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Consumer purchase intention of remanufactured EEE products – A study on robotic lawn mowers in Sweden

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ABSTRACT

The lack of consumer acceptance of remanufactured products prevents the transition to a circular economy. The aim of this study was to determine the degree of importance of influencing factors to the consumer's purchase intention of a remanufactured robotic lawn mower. The results indicated that the consumer's purchase intention can be measured as a function of attitude, social pressure and the availability of remanufactured products, among which attitude had the highest effect on the purchase intention. The attitude was significantly predicted by the expected product quality, perceived risk and price advantages, among which expected product quality has the highest effect.

1. Introduction

It is crucial to overcome multiple barriers to make the shift to a circular economy, one of which is the consumer's acceptance of remanufactured products (Jansson et al., 2017). Remanufactured products are worn-out products that are restored to the same condition as new (Ijomah et al., 1999; Sundin, 2004). A circular economy aims to keep materials, components and products at their highest utility and value (Didenko et al., 2018) and is particularly important for electrical and electronic equipment (EEE), which contain large quantities of valuable materials. Remanufacturing has been shown beneficial from both economic and environmental perspectives (Sundin and Bras, 2005). Thus, a remanufactured EEE product is often seen as a sustainable option for consumers. However, Michaud and Llerena (2011) revealed that environmental benefits associated with a remanufactured product do not significantly increase a consumer willingness to pay. Consumers may also be uncertain regarding the information that is provided beforehand and how well the information predict future performance (Michaud and Llerena, 2011). Another challenge is that consumers product knowledge is limited (Milios and Matsumoto, 2019). To overcome these barriers, companies need to focus on the right factors that are influencing the consumer's purchase intention. Addressing a consumer's perception of remanufactured EEE products is particularly important when closing the loop on the circular economy.

This study examined how influencing factors shaped the consumer's purchase intention of remanufactured EEE products, and particularly a robotic lawn mower. Influencing factors were derived from previous research. The aim was to identify the factors that consumer valued the most, from which companies can establish remanufacturing and marketing strategies. A robotic lawn mower was chosen in a Swedish context because the country is well-known for promoting sustainable development (Baker and Eckerberg, 2007), Swedish consumers are aware of the benefits (Milios and Matsumoto, 2019) and because Husqvarna was investigating the potential of introducing remanufactured robotic lawn mowers in Sweden.

2. Theoretical framework and model development

This study was rooted in the theory of planned behavior (TPB), which describes the likelihood of an individual engaging in a specific behavior (Fishbein and Ajzen, 2015). The individual's attitude, subjective norm and perceived behavioral control influences the intention to engage in a specific behavior (Fishbein and Ajzen, 2015; Ajzen, 1991). TPB can provide a unique lens to view the consumer's purchase intention, as seen Fig. 1. In the following paragraph, the model with its underlying theory, factors and hypothesis is presented.

The factor of attitude refers to the degree to which an individual has a favorable or unfavorable evaluation or appraisal of the

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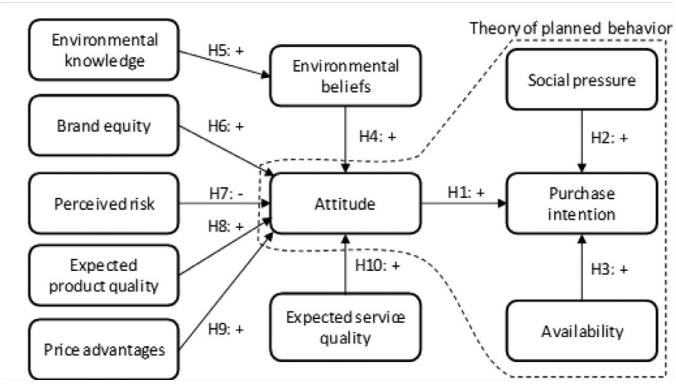

Fig. 1. Hypothesized relationships between factors.

purchasing of a remanufactured robotic lawn mower. Fishbein and Ajzen (2015) have shown that the more favorable or positive the consumer's attitude, the stronger the intended behavior. Therefore, we hypothesize the following:

H1: Positive attitude towards remanufactured robotic lawn mowers positively influences the consumer's purchase intention.

