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Environmentally-conscious behaviours in the circular economy. An analysis of consumers' green purchase intentions for refurbished smartphones

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ABSTRACT

The management of waste from electrical and electronic equipment (WEEE) is a hot issue for both the scientific community and practitioners. Among the strategies that lead a system to circularity, that of reconditioning (or refurbishing) appears to be very suitable and profitable for WEEE management. According to it, this paper aims to contribute to the existing literature on consumer behavior and Circular Economy by studying what determines the green purchase intention of a refurbished smartphone. By applying a Discriminant Analysis it was found that psychological factors, such as green perceived value and environmental knowledge, are the most powerful predictors of green purchase intention of refurbished smartphones, while social and emotional ones, i.e. collectivism, subjective norms and environmental concern, do not influence it. Our results can be useful to both remanufacturers and retailers of refurbished products to identify more effective marketing strategies, as well as to policymakers to define specific measures and policies able to improve the environmental concern of the end consumers.

1. Introduction

The Circular Economy paradigm is attracting considerable interest among both scholars and practitioners, as evidenced by the significant increase in scientific production on the subject. A search on the Scopus database showed that more than 4,500 articles on the topic were published in 2021, while only two years earlier, in 2019, scientific output stood at around 2,000. The reason lies in the fact that the Circular Economy is seen as a way to approach economic growth while simultaneously pursuing the goal of sustainable development (Kirchherr et al., 2017). Indeed, in recent years, there has been an urgent need to minimise waste generation alongside a concern to optimise resources and material consumption, as evidenced by the 17 Sustainable Development Goals proposed by the United Nations in 2015 (Colglazier, 2015). Globally, the Circular Economy is recognised as a key element in achieving an inclusive, equitable and environmentally self-sufficient economy (Centobelli et al., 2021; Mazur-Wierzbicka, 2021).

At its core there is the need to implement a radical change not only in production models but also, and above all, in consumption models, with the aim of making a transition to more sustainable models able to respect the Planet and support the society's development. Phipps et al. (2012 p.1227) define sustainable consumption as "consumption that simultaneously optimizes the environmental, social, and economic consequences of consumption in order to meet the needs of both current and future generations". The concept of sustainable consumption, presented as the twelfth goal of the 2030 Agenda drawn up by the United Nations, is closely linked to that of sustainable lifestyle, which in turn has its roots in consumer behaviour (Calculli et al., 2021). Indeed, consumer decisions have the power to influence demand and consequently force a change in production paradigms to meet customer needs. The consumer plays a fundamental role within the market, as he can become loyal to a specific product, brand or company, modifying accordingly his purchase intentions (Green et al., 2018). In a context of sustainable development, the role of the consumer and its lifestyle even more important (Lubowiecki-Vikuk et al., 2021). Embracing a sustainable, or low-impact, lifestyle means implementing practices oriented to reduce the individual's impact on the environment and society. It implies establishing a more conscious relationship with the environment, focusing on the ways and uses of natural resources rather than their overconsumption (Dimitrova et al., 2021). However, although the literature (e.g. Bigliardi and Filippelli, 2022; Perri et al., 2020) shows that in the last decade consumers are more concerned about environmental

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issues, they are still reluctant to radically change their habits, sacrificing convenience for the sake of the environment (Zabkar and Hosta, 2013). It follows that further research needs to be conducted to better understand why consumers adopt more environmentally sustainable purchasing behaviours. In this regard, our study aims to expand knowledge about consumers' intention to purchase a green product. Indeed, Mugge et al. (2017) state that purchase intention does not always translate into actual purchase, and this paradigm occurs with even more intensity in the case of green products.

Specifically, this paper focuses on the purchase intention of a particular green product, namely the refurbished smartphone, using consumer behaviour theory to understand what social, psychological and individual factors it is determined by. It is worth underlying that we focus on smartphones as an electronic device given that the number of smartphones purchased in the last years has increased exponentially with a consequent steep growth in the related environmental issues (e.g. mining, transport and assembly of the several chemical elements). In fact, on the one hand, these devices represent a tremendous e-waste challenge as they contain toxic and rare-earth materials such as copper, chromium, lithium, neodymium, terbium, etc. To make matters worse, the average user switches phone every two years without properly recycling them (Zink et al., 2014). On the other hand, by 2020 smartphones generate more greenhouse gases than any other consumer electronic devices, surpassing the individual contribution of desktops, laptops and displays (Belkhir and Elmeligi, 2018). Particularly, greenhouse gas emissions related to a specific smartphone is estimated to be 19 kg CO2-equivalents annually. If we also consider the environmental impact from using networks and data centers, the annual emissions increase to 62 kg CO2-equivalents (Joshi et al., 2021). Therefore, given the remarkable social and environmental cost of creating new smartphones, it would make sense to identify proper actions and strategies to try to reduce their impacts.

