first stage and the characteristics of the Likert scale that were to be used in the questionnaire. We asked the panel of experts to participate in at least two ways: analyzing the wording of the items and analyzing the relationship of the item with the corresponding variable.

Suggestions received

The panel of experts contributed with observations at several points. They pointed questions that have a high probability of being confusing for the respondents because of the wording, the use of negative concepts, or the structure of the sentence. We also receive suggestions about the possibility to change some terms that could be difficult to identify by the respondents, such as the use of “environmentally friendly products” rather than “environmentally sustainable alternative” and the use of “brand new” products instead of just “new products” in order to differentiate them from remanufactured products.

We also received suggestions to include a previous section in the questionnaires that could act as a filter of those people who have less likelihood of knowing about the topics that we were addressing. Therefore, we developed an initial filter with nine questions that had to be answered positively to be available to continue with the survey. This initial questionnaire asked if the person was an undergraduate student, between 18 and 25 years old, if they had used and bought a cellphone at least one time, and if they had a clear understanding of the following concepts: government subsidy, environmentally friendly products, company responsible with the environment, natural resources and the difference between reusing and recycling.

After analyzing the judges' observations and the results obtained in the first stage, we decided to eliminate one item of each variable, since those items were loading in different factors and it was complicated to improve the structure and wording of some of them. Additionally, we found it necessary to reduce the size of the instrument. The items that were eliminated are listed in Table 6. Once we incorporated the suggestions by the expert judges, we proceeded to the administration of this new 25-item questionnaire (5 items in each variable) for a second test.

2.4 Second empirical test

Data collection

To search for context validity, we administered the new 25-item questionnaire in two different universities in two different states: Hidalgo and Oaxaca, Mexico. Both universities are located in the capital city of each state. We maintain the described profile of the participating undergraduate students. We asked the coordinator of the

management faculty to distribute an online survey among their students. In total, we obtained 167 responses to an online survey. Of these responses, 113 failed the initial filter questionnaire; therefore, we obtained 54 effective responses, giving us a response rate of 32.3 %.

Reliability and validity

Using the same procedure described in Stage One, we tested for convergent, discriminant and criterion-related validity. In Table 4, we can appreciate that despite the variables being grouped better, which helped us obtain more convergent results, we did not obtain the result we expected. Three items of the variable value converged with factor loadings up to 0.8; nevertheless, two items loaded in a different factor joining with some switch intention items. A comparable situation could be observed with the rest of the variables, except for the variable government incentives, from which we obtained satisfactory results in terms of convergent and discriminant criteria. We also obtained Cronbach’s alpha for reliability. These results are presented in Table 7. As we can see, values between 0.83 and 0.94 were obtained, providing us acceptable values of internal reliability (Gliem & Gliem, 2003).

Table 4
Convergent and Discriminant Validity. Stage three

Item code	Factor loadings*							
	1	2	3	4	5	6	7	8
Ben2	0.922							
Ben3	0.858							
Ben4	0.814							
Ben5	0.771							
Ben1	0.737							
Val1		0.896						
Val2		0.871						
Val4		0.844						
Val5				0.74				
Val3		0.466		0.666				
Swi3				0.599				
Swi2				0.543		-0.401		
Swi4								
Gov3					-0.836			
Gov4					-0.724		0.522	
Gov1					-0.648			0.458
Gov6					-0.613			
Gov2					-0.502		-0.407	
Att3						-0.918		
Att2						-0.799		
Att1						-0.628		
Att3						-0.525		
Att5						-0.511	0.444	
Swi5							0.813	
Swi1						-0.437		-
								0.639

* Extraction method: principal component analysis. Rotation method: Oblimin with Kaiser normalization (Kaiser, 1958). Rotation converged in 21 iterations.

Considering the results obtained, we modified the wording of 3 items, we decided to eliminate 5 more items, mainly because in the first and second administration of the questionnaire, we showed low values, even when we tried to modify the sentences. The modified and eliminated items can be consulted in Table 6. We also observed that the rate response can be improved if we added some common definitions at the beginning of the

questionnaire to introduce the respondents to the topic. The definitions introduced were “environmentally friendly product”, “subsidy”, “environmentally responsive corporation” and the difference between “reusing and recycling”. After reading those definitions, the respondent could answer the filter questions.