The factor of subjective norm refers to social pressure perceived by the individual. Social pressure is formed by important referents' opinions that can either like or dislike the intended behavior (Fishbein and Ajzen, 2015; Ajzen, 1991, 2012). We expect that consumers who value important referent opinions also have a greater purchase intention. Given that Sweden is well-known for sustainable development (Baker and Eckerberg, 2007), we further expect a positive influence from important referents.

H2: Positive subjective norm positively influences the consumer's purchase intention associated with remanufactured robotic lawn mowers.

The factor perceived behavioral control refers to the probability of successfully performing the behavior (Fishbein and Ajzen, 2015). In our case, this depends on every consumer's obstacles to find a remanufactured robotic lawn mower. It reflects the availability of remanufactured robotic lawn mowers and access to related information. We expect that consumers who know where to get information and a remanufactured robotic lawn mower also are more willing to pay.

H3: Positive perception of the availability for remanufactured robotic lawn mowers positively influences the consumer's purchase intention.

The factor of environmental beliefs refers to the consumer perception of how well a robotic lawn mower can support the process to minimize environmental impacts. In our case, it reflects the attractiveness of buying an environmentally labeled robotic lawn mower, and the consumer's willingness to repair it themselves and serve a robotic lawnmower instead of buying a new one, thereby preventing waste by repairing, reusing and recycling products, also known as 3R (Ijomah et al., 1999; Joshi et al., 2006). This factor deals with the consumer's intention to extend the life of a robotic lawn mower. The willingness of extending the product's life is often linked to after service and maintenance. This is an intended or unintended belief that has an impact on the environment. We expect that environmental beliefs positively influence the consumer's attitude.

H4: Positive environmental beliefs positively influence the consumer's attitude towards remanufactured robotic lawn mowers.

The factor of environmental knowledge refers to the degree of knowledge about the environmental outcome (recycling, waste treatment and pollution) associated with remanufactured robotic lawn mowers. Researchers (Michaud and Llerena, 2011; Milios and Matsumoto, 2019; Wang et al., 2018) revealed that the greater the consumer's knowledge, the more likely the consumer would have a positive belief and perceive higher consumer value. Therefore, we expect environmental knowledge to positively influence the consumer's environmental beliefs.

H5: Environmental knowledge positively influences the consumer's environmental beliefs associated with remanufactured robotic lawn mowers.

The factor of brand equity refers to the value added by its brand name (Aaker, 1999). A previous study (Abbey et al., 2015) revealed that a technical remanufactured product, depending on which brand, had a positive influence on attractiveness. In this study, the brand name Husqvarna was used as they were investigating the potential of introducing remanufactured robotic lawn mowers. We propose the following:

H6: Strong brand equity positively influences the consumer's attitude towards remanufactured robotic lawn mowers.

The factor of perceived risk refers to a "subjective expectation of a loss" associated with a remanufactured robotic lawn mower (Sweeney et al., 1999, p. 81). In our case, perceived risk was determined by three sub-factors, namely physical, time and financial risk. These three dimensions result in unpleasant consequences. Therefore, we propose the following:

H7: Perceived risks negatively influence the consumer's attitude towards remanufactured robotic lawn mowers.

The factor of expected product quality refers to a consumer's expectations about a remanufactured product's "overall excellence or superiority" (Zeithaml, 1987, p. 3). In our case, expected product quality was determined by six sub-factors, namely reliability, performance, features, conformance, durability and aesthetics. We expect that if consumers are more familiar with the quality of remanufactured products, they would be more willing to purchase a remanufactured product.

H8: Positive perception of the excepted product quality for remanufactured robotic lawn mowers positively influences the consumer's attitude.

The factor of price advantages refers to "the degree to which the consumers agree with the suitability of a price point" (Wang et al., 2018, p. 483). There are several studies (Wang et al., 2018; Abbey et al., 2015; Jiménez-Parra et al., 2014) confirming that price discounts are a significant factor that positively influences the perceived value and the consumer purchase intention. A consumer expects to receive some price advantage when buying a remanufactured product because the product is already used. Therefore, we propose the following:

H9: Price advantage positively influences the consumer's attitude towards remanufactured robotic lawn mowers.

The factor of expected service quality refers to the consumer's expectations of a process which provide solutions to their problems (Grönroos, 2007). In our case, expected service quality reflects the service agreement in case the remanufactured robotic lawn mower fails, and needs to be served. Otieno and Liu (2016) point out that warranties such as service agreements are important for remanufactured electronic products and the consumer relationship. Thus, we propose the following:

H10: Positive perception of the excepted service quality for remanufactured robotic lawn mowers positively influences the consumer's attitude.