In line with it, this paper contributes to the literature in several ways. Firstly, it broadens knowledge about consumer behaviour towards refurbished high-tech products. Previous studies on the subject have mostly evaluated the relationship between social, psychological, individual constructs and the purchase intention, but to date no work has attempted to apply a discriminant analysis to identify what actually determines the intention to purchase of a refurbished smartphone. Secondly, this study differs from previous ones on the topic as it includes a validation of the constructs derived from the literature by experts in the field, i.e. academics investigating issues concerning the circular economy and environmentally preferable purchasing. It brings validity to the entire study.

The paper is structured as follows. Section 2 sets out the theoretical background, section 3 explains the three-step methodology adopted, while Section 4 presents the results of the analyses conducted. Section 5 is devoted to discussion, while in section 6 the conclusions are derived. Finally, in section 7 implications, both managerial and theoretical, limitations of the study and proposals for future research are presented.

2. Theoretical background

2.1. Circular strategies for electrical and electronic waste management

The urgency to minimise waste generation, which has become more pronounced since the early 2000s, has resulted in the development of strategies that can lead a system to greater circularity, summarized in the so-called “9R framework”. It has been proposed by Potting et al. (2017) and it includes the following nine strategies: refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle and recover. The model proposed by the authors identifies three distinct groups of goals: i) useful application of materials, ii) life extension of the product and its component parts, and iii) smarter manufacturing and use of the product. A high level of circularity of materials results in their permanence for a longer period in the product chain or the ability to be used them again after being discarded, preferably returning to original quality levels. In this way, fewer natural resources are needed to produce new materials and products, limiting their extraction and benefiting the environment.

In this context, the management of waste from electrical and electronic equipment (WEEE) is a hot issue for both the scientific community and practitioners, which needs to be addressed in order to move toward a more circular economy (Corsini et al., 2020; Bruno et al., 2021). Such devices (e.g. smartphones, laptops, desktops, displays, etc.) have proven to be a fundamental accessory in our daily lives due to their easy accessibility and the possibility they give to improve our lifestyle. However, the issue related to their disposal is of vital importance. According to a United Nations report on 2021 estimates, each individual over his lifetime may generate up to 7.6 kg of electronic waste (Murthy and Ramakrishna, 2022). The consequence is an increase of this type of waste by about 3–5% each year (Cucchiella et al., 2015). For these reasons, the management of WEEE has been included among the sustainability challenges embodied in the UN Sustainable Development Goals. It can be traced back to one of the main goals of circularity, which is to extend the useful life of products through different strategies. Devices, such as computers or smartphones, in most cases are not discarded because they are no longer functional, but due to the rapid advancement of technology that quickly makes them obsolete.

Among the circularity strategies belonging to the goal of life extension, refurbishing (also called reconditioning) is particularly suitable for WEEE. It is defined as the process of restoring a product so that it can achieve satisfactory results, both in terms of function and aesthetics, although not to the levels of the corresponding new product (Reike et al., 2018). The refurbishing strategy is considered environmentally beneficial as it allows companies to save raw materials and energy, decreasing CO2 emissions and contributing positively to the shift toward a more circular economy (Linton, 2008). It also decreases the amount of WEEE, which is highly polluting if not properly disposed of. High-tech products, particularly smartphones, have a short life cycle as manufacturers continuously release new models into the market to chase the latest fashions in design and technology (Aytac and Wu, 2013). In particular, scholars have found that refurbishing smartphones at the end of their life is one of the most profitable processes with high environmental benefit (Zink et al., 2014).

Although this strategy is considered successful in addressing the waste problem of electrical and electronic products, end consumers represent a critical success factor. In fact, there is a line of research focused on studying consumer behaviours regarding the purchase of refurbished smartphones.

2.2. Models of consumer behaviour

The role of consumers is critically important to the success of the refurbishing strategy. Previous research has analyzed consumer purchase behaviour toward refurbished products by taking different perspectives. A first strand focused on the study of willingness to pay, showing that consumers are willing to pay less for a refurbished product than a new one (Michaud and Llerena, 2011; Harms and Linton, 2016; Liu and Tsaur, 2020). Moreover, several scholars investigated how consumers respond to refurbished products, identifying factors that influence their purchase, such as perceived value and risk (e.g., Matsumoto et al., 2017; Wang and Hazen, 2016), quality (e.g., Hazen et al., 2017a; Wong and Zeng, 2015), consumer knowledge of the product (e.g., Wang et al., 2013; Matsumoto et al., 2018b) or marketing mix variables such as price (e.g., Wong and Zeng, 2015), distribution channels (e.g., Agostini et al., 2021) or green characteristics of the product (e.g., Abbey et al., 2015). These studies build from consumer behaviour theory, which is based on rational models of behavioural decisions. The most influential one is the theory of planned behaviour (TPB), which has been widely