2.5 Final empirical test

Data collection

The last two administrations of the instrument gave us the information needed to depurate the instrument. As a four stage, a final pilot test was performed. This time, we administered the 20-item scale to undergraduate students with the profile previously described but in two faculties of the same university. One faculty was related to agriculture, and the other was related to nursing and medicine. An online survey was sent to 156 students, from which we obtained 129 effective responses (82.6 % rate response). The 27 responses that did not have a correctly completed filter section were eliminated; nevertheless, we observed an increase in the response rate.

Reliability and validity of the final scale

The results of this final administration of the instrument can be seen in Table 5. The same statistical processes to test for convergent and discriminant validity used in the last stages were used. This time, items from the same variable were grouped in the same factor, were factor loadings above 0.7 except for two items about attitude. Cronbach’s alpha values are shown in Table 7. This parameter was between 0.83 and 0.90.

Table 5
Convergent and Discriminant Validity. Stage four.

Item code	Factor loadings*					
	1	2	3	4	5	6
Att3	0.877					
Att4	0.833					
Att5	0.676					
Att1	0.661					
Swi5		-0.828				
Swi3		-0.821				
Swi4		-0.790				
Swi1		-0.774				
Ben4			-0.887			
Ben5			-0.828			
Ben3			-0.819			
Ben2			-0.751			
Val2				-0.865		
Val3				-0.818		
Val4				-0.810		
Val1				-0.805		
Gov3						0.867
Gov2						0.866
Gov6						0.822
Gov1						0.800

* Extraction method: principal component analysis. Rotation method: Oblimin with Kaiser normalization (Kaiser, 1958). Rotation converged in 14 iterations.

2.6. Summary of modifications and results

In Table 6, the process of elimination and modification administered in the development of this instrument is presented. We started with a 30-item scale with low convergent and discriminant validity, and we ended with a 20-item scale with acceptable parameters.

Table 6
Summary of modifications to the scale through the three pilot tests.

Item code	Item name	1st pilot test	2nd pilot test	3rd pilot test
Variable 1: Value (Push)				
Val1	Brand new cellphones are expensive	Included	Modified	Included
Val2	Brand new cellphones are not reasonably priced	Included	Modified	Included
Val3	Brand new cellphones are not good for the price	Included	Modified	Modified
Val4	Brand new cellphones are not an economical purchase	Included	Modified	Included
Val5	Brand new cellphones offer more value	Included	Modified	Eliminated
Val6	The price of remanufactured cellphones is better	Included	Eliminated	.
Variable 2: Government incentive (Pull)				
Gov1	Price ceilings	Included	Modified	Included
Gov2	One-time purchase subsidies	Included	Modified	Included
Gov3	Availability of remanufactured products	Included	Modified	Included
Gov4	Identical guarantees	Included	Modified	Eliminated
Gov5	Tax incentives	Included	Eliminated	.
Gov6	Labeling favoring remanufactured	Included	Modified	Included
Variable 3: Environmental benefits (Pull)				
Ben1	Fewer finite resources	Included	Modified	Eliminated
Ben2	More recyclable resources	Included	Included	Included
Ben3	Minimize landfill waste	Included	Included	Included
Ben4	Minimize atmospheric emissions	Included	Included	Included
Ben5	Minimize effects on natural ecosystems	Included	Included	Included
Ben6	Minimize effects because of mining	Included	Eliminated	.
Variable 5: Attitude (Mooring)				
Att1	I like remanufactured products	Included	Included	Included
Att2	Good idea	Included	Included	Eliminated
Att3	Good attitude	Included	Included	Included
Att4	Intelligent decision	Included	Included	Included
Att5	Remanufactured product advantages	Included	Included	Included
Att6	Lifestyle compatibility	Included	Eliminated	.
Variable 6: Switching intention				
Swi1	Considering switching	Included	Modified	Modified
Swi2	Likelihood of switching	Included	Modified	Eliminated
Swi3	Determined to switch	Included	Modified	Included
Swi4	Using a remanufactured product next time	Included	Included	Included
Swi5	Future purchase	Included	Included	Included
Swi6	Stop buying brand new	Included	Eliminated	.

In Table 7, the values of Cronbach's alpha in the different stages are presented. According to Gliem & Gliem (2003), Cronbach's alpha measures the possible deviations that a group of items have in order to measure a single construct (p. 84). The items used to measure environmental benefits obtained the highest value in the 3rd test, and the other variables, even when they present low values, are all acceptable.

Table 7
Reliability measures for variables in the distinct stages.