3. Research methodology

A survey-based data collection method was used to test the hypothesized model. In order to reach consumers with access to robotic lawn mowers, the questionnaire was published in a private Facebook group targeting Husqvarna robotic lawn mower users. The questionnaire was also sent electronically to 134 handpicked participants. Three reminders were sent out in intervals of three

Table 1
Specification of the sample and information analysis.

Geographical area	Sweden
Sample size	118
Sample design	Convenience sample
Fieldwork	April - 2019
Pre-test	1st test: Three academics2nd test: Five industry experts
Information analysis	SmartPLS 3 and IBM SPSS statistics 25

Table 2
Evaluation of convergent validity and internal reliability.

Construct/factor	Composite reliability (CR)	Average variance extracted (AVE)	Cronbach's alpha
Attitude (A)	0.946	0.85	0.914
Social pressure (SN)	0.789	0.56	0.610
Availability (C)	0.943	0.68	0.909
Environmental beliefs (E)	0.798	0.57	0.635
Environmental knowledge (EK)	0.938	0.83	0.900
Brand equity (B)	0.821	0.70	0.679
Perceived risk (R)	0.781	0.55	0.631
Expected product quality (PQ)	0.928	0.68	0.906
Price advantages (P)	0.794	0.56	0.620
Expected service quality (SQ)	1	1	1
Purchase intention (I)	0.935	0.83	0.894

to five days after the first questionnaire was sent out or published. In total, 118 survey responses were received back, with 103 coming from the private Facebook group and 15 handpicked ones. Inspiration and existing items were used from previous research to assess each factor (see Appendix A). A scale ranging from "completely agree" (7) to "completely disagree" (1) was used. A pretest was conducted to validate the measures. As this study was a part of a master's thesis, it was convenient to ask academics from Linköping University and industry contacts from Husqvarna to evaluate the questionnaire. During the evaluations, items were changed after their recommendations. It was observed that some industry experts were not familiar with the remanufacturing concept. Therefore, as in previous research (Hazen et al., 2017; Wang et al., 2013), a vague description of a remanufactured product was provided in the questionnaire. The specifications of the sample are presented in Table 1.

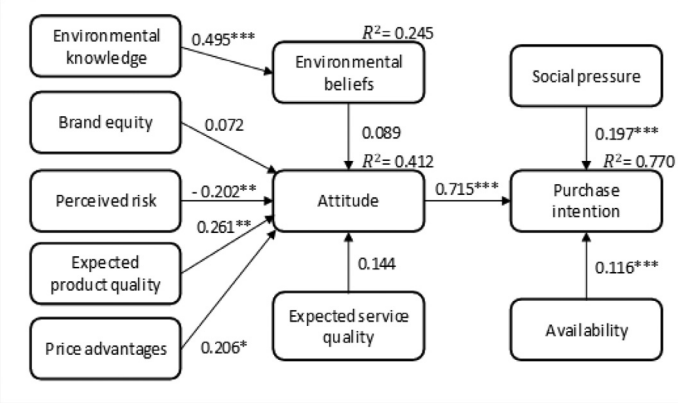

Fig. 2. Structural equation modelling results on consumer purchase intention.

4. Result

We used the structural equation model, applying partial least squares optimization as recommended for low samples sizes, for data that is not normally distributed, and less developed theoretical models (Hair et al., 2017; Joreskog and Wold, 1982). A reflective measurement model was used as recommended for constructs that contain highly correlated items (Hair et al., 2017). There was no significant difference between early and late responses to items. The factor of loadings, cross-loadings, composite reliability (CR), Cronbach's alphas and average variance extracted (AVE) were assessed, as suggested by Hair et al. (2017) and Fornell and Larcker (1981), to demonstrate convergent validity and internal reliability. The composite reliability and Cronbach alpha need to exceed 0.7, and the average variance extracted was 0.5 (Hair et al., 2017). Field (2019) points out that Cronbach alphas between 0.6 and 0.7 are on the lower limit, but acceptable. According to some researchers, including the creator of this index, this criterion is too strict (Cronbach, 2014). From Table 2, it is shown that conditions for convergent validity and internal reliability were acceptable. The expected service construct consisted of a single item that was inappropriate for convergent validity and internal reliability. Factor loadings loaded on their corresponding construct and exceeded the recommended value of 0.5 (Hulland, 1999). All items had higher loadings on their corresponding construct than the cross-loadings on the other constructs.