exploited in the literature related to consumer behaviour toward closed-loop supply chain products (Jiménez-Parra et al., 2014). It stems from a reworking of the Theory of reasoned action (TRA) (Fishbein et al., 1975), which presents the three predictive factors that contribute to recognize three elements of a given voluntary goal: intention to behaviour, attitude toward behaviour, and subjective norms. Intention to behaviour exerts direct action toward specific conduct, and it is influenced by the other two factors included in the theory. Attitude takes on the features of an individual's predisposition to adopt or not adopt a specific behaviour, while subjective norms represent the influence that the opinions of close people, such as friends or family members, have on the indi'idual's choices. According to TPB, on the other hand, purchase intention and purchase behaviour are influenced by the combined effect of three variables: attitude, subjective norms and perceived behavioural control (Ajzen, 1991). These theories, when used to explain consumer behaviour toward the purchase of a green product, are combined with others that have constructs suitable for understanding pro-environmental behaviour. In fact, some scholars (Dhir et al., 2021; Guagnano et al., 1995) have integrated TPB with the Attitude-Behaviour-Context (ABC) Theory, according to which consumer behaviour is the result of attitude, or internal processes, and contextual factors, or processes external to the individual. Underlying this theory is a means-end approach that predicts that individuals act in a way that benefits as much as possible from such behaviour (Zhuang et al., 2021).

Other scholars (Corrado et al., 2021; Bamberg et al., 2007; Bamberg and Möser, 2007) have combined TPB with the Norm Activation Theory (NAT) proposed by Schwartz (1977). According to NAT, behaviour is anticipated by three factors: personal norms, awareness of consequences and ascription of responsibility. Personal norms refer to an individual's moral obligation to perform a certain behaviour; awareness of consequences relates to the individual's understanding of the effects that his behaviour can cause; and ascription of responsibility relates to the individual's sense of responsibility for the negative consequences his behaviour may have. These constructs are well suited to explain environmentally friendly behaviour since they imply elements of moral responsibility that come into play when one takes action in favour of environmental sustainability (Guagnano, 2001).

These theories are rooted in the Theory of Consumer Behaviour, according to which the factors involved in the purchase decision belong to three categories: psychological factors, individual characteristics and social factors. This theory, combined with those previously set forth (e.g., TRA, TPB, NAT, ABC) can be used to identify factors that describe the purchase intention of a green product (Bigliardi et al., 2020). In this regard, Zhuang et al. (2021) proposed a framework combining TPB and ABC. The authors identified cognitive, social, and personal (i.e., related to consumer characteristics) constructs that can influence green purchase intention, defined as the desire of a consumer interested in environmental issues to choose a greener product over conventional products (Chen and Chang, 2012).

3. Methods

The objective of this paper is to contribute to the literature on consumer behavior and Circular Economy by investigating the determinants of green purchase intention of a refurbished smartphone. The research aim has been achieved through an empirical study composed of three subsequent phases, displayed in Fig. 1.

3.1. First phase: construct identification

The first phase consisted of a literature review to identify factors to be considered in the subsequent analyses. The research articles were identified through a systematic search procedure that included searching for keywords in the title, abstract and keywords section of the Scopus database. The choice of the Scopus database alone is motivated by the fact that it is considered the most comprehensive in terms of scientific publications in peer-reviewed journals, thus ensuring the reliability of the results (Bosman et al., 2006; Strazzullo et al., 2022). Moreover, several studies (e.g., Govindan et al., 2019; Cricelli and Strazzullo, 2021) used Scopus database as the only tool to conduct a valuable literature review, confirming its reliability. The keywords entered were the following, used in various combinations: "green purchase intention", "purchase intention", "intention to buy", "green purchase", "refurbish*", "recycl*", "remanufacture*", "renew*", "recondition*", "repurpose*". Following the indications of Bigliardi et al. (2020), the search was extended to all circular strategies. It returned 154 documents. In the next step, inclusion criteria were applied to limit the sample of articles. Specifically, only English-language papers were selected, published in peer-reviewed journals investigating the intention to purchase a green product (green refers to a product resulting from the adoption of one of the nine circular strategies). This skimming resulted in 74 articles subjected to a deeper reading. Based on the full-text reading, 24 papers were further excluded, leaving 50 valid studies for the analysis. An in-depth examination of the sample of articles resulted in a list of 24 factors, presented in Table 1. For each factor we highlighted if it has been studied in the context on refurbishing/remanufacturing strategy and if it is positioned as a direct antecedent of purchase intention or as a mediator between purchase intention and another construct. In particular, we considered only those ones related to the green dimension of purchase intention. As can be seen, numerous constructs