Variable	Cronbach's alpha		
	1st test	2nd test	3rd test
Value	0.903	0.868	0.830
Government incentives	0.893	0.831	0.879
Environmental benefits	0.963	0.942	0.904
Attitude	0.944	0.914	0.867
Switching intention	0.896	0.852	0.838

3. Results

With the intention to contribute not only with the questionnaire designed but also with the knowledge of consumer behavior regarding remanufactured products, in this section, we present the results of the final questionnaire administered to a population of 184 undergraduate students (Table 8). The majority (66.5 %) of the subjects were between 18 and 25 years old, 57 % were female and 41.6 % were male, all of whom were distributed from the first to the last year of their studies. Additionally, we explored the main environment in which they lived (rural 56.8 % or urban 41.6 %) and the socioeconomic level measured by the Mexican Association of Markets Research recommendations (AMAI, 2008) being the majority (50.3 %) in the C and D+ levels, which represent the middle class and low middle class, respectively.

We also measured the knowledge regarding remanufactured products with three questions. We asked if they had heard about remanufactured products. The answers were between 35.7 % affirmative and 45.4 % more or less, which shows certain doubts about the remanufactured products. We also asked if the term "remanufactured products" was clear, and they answered very clear (41.1 %) and somewhat clear (47.6 %). Regarding the difference among the terms reused, restored and with replacement of components, the majority (53.5 %) answered to have clarity. Finally, we asked if they purchased a remanufactured product, and 45.9 % answered affirmatively. These results represent a young middle-class population that has an average knowledge or higher about remanufactured products, with some doubts and uncertainties.

Table 8
Sample profile

Demographics	Frequency n=184	Percentage (%)
Gender		
Female	107	57.8
Male	77	41.6
Age		
18-20	62	33.5
21-25	61	33.0
26-30	6	3.2
No answer	56	30.3
Year in the university		
First	18	9.7
Second	31	16.8
Third	23	12.4
Fourth	11	5.9
Fifth or more	47	25.4
Main environment		
Rural	105	56.8
Urban	77	41.6
Socioeconomic level		
E	11	5.9
D	16	8.6
D+	51	27.6

Demographics	Frequency n=184	Percentage (%)
C	42	22.7
C+	32	17.3
A/B	32	17.3
Have heard about remanufactured products		
Yes	66	35.7
More or less	84	45.4
No	32	17.3
Don't know	1	0.5
Clarity of the term "remanufactured product"		
Very clear	76	41.1
Somewhat clear	88	47.6
Somewhat confusing	14	7.6
Unclear	6	3.2
Clarity among terms: reused, restored and with replacement of components		
Very clear	99	53.5
Somewhat clear	66	35.7
Somewhat confusing	17	9.2
Unclear	2	1.1
Have purchased remanufactured products previously		
Yes	85	45.9
No	60	32.4
Don't know	39	21.1

Regarding the variables used to explore the propension to buy remanufactured products, in **¡Error! La autoreferencia al marcador no es válida.**, we graph those results. The average frequency curve of the response of each variable (group of items) from the negative answer (disagree strongly) to the positive answer (agree strongly) is presented according to the Likert scale of seven points used. The uncertainty answer (don't know) is also shown.

Among the five variables, *switching intention* and *environmental benefits* were the main variables in which the answer was more concentrated, corresponding to the neutral and slightly agree points of the scale, respectively. The response to the *government incentives* variable was concentrated on the positive side of the scale (from slightly agree to strongly agree). The *attitude* towards remanufactured products was distributed mainly at the slightly agree point but also at the neutral point. The *value* variable is the one where we found a less clear concentration of the answers distributed on the neutral, slightly agree and strongly agree points of the scale. This finding shows a population where the intention to switch and the attitude towards remanufactured products is clearly neither positive nor negative; however, it recognizes the environmental benefits and agrees with the need for government incentives. When speaking about how to promote remanufactured products, frequently, the answer is concentrated in the reduction of the value; however, in this study, we did not obtain a clear response from the population, which leads to the possibility for future research.

In addition, in **¡Error! La autoreferencia al marcador no es válida.**, the vertical lines represent the standard deviation where the higher values for each variable were found. All the standard deviations for all the variables are not graphed for visual reasons; however, all the values are presented in ----

Table 9. We can observe that the lowest standard deviation was obtained in the *environmental benefits* and *switching intention* variables, showing a more homogeneous response than the rest of the sample. In contrast, *value* was the variable with the highest standard deviation.