For discriminant validity, the Fornell and Larcker criterion was performed. This criterion checks whether all constructs are not too highly correlated with each other (Fornell and Larcker, 1981). This criterion is fulfilled if the square root of AVE in the diagonal is higher than all the correlation coefficients in the off-diagonal. As shown in Table 3, this criterion was met.

The hypotheses were tested using a two-tailed t-test with bootstrap and 500 sub-samples. The coefficient of a linear regression, also known as a path coefficient, is denoted as a β-value (Hair et al., 2017) – the greater the β-value, the stronger the effect on the dependent variable. As suggested by Hair et al. (Hair et al., 2017), the critical t-values and the significance levels were examined. Table 4 presents all hypotheses with corresponding β-values and t-values. Seven out of ten hypotheses were supported with a 90%, 95% or 99% confidence interval. These controls for internal reliability as well as convergent and discriminant validity provided evidence that the measures were adequate for the hypothesized model

After confirming the measures, the hypotheses were presented via a structural model, as shown in Fig. 2.

The structural model indicates that a consumer purchase intention was primarily influenced by his or her attitude (β =0.715, p<0.01) towards a remanufactured product, followed by social pressure (β=0.197, p<0.01) and availability (β =0.116, p<0.01). In total, the model explains 77% of the variance in intention to pur-

Table 3
Comparison between correlation coefficients and AVE of constructs.

Construct/factor	A	B	E	EK	SQ	R	P	PQ	C	I	SN
Attitude (A)	0.92										
Brand equity (B)	0.17	0.84									
Environmental beliefs (E)	0.38	0.04	0.76								
Environmental knowledge (EK)	0.61	0.11	0.50	0.91							
Expected service quality (SQ)	0.34	0.10	0.26	0.40	1.00						
Perceived risk (R)	-0.39	-0.01	-0.28	-0.28	-0.03	0.74					
Price advantages (P)	0.45	0.22	0.44	0.42	0.36	-0.10	0.75				
Expected product quality (PQ)	0.56	0.14	0.39	0.45	0.35	-0.54	0.44	0.83			
Availability (C)	0.09	-0.16	0.00	-0.03	-0.08	0.03	0.07	0.09	0.92		
Purchase intention (I)	0.86	0.07	0.34	0.51	0.31	-0.48	0.44	0.62	0.18	0.91	
Social pressure (SN)	0.68	0.18	0.42	0.46	0.23	-0.32	0.37	0.48	0.01	0.69	0.75

Note: Diagonal elements are square roots of average variance extracted.

Table 4
Evaluation of hypotheses.

Hypothesis test	β-value	t-value (bootstrap)
Attitude (A) → Purchase intention (I)	0.715***	12.024
Social pressure (SN) → Purchase intention (I)	0.197***	3.160
Availability (C) → Purchase intention (I)	0.116***	3.863
Environmental beliefs (E) → Attitude (A)	0.089	0.945
Environmental knowledge (EK) → Environmental belief (E)	0.495***	4.969
Brand equity (B) → Attitude (A)	0.072	0.811
Perceived risk (R) → Attitude (A)	-0.202**	2.045
Expected product quality (PQ) → Attitude (A)	0.261**	2.186
Price advantages (P) → Attitude (A)	0.206*	1.811
Expected service quality (SQ) → Attitude (A)	0.144	1.613

Note: *** = $p < 0.01$, ** = $p < 0.05$, * = $p < 0.1$.

chase remanufactured robotic lawn mowers (R^2= 0.770). A consumer's attitude was significantly predicted by the product quality (β=0.261, p=0.029), price advantages (β =0.206, p=0.071) and perceived risk (β =-0.202, p=0.041), among which expected product quality had the strongest effect on a consumer's attitude. In other words, to increase the probability that a consumer purchases a remanufactured robotic lawn mower the product quality, perceived risk and price must have priority. The risk consumers feared the most, based on the mean (μ), is time risk associated with serving and maintenance (μ=4.10), followed by safety risk (μ=3.40) and financial risk (μ=2.72). Regarding the product quality, consumers ranked product performance (μ=5.98) the highest, followed by conformance (μ=5.11) and aesthetics (μ=4.86). Given the fact that the difference in factor loadings was insignificant, the mean values were investigated instead. As described by Field (2019), this does not necessarily mean that these sub-factors had the greatest influence on the construct. The consumer's attitude was not significantly influenced by the expected service quality, brand equity and environmental beliefs. Together, the constructs explain 41.2% of the total variance in the consumer's attitude (R^2=0.412). Swedish consumers had good environmental knowledge which contributed positively to their environmental beliefs (β =0.495, p<0.01), but these beliefs did not significantly contribute to more sales. This construct explains 24.5% of the total variance in the consumer's environmental beliefs (R^2= 0.245).