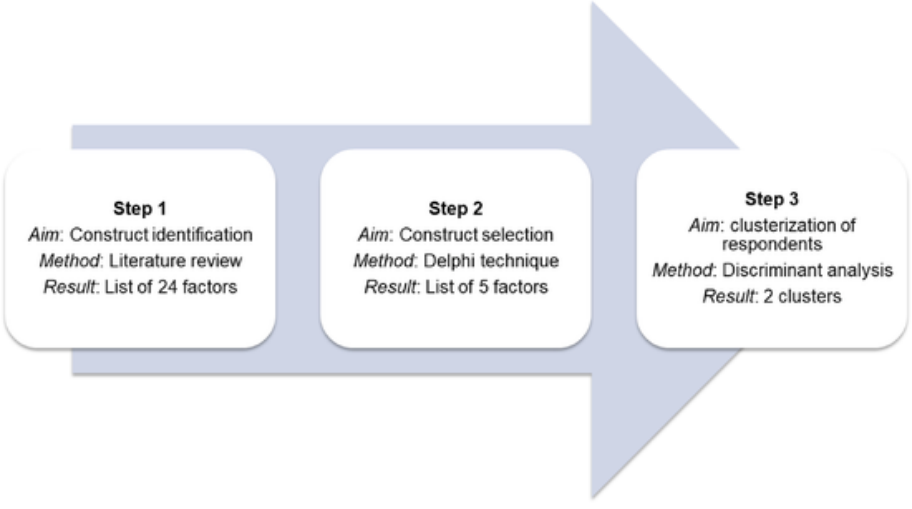

Fig. 1. The phases of the research.

Table 1
Factors affecting purchase intention in a circular economy context.

Construct	Direct antecedent of Purchase Intention	Mediator	Remanufacturing/ Refurbishing	Source
Altruistic values		X		Guagnano (2001)
Ambiguity tolerance	X		X	Hazen et al. (2012); Wang et al.°(2018a)
Ascription of responsibility	X			Guagnano (2001)
Attitude	X			Khaola et al. (2014); Gaur et al. (2018); Zhuang et al. (2021)
	X		X	Jiménez-Parra et al. (2014); Ma et al. (2017); Khor and Hazen (2017); Hazen et al. (2017b); Wang et al. (2018a); Wahjudi et al. (2018); Singhal et al. (2019)
Awareness of consequences	X		X	Mugge et al. (2017)
		X		Guagnano (2001)
Brand equity		X	X	Abbey et al. (2015); Ma et al. (2017)
	X		X	Hamzaoui-Essoussi and Linton (2014); de Vicente Bittar (2018)
Collectivism	X			Kim and Choi (2005); Zhuang et al. (2021)
Consumer familiarity	X		X	Wang et al.° (2018a)
Cost knowledge		X	X	Wang and Hazen (2016)
Environmental consciousness (Environmental concern)		X	X	Abbey et al. (2015); Sun et al. (2018)
	X		X	Gaur et al., 2015); Harms and Linton (2016); Vogtlander et al. (2017); de Vicente Bittar (2018); Zhao et al. (2018)
	X			Kim and Choi (2005); Khaola et al. (2014); Zhuang et al. (2021)
Environmental knowledge	X		X	Sun et al. (2018)
	X			Zhuang et al. (2021)
Green characteristics		X	X	Abbey et al. (2015)
	X		X	Wang and Hazen (2016); Vogtlander et al. (2017); Singhal et al. (2019)
Individual values	X		X	Gaur et al. (2015)
Motivation	X		X	Jiménez-Parra et al. (2014)
Perceived behavioural control	X			Kim and Choi (2005); Gaur et al. (2018); Park and Lin (2020); Zhuang et al. (2021)
	X		X	Ma et al. (2017); Khor and Hazen (2017); Wang et al.°(2018a); Singhal et al. (2019)
Product knowledge	X		X	Matsumoto et al. (2017); Wahjudi et al. (2018); Matsumoto et al.° (2018a); Matsumoto et al. (2018b)
		X	X	Ma et al. (2017)
Perceived risk	X			Magnier et al. (2019); Park and Lin (2020); Zhuang et al. (2021)
	X		X	Hamzaoui-Essoussi and Linton (2014); Wang and Hazen (2016); Vogtlander et al. (2017); Matsumoto et al. (2017); Ma et al. (2017); Mugge et al. (2017); Wahjudi et al. (2018); Matsumoto et al. (2018b); Wang et al. (2018b); Singhal et al. (2019);
		X	X	Sun et al. (2018)
Perceived trust	X		X	Wang et al.° (2018a)
	X			Zhuang et al. (2021)
Perceived value	X		X	Wang and Hazen (2016); Matsumoto et al. (2017); Wahjudi et al. (2018); Wang et al.° (2018a); Matsumoto et al.° (2018a); Matsumoto et al. (2018b)
	X			Zhuang et al. (2021)
Personal norms				Park and Lin (2020)

(continued on next page)

Table 1 (*continued*)

Construct	Direct antecedent of Purchase Intention	Mediator	Remanufacturing/ Refurbishing	Source
Price	X		X	Wong and Zeng, (2015); Hazen et al. (2017b); Matsumoto et al. (2017); de Vicente Bittar (2018); Matsumoto et al. (2018b); Wang et al. (2018b)
		X	X	Abbey et al. (2015)
Perceived quality		X	X	Abbey et al. (2015)
	X		X	Hazen et al. (2012); Wong and Zeng (2015); Wang and Hazen (2016); Vogtlander et al. (2017); Ma et al. (2017); Hazen et al. (2017a); Sun et al. (2018); Wang et al. (2018b); Matsumoto et al. (2018a); Zhuang et al. (2021)
Subjective norms	X			Gaur et al. (2018); Park and Lin (2020); Zhuang et al. (2021)
	X		X	Jiménez-Parra et al. (2014); Ma et al. (2017); Khor and Hazen (2017); Wang et al.˚(2018a); Singhal et al. (2019)
Warranty and certification		X	X	Harms and Linton (2016); Matsumoto et al. (2018a)