Figure 1
Response towards remanufactured products among the population sample

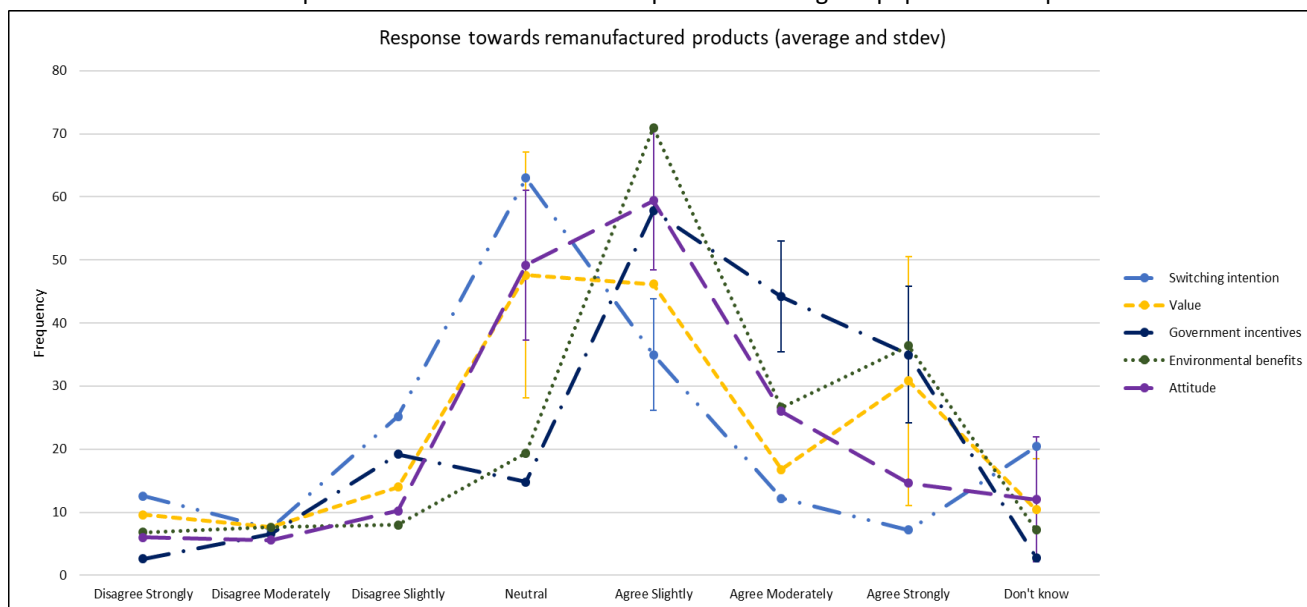


Table 9

Average and standard deviations for each variable.

Variable	Metric	Disagree Strongly	Disagree Moderately	Disagree Slightly	Neutral	Agree Slightly	Agree Moderately	Agree Strongly	Don't know
Switching intention	Average	12.6	7.4	25.2	63.0	35.0	12.2	7.2	20.4
	StDev	1.8	1.3	4.5	6.6	8.8	2.0	2.1	5.3
Value	Average	9.6	7.6	14.0	47.6	46.2	16.8	30.8	10.4
	StDev	4.6	1.3	6.7	19.5	7.4	4.5	19.7	8.1
Government incentives	Average	2.6	6.6	19.2	14.8	57.8	44.2	35.0	2.8
	StDev	0.9	3.2	6.7	4.6	5.0	8.8	10.8	0.8
Environ. Benefits	Average	6.8	7.6	8.0	19.4	71.0	26.6	36.4	7.2
	StDev	1.6	1.8	1.4	1.9	5.5	6.9	3.1	2.3
Attitude	Average	6.0	5.6	10.2	49.2	59.4	26.0	14.6	12.0
	StDev	1.9	1.8	1.3	11.9	11.0	7.3	3.1	9.9

The underline values are those presented in Figure 1.

The results presented show a method to analyze the intention to buy remanufactured products using 5 variables. This is relevant because it can be used by researchers and practitioners to measure this intention among populations. In future studies, it can be extended to different and larger populations.

4. Conclusions

In this work, we described the process of building a scale to measure variables that can be associated with the intention to purchase remanufactured products in a Mexican context. It was found that the variables *value*, *government incentives*, *environmental benefits*, *attitude* and *purchase intention* presented good values of reliability and validity. To develop other items for this construct in a better way, qualitative research might provide some insights and might be the focus of a particular scale development study for Mexico and countries with similar cultural backgrounds.