5. Discussion and implications

This study suggested that expected product quality, price advantages and perceived risk were key determinants for consumers in relation to attitude. These benefits and risks were supported by perceived value and social exchange theory, which suggested that consumers seek benefits relative to risks or sacrifices (Grönroos, 2007; Dodds et al., 1991). Similar studies have been conducted to quantitatively predict the consumer's purchase intention of remanufactured products. These studies were a useful benchmark to test the validity of this study's result. This study achieved a similar result to Abbey et al. (2015), which also revealed that product quality had the highest path coefficient, followed by price advantages. This applied to technical products (camera, laptop, printer and camcorder), which also fall under the EEE category and which was conducted nationwide in the United States. A contradicting study from Wang et al. (2018) revealed that Chinese consumers consider price advantages slightly higher than product quality in relation to perceived value. However, in his study, automobile parts were investigated, which were a technical product but not an EEE product.

Consumers had the highest expectations on product performance and a time loss associated with serving and maintenance. This time risk can be related to durability and serviceability as it is time-related, according to Garvin (1987). This result was, for the most part, supported by Hazen et al. (2017), which also revealed that the perceived quality of a remanufactured product is determined by performance, durability, serviceability and features. The fact that environmental beliefs were not significant was in line with Michaud and Llerena (2011), which showed that environmental considerations have a low impact on the consumers' willingness to pay. This result was unexpected since Sweden was well-known for promoting sustainable development (Baker and Eckerberg, 2007). Despite our similarity, we discovered a disagreement in the existing literature regarding the consumer's environmental considerations in a circular economy. For example, Wang et al. (2018) and Hazen et al. (2016) revealed that environmental benefits had a significant impact on the perceived value and that consumers with a favorable attitude considered that environmental benefits could lead to a switching behavior towards remanufactured products.

This study can be used for theory development regarding the consumer's role in a circular economy, specifically in the initial phase, when a new EEE product is sold for the second time but as remanufactured. Identified influencing factors that were identical from similar studies can be used to help remanufacturers develop marketing and remanufacturing strategies. Given that prod-

uct quality was the dominant determinant in which performance (see item PQ6 in Appendix A) received the highest mean value within this construct, from a marketing standpoint we recommend using Ijomah et al. (1999), p. 192) definition that a remanufactured product should be in a "like-new functional state" in which the product has the same quality as new. The factor of social pressure was also shown to have a significant impact with respect to the consumer's purchase intention. Therefore, companies could also benefit from marketing activities that let consumers write a review or rate a product. Furthermore, consumers that knew where to buy (or not to buy) a remanufactured robotic lawn mower and where to get related information were more likely to make a purchase. Therefore, an overall increase in a company's marketing activities related to market offerings of remanufactured products would significantly increase sales.

6. Conclusions and future research

This study has described, using the TPB, how factors influence the consumer's purchase intention for remanufactured robotic lawn mowers. This study concludes that the consumer's purchase intention is significantly predicted by their attitude, followed by social pressure and availability. Consumers with a positive attitude or who value important referents were more likely to make a purchase. As the availability of one type of remanufactured product increases on the market, it increases the probability for a consumer to make a purchase. The consumer's attitude is significantly predicted by the product quality, price advantages and perceived risk.

To this end, we want to acknowledge certain limitations of this study. From a methodological standpoint, the convenience sampling technique partially led to some sample characteristics being overrepresented. Despite the convenience sampling technique, the result from the formulated hypotheses was consistent with similar EEE products. Another limitation that made comparisons difficult was the newly established items for the expected service quality and environmental beliefs constructs. The items for environmental beliefs (E1-E3) could have been misunderstood for after service or maintenance. The fact that Swedish consumers had good environmental knowledge (EK1-EK3), and that well-known theoretical concepts (3R and environmental labels) were used, we expect that Swedish consumers also link these items to their environmental beliefs.