have been studied both in a general circular economy context, i.e. it has been analyzed their impact on the purchase intention of a generic recycled product, and in the specific case of refurbished (or remanufactured) products. It should be noted that some authors (see Zhuang et al., 2021) added the word green in front of the constructs purchase intention (green purchase intention), perceived value (green perceived value), and perceived risk (green perceived risk). Since the present study is an investigation in the specific context of the circular economy, the green dimension is intrinsically present in each construct. It follows that the version without the green prefix and the one with the green prefix have been considered as synonyms. These 24 factors represent the input for the next phase of the investigation.

3.2. Second phase: construct selection

Subsequently (step 2), constructs that influence the green purchase intention of a refurbished product have been identified from those proposed in the models previously described (see section 2). Since previous studies presented numerous variables, the selection of those most suitable for the purposes of our study was done by resorting to the knowledge of experts in the field. The Delphi technique has been adopted to conduct this part of the research as it is particularly recommended to assess the relevance of different variables and understand them thoroughly (Prieto-Sandoval et al., 2018). The main advantages of this technique are the lack of group pressure, since experts respond anonymously, and efficiency in the method of collecting and processing information. The process involved two email rounds with written questions coordinated by the facilitator (first author). Participants were informed in advance about the study objective, procedure, and schedule, and they were assured of the anonymity of the results.

Following Taber (1991), a panel of 20 experts in the field was selected. Specifically, it consists of academics specialized in closed-loop supply chains, circular strategies, environmentally preferable purchasing and green practices. Fig. 2 and Fig. 3, respectively, present the composition of the panel and the areas of expertise of the 20 experts surveyed. The majority of respondents are divided between assistant professors and research fellows, while only 15% are full professors. Their nationality is heterogeneous: half of them are affiliated with a European university, while the remainder were selected from countries that contribute most to the literature on green purchasing intention, e.g. China, Japan, Malaysia and India. As for the average age, it is 45.5 years: 45% of the respondents are over 50 years old, 30% are between 35 and 50 years old, and 25% are under 35 years old.

In the first round, the 20 participants were provided with a list of 24 constructs identified from the literature study (Table 2), each of which appropriately described. An explanation of how each construct impacts, according to the authors in the literature, the purchase intention of a generic recycled product was also provided. One construct, altruistic value, only takes on the role of a mediator, not directly affecting purchase intention. Consequently, it was included in the list, but the panel was asked not to rate it since it was not directly related to purchase intention. In this first round, respondents were asked to agree on the relevance of the above constructs to the analysis of purchase intention of a recycled product, and to indicate those that were not relevant, if any. The outcome of the first round showed that all members agreed that the 23 constructs directly involved in influencing purchase intention were valid.

In the second round, however, participants were asked to quantitatively rate the relevance of the 23 constructs using a 5-point Likert scale (1 ″not relevant," 5 ″very relevant) in relation the purchase intention of a refurbished smartphone. After collecting the results, the facilitator analyzed the responses by median and interquartile range (IQR) to decide which ones to consider for the next analysis (i.e., discriminant analysis). In fact, the median indicates the agreement on the relevance of each investigated construct, while the IQR indicates the dispersion of agreement among experts on the relevance of the scores. Following the directions of Lohuis et al. (2013) and Jenkins and Smith (1994), constructs with a median score ranging from 4 to 5 and an IQR less than 1.5 were considered.

3.3. Third phase: clusterization of respondents

The Delphi technique allowed us to identify, through the opinion of experts in the field, 5 constructs relevant to our study, presented in detail in section 4. The research objective was achieved through an empirical study based on a survey for data collection. Firstly, a questionnaire has been developed in which scale items were included for each of the constructs included in the analysis (Table 3). It is worth noting that the construct green purchase intention was added to the questionnaire, although it did not figure among those that emerged from the Delphi rounds. This construct, in fact, represents the discriminating variable used in the subsequent analysis, thus it must be included in the questionnaire. Responses were formulated in closed form and a five-point Likert-type scale was used. Participants were provided with a definition of a refurbished smartphone in order to clarify the subject matter of the survey. Afterwards, the questionnaire was pre-tested in order to assess