We could also see that some items evaluated in other contexts did not have the same response in the aforementioned context. Initially, an instrument of 30 items was tested, finalizing with one of 20 items. This instrument can be evaluated in subsequent studies to determine the intention of switching towards remanufactured products. The fact that this scale was tested within the Mexican context also provides the opportunity to conduct comparative cross-cultural studies, using the same scale proven in the current work, in order to analyze the differences in the relevance of the variables that have an effect on switching intention. This becomes particularly relevant considering the recent increased attention to sustainable purchase behavior and related topics. Circular economy analysis, for example, might widely benefit from the use of this type of instrument in order to assess the potential of the consumption of this type of product, which as previously stated, is key to the success of this type of business model.

The responses towards remanufactured products in the sample that we used were mixed. In general terms, the population sample was found to have satisfactory knowledge about the remanufactured products and their benefits. However, this was not equally relevant regarding the attitude and switching intention to purchase remanufactured products. In addition, the variable related to value did not present a homogeneous response; therefore, more research is needed. In this study, the sample included only university students. In this sense, some differences might be found when the instrument is administered to subjects with different characteristics. The results may be different if the data gathering extends to a different population.

According to the obtained results, we can see that there is little literature that analyzes the change of purchase intention towards remanufactured products, particularly in Latin America. A greater focus on consumers in this context, which may have different behaviors than consumers in developed countries, might be valuable to several industries and companies with a sustainable business approach. Furthermore, circular economy proposals might have a greater impact in these less developed countries, and therefore, it would be important to understand their consumers' attitudes and intentions to buy remanufactured products.

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Annex A

As we have indicated, this study was performed in the states located in the central region of Mexico; therefore, all the questionnaires were administered in Spanish. In the next table, the original items in Spanish of the six different variables of the final 20-item survey form can be consulted.

Item code	Item in Spanish
Variable 1: Valor (Push)	
Escala Likert de 7 puntos. Rango: Totalmente en desacuerdo / Totalmente de acuerdo.	
Val1	Los teléfonos celulares "completamente nuevos" son caros
Val2	Los teléfonos celulares "completamente nuevos" no tienen un precio justo.
Val3	Los teléfonos celulares completamente nuevos son muy caros para lo que ofrecen
Val4	Los teléfonos celulares "completamente nuevos" no son económicos.
Variable 2: Incentivos gubernamentales (Pull)	
Escala Likert de 7 puntos. Rango: Nada importante / Totalmente importante.	
Gov1	Que el gobierno regule precios máximos para productos remanufacturados (es decir, que no superen el precio del producto nuevo)
Gov2	Que existan subsidios a la compra de productos que ya han sido remanufacturados.
Gov3	Que los productos remanufacturados estén disponibles en distintos puntos de venta.
Gov6	Que el etiquetado incluya elementos que incentiven a la compra de productos remanufacturados.
Variable 3. Beneficios ambientales (Pull)	
Escala Likert de 7 puntos. Rango: Totalmente en desacuerdo / Totalmente de acuerdo	
Ben2	Comprar un teléfono celular remanufacturado ayudará a usar más recursos reciclables.
Ben3	Comprar un teléfono celular remanufacturado ayudará a minimizar los residuos en rellenos sanitarios (tiraderos de basura).
Ben4	Comprar un teléfono celular remanufacturado ayudará a minimizar emisiones atmosféricas dañinas.
Ben5	Comprar un teléfono celular remanufacturado ayudará a minimizar efectos negativos en los plantas y animales.
Variable 4. Actitud (Mooring)	
Escala Likert de 7 puntos. Rango: Totalmente en desacuerdo / Totalmente de acuerdo	
Att1	Me gusta la idea de comprar teléfonos celulares remanufacturados.
Att3	Tengo una buena actitud hacia el uso de teléfonos celulares remanufacturados.
Att4	Usar teléfonos celulares remanufacturados es una decisión inteligente.
Att5	Las ventajas de los teléfonos celulares remanufacturados superan sus desventajas.
Variable 5: Intención de cambio	
Escala Likert de 7 puntos. Rango: Totalmente en desacuerdo / Totalmente de acuerdo	
Swi1	Estoy considerando cambiar a un teléfono celular remanufacturado
Swi3	Estoy decidido a cambiar a un teléfono celular remanufacturado.
Swi4	La próxima vez que requiera un teléfono celular adquiriré uno remanufacturado.
Swi5	No volveré a comprar un teléfono celular "completamente nuevo", compraré uno remanufacturado.