There is an opportunity for future research. First, other theoretical models could be used to explain the consumer's purchase intention. Second, to increase the generalizability, a random sampling technique could be used, and participants that are more neutral and less influenced by a brand. Third, similar studies need to be conducted for other EEE products and in other countries and markets to get a broader perspective.

CRediT authorship contribution statement

Daan Kabel: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing - original draft, Visualization. **Simon Ahlstedt:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing - original draft, Visualization. **Mattias Elg:** Methodology, Writing - review & editing, Visualization. **Erik Sundin:** Conceptualization, Writing - review & editing, Supervision, Project administration, Funding acquisition.

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Appendix A. Measures

Attitude, references (*Hazen et al., 2016*, *Kumar, 2012*)
A1: I like the idea of buying a remanufactured robotic lawn mower.
A2: I expect that buying a remanufactured robotic lawn mower will do good for society.
A3: I would like to use a remanufactured robotic lawn mower.
Subjective norm, references (*Jiménez-Parra et al., 2014*; *Nahavandi, 2014*)
SN1: People around me whose opinion I value would agree with me buying a remanufactured robotic lawn mower.
SN2: People around me whose opinion I value would disagree with me buying a remanufactured robotic lawn mower.
SN3If an expert in technology would recommend a remanufactured robotic lawn mower, I would buy it.
Availability, reference (*Kumar, 2012*)
C1: I know where I can find information about remanufactured robotic lawn movers.
C2: I know where I can get a remanufactured robotic lawn mower.
C3: I know that remanufactured robotic lawn mower is available in shops I usually go to.
Environmental beliefs, reference (*Joshi et al., 2006*; *Houé Ngouna and Grabot, 2009*)
E1: I would like to buy an environmental labelled robotic lawn mower.
E2: I'd rather repair my robotic lawn mower than buy a new one.
E3: I'd rather leave my robotic lawn mower on service than buying a new one.
Environmental knowledge, reference (*Hazen et al., 2016*)
EK1: Purchasing a remanufactured robotic lawn mower can help use more recycled parts of the product.
EK2: Purchasing a remanufactured robotic lawn mower can help minimize landfill waste.
EK3: Purchasing a remanufactured robotic lawn mower can help minimize emissions in soil and the atmosphere.
Brand equity, reference (*Yoo and Donthu, 2001*)
B1: If another brand is as good as Husqvarna, I would choose Husqvarna.
B2: If another brand is as good as Husqvarna, I would buy Husqvarna's even if it is slightly more expensive.
Perceived risk, references (*Schrank and Dubinsky, 2004*; *Jahankhani, 2009*, *Ming-Chi, 2009*)
R1: I am afraid that the safety of a remanufactured robotic lawn mower is not as good as a new one.
R2: I am afraid that an investment in a remanufactured robotic lawn mower is a bad idea.
R3: I am afraid that I have to spend more time to maintain and serve a remanufactured robotic lawn mower.
Expected product quality, reference (*Garvin, 1987*)
PQ1: I expect that a remanufactured robotic lawn mower will stay as good as a new one.
PQ2: I expect that a remanufactured robotic lawn mower will function as good as a new one.
PQ3: I expect that a remanufactured robotic lawn mower offers the same features as a new one.
PQ4: I expect that a remanufactured robotic lawn mower is nice-looking as a new one.
PQ5: I expect that a remanufactured robotic lawn mower has the same specifications as a new one.
PQ6: I expect that a remanufactured robotic lawn mower can cut grass as good as a new one.
Price advantages, references (*Ijomah et al., 1999*; *Wang et al., 2018*; *Abbey et al., 2015*)
P1: A remanufactured robotic lawn mower is worth to buy if the quality is the same as new.
P2: A remanufactured robotic lawn mower is worth buying if the installation kit is included in the price.
P3: A remanufactured robotic lawn mower should cost less than a new one.
Expected service quality, reference (*Otieno and Liu, 2016*)
SQ: It would be good to be able to buy the remanufactured robotic lawn mower with the same service agreement as for a new one.
Purchase intention, references (*Kumar, 2012*; *Wang and Hazen, 2015*)
I1: I consider buying a remanufactured robotic lawn mower in the future.
I2: I would encourage others to buy a remanufactured robotic lawn mower.
I3: I would actively seek a remanufactured robotic lawn mower in a store in order to purchase it.

*=completely agree (1) and completely disagree (7).

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