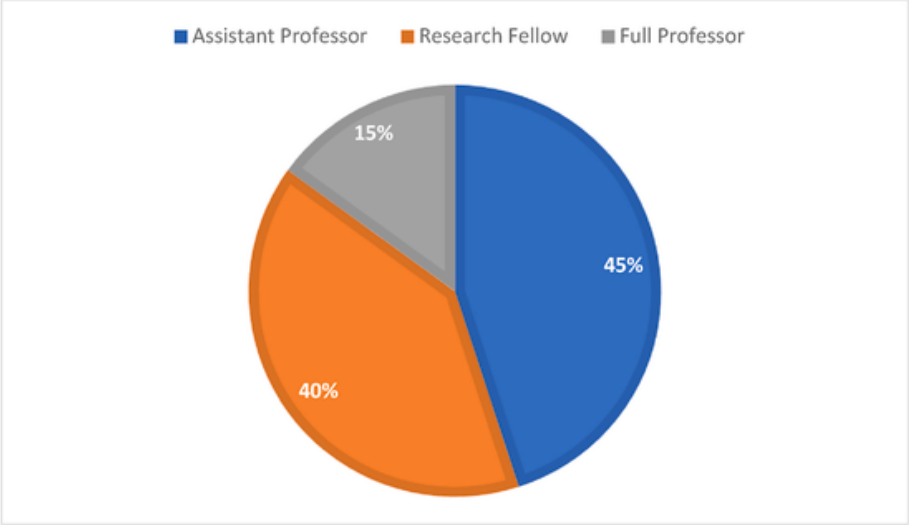

Fig. 2. Panel composition.

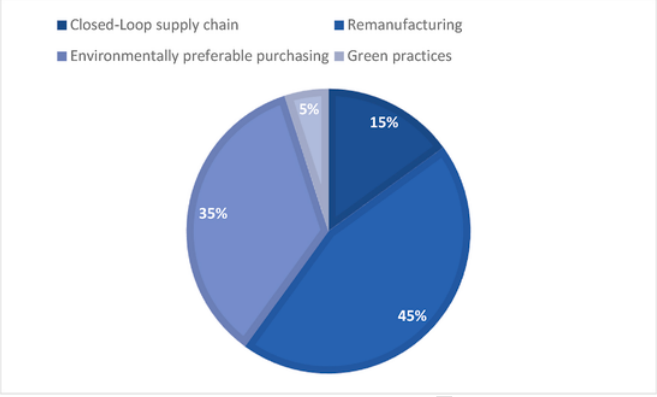

Fig. 3. Respondents' area of expertise.

Table 2
Panel members evaluation results.

Construct	Median	IQR	Selected for the subsequent analysis
Ambiguity tolerance	2.0	1.5	
Ascription of responsibility	2.0	1.0	
Attitude	3.5	2.5	
Awareness of consequences	2.5	1.5	
Brand equity	3.0	1.0	
Collectivism	4.0	1.0	X
Consumer familiarity	3.0	1.0	
Cost knowledge	3.5	2.5	
Environmental concern	4.0	1.5	X
Environmental knowledge	5.0	1.0	X
Green characteristics	2.5	1.5	
Individual values	3.0	1.0	
Motivation	3.5	2.5	
Perceived behavioural control	1.0	1.0	
Product knowledge	3.0	1.0	
Perceived risk	2.5	1.5	
Perceived trust	2.5	2.0	
Perceived value	4.0	0.5	X
Personal norms	2.5	1.5	
Price	2.5	1.5	
Perceived quality	2.0	1.5	
Subjective norms	4.0	1.0	X
Warranty and certification	3.5	2.5	

the clarity of the questions by administering it to a sample of 30 participants. Once the functionality of the instrument was tested, the questionnaire was sent to the selected sample of engineering students of an Italian university (Thomas, 2011). A total of 250 valid responses were collected and used for further analysis. The Statistical Package for Social Sciences (SPSS) computer program version 28 was used to conduct a multiple discriminant analysis to cluster all the respondents.

4. Results

4.1. Delphi technique results: the research framework

Using the Delphi technique, it was possible to delineate the research framework, composed of 5 constructs out of the 24 identified from the literature. They are listed and described in Table 4.

4.2. Empirical survey results

4.2.1. Scale reliability and validity

Confirmatory Factor Analysis was performed using SmartPLS software, which allowed the reliability and validity of the investigated constructs to be assessed. The reliability of the scale was verified by calculating two distinct statistical measures: first, Cronbach's α reliability coefficient of constructs (included green purchase intention) was determined, calculated on the responses provided by the 249 survey participants. All six constructs had a Cronbach's α value above the minimum threshold of 0.70 (Table 5) to be considered acceptable, thus satisfying the internal consistency conditions that ensure the validity of the scale. Second, the composite reliability (CR) of each construct was calculated, whose threshold value for acceptability is 0.70 (Hair et al., 2009). As shown in Table 5, the CR values of the six constructs considered are considerably high, ranging from a minimum of 0.826 to a maximum of 0.926, satisfying the convergent consistency condition of scale reliability. Next, the validity of the scale was verified by estimating the two dimensions of which it is composed, namely convergent validity and discriminant validity. To verify convergent validity, the average variance extracted (AVE) of all the latent factors has been estimated. The AVE values exceed the minimum threshold of 0.50 recommended by Hair et al. (2009). Finally, discriminant validity is measured by comparing the square root of AVE of each construct with the variance between constructs, as established by Fornell and Larcker (1981). Table 6 shows the values of the square root of AVE along the diagonal, while the other elements of the matrix report the value of the variance across constructs.

Table 3
Constructs measures.

Construct	Items	Source
Green purchase intention	**GP1_** I intend to buy a refurbished smartphone because it is an environmentally friendly product. **GP2_** I plan to buy a refurbished smartphone in the future because of its environmental performance. **GP3_** On an overall basis, I am willing to buy a refurbished smartphone because it is environmentally friendly.	Chen and Chang (2012)
Green perceived value	**GPV1_** I believe that the environmental features of a refurbished smartphone add value to the product. **GPV2_** I believe that buying a refurbished smartphone meets my expectations in terms of environmental performance. **GPV3_** I believe that a refurbished smartphone is more environmentally friendly than a new smartphone. **GPV4_** I would buy a refurbished smartphone because it is environmentally friendly. **GPV5_** I would buy a refurbished smartphone because it has more environmental benefits than a new smartphone.	Chen and Chang (2012)
Environmental knowledge	**EK1_** I am better informed than average about recycling issues. **EK2_** I am abecognizeognise and understand environmental phrases and symbols on product packaging. **EK3_** I am well informed about environmental issues.	Ahmad and Thyagaraj (2015)
Subjective norms	**SN1_** People important to me think I should buy a refurbished smartphone. **SN2_** People important to me would approve of my buying a refurbished smartphone. **SN3_** People who are important to me want me to buy a refurbished smartphone.	Ko and Jin (2017)
Collectivism	**COL1_** Groups make better decisions than individuals. **COL1_** It is better to work in groups than alone. **COL3_** Decisions made by individuals are usually of higher quality than those made by groups. **COL4_** I would not support my team if I thought they were wrong.	Lee (2017)
Environmental concern	**EC1_**I believe that humanity is severely mistreating the environment. **EC2_**I believe that there are limits to growth beyond which our industrialised society cannot expand. **EC3_** I believe that human beings must live in harmony with nature in order to survive.	Hartmann and Apaolaza-Ibáñez (2012)

As can be seen, the values along the diagonal exceed the value of the shared variance, ensuring the discriminant validity of all six constructs.

4.2.2. Discriminant analysis

Discriminant Analysis was conducted in order to identify the determinants of green purchase intention of a refurbished smartphone. In fact, the Discriminant Analysis allows to separate statistical observations into distinct groups on the basis of a variable called grouping variable. In the present study, two groups were distinguished: the group of those who showed a low Green purchase intention (GPI), and the group of those who showed a high Green purchase intention. Table 7 displays the descriptive findings of the two groups considered. It emerges that the constructs Subjective norms and Collectivism received the lowest scores both in the group of those who showed high GPI, and in that of those who manifested low GPI.

Table 4
Constructs included in the study.

Construct	Definition	Classification	Source
Green perceived value	A consumer's overall assessment of the benefit of a product or service based on the consumer's environmental desires and sustainability expectations.	Psychological factor	Chen and Chang (2012)
Environmental knowledge	The amount of information individuals have about environmental issues and their ability to understand and assess their impact on society and the environment.	Psychological factor	Ahmad and Thyagaraj (2015)
Subjective norms	The perceived social pressure to perform or not to perform a given behaviour.	Social factor	Ko and Jin (2017)
Collectivism	A particularly strong desire for interaction and recognition.	Social factor	Lee (2017)
Environmental concern	Individual assessment of the environmental consequences th't one's behaviour may have.	Individual factor	Hartmann e Apaolaza-Ibáñez (2012)

Table 5
Confirmatory factor analysis: constructs reliability and validity.

Construct	No. of items	Cronbach's alpha	Composite reliability	AVE
Green purchase intention	3	0.880	0.926	0.807
Green perceived value	5	0.864	0.902	0.649
Environmental knowledge	3	0.818	0.890	0.730
Subjective norms	3	0.815	0.888	0.726
Collectivism	4	0.728	0.826	0.548
Environmental concern	3	0.749	0.856	0.666

Table 6
Discriminant validity of constructs.

	COL	EC	EK	GPI	GPV	SN
COL	0.740					
EC	0.018	0.816				
EK	0.058	0.151	0.855			
GPI	0.181	0.202	0.206	0.898		
GPV	0.165	0.241	0.279	0.796	0.806	
SN	0.293	0.097	0.235	0.364	0.380	0.852

Table 7
Summary statistics of the two clusters.

	Consumers with high levels of GPI		Consumers with low levels of GPI	
	Mean	SD	Mean	SD
GPV	3,43	0,99	3,39	0,98
EK	3,26	0,96	3,25	0,95
SN	2,29	0,95	2,28	0,94
COL	3,04	0,82	3,02	0,82
EC	4,18	0,84	4,16	0,84

Since the grouping variable distinguished the members of the sample into two groups, the Discriminant Analysis identified only one canonical discriminant function. In order to prove that this discriminant function is able to explain the differences between the identified clusters, the Lambda test of Wilks was performed ($\lambda = 0.590$; $\chi^2 = 129.182$; df = 5; p-value < 0.001) which returns a high level of significance (Hair et al., 2009). Table 8, on the other hand, shows the standardized coefficients of this canonical function that allow us to identify the factors that weigh most in discriminating between the group of those who present low GPI and the group of those who present high GPI.

Table 8
Discriminant function coefficients.

Construct	Coefficients
GPV	1,002
EK	,125
SN	-,053
COL	-,025
EC	-,060

The higher the values of the standardized canonical coefficients of the discriminant function, the greater the contribution of the respective constructs to the discrimination between the two groups into which the sample was divided. In fact, the coefficients allow us to identify the correlations between the constructs under examination and the discriminant function. It emerges that the constructs with the greatest discriminating power are those of a cognitive type, that is, Green perceived value and Environmental knowledge. On the contrary, both the social type variables and the one linked to individual consumer characteristics present negative coefficients, thus demonstrating a null discriminating power. That is to say that the variables Subjective norm, Collectivism and Environmental concern are irrelevant for the purposes of classification, that is, they are not able to tell us whether the Green purchase intention increases or decreases.

5. Discussion

This study aimed to identify the factors able to affect the green purchase intention of a technologically educated consumer with respect to a refurbished smartphone. To this end, a Discriminant Analysis was carried out in order to divide the sample into two distinct groups, namely the group of those who show high green purchase intention and the group of those who show low green purchase intention, and to assess the relative importance of psychological, social and individual characteristics of the consumer. By analysing the standardized coefficients of the discriminating function, we can see that there is a substantial difference in terms of values between the five constructs analyzed: the cognitive constructs, i.e. Green perceived value and Environmental knowledge have the highest discriminating power, while Collectivism, Subjective norms and Environmental concern show negative standardized coefficients. This means that such constructs are less successful as predictors of Green purchase intention. The result obtained from the analysis reveals that being an individual who can be influenced by the community or by the opinions of people close to him does not have discriminating power, nor does having a high degree of concern for environmental issues. The outcome of the Discriminant Analysis seems, therefore, counterintuitive, suggesting that the interest in the damage caused to the environment and the emotional involvement that this awareness brings with it do not play any role in determining the type of consumer chosen towards the purchase of a green product, such as the refurbished smartphone. Specifically, the results suggest that the degree of correlation between the Green purchase intention variable and the Environmental concern variable is very low. In this regard, the Pearson correlation index was calculated to assess the relationship between these two variables, whose value of $r = 0.202$, with p-value < 0.001 confirms the absence of correlation. What the Discriminant Analysis brings out, therefore, is the lack of a link between the purchase intention a refurbished smartphone and the concern towards environmental issues. In simple terms, this means that the sample of respondents used for the analysis shows the purchase intention a refurbished smartphone regardless of the degree of concern for environmental issues, such as the degradation of natural resources or pollution. In this regard, interpretative hypotheses of this phenomenon can be formulated. One model that can explain the results obtained is the one proposed by Vaughn (1980), called FCB grid. The authors identify four distinct purchasing approaches, shown in Fig. 4, based on the combination of two dimensions:

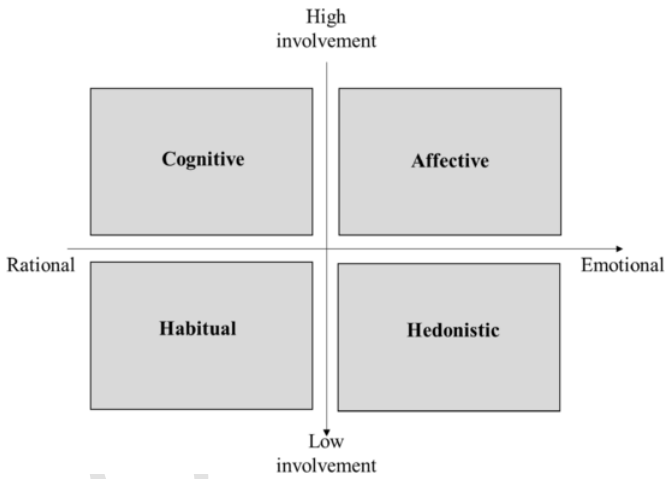

Fig. 4. The FCB grid. Adapted from Vaughn (1980).

degree of involvement of the individual and type of approach to purchase (e.g. emotional or rational). In the case under consideration, the purchase approach is rational, as the consumer shows a strong interest in environmental issues, demonstrating to inform himself to increase his knowledge on the subject and focusing on the fulfilment of his expectations and desires in terms of sustainability.

Therefore, purchase of a refurbished smartphone is aligned to the cognitive approach, characterized by a high level of involvement and a purchase decision based on rationality rather than on emotional impulses. For products or services that fall into this category, the consumer requires a large amount of information, and the decision-making process is driven by mostly economic motivations. The paradigm of purchase is the cognitive one, in which the action of purchase is seen as the result of a series of purely rational decisional processes. Such paradigm, in fact, presupposes the rationality of the consumer who evaluates the choice on the base of the own opinions formed through the active search of information. It is the type of approach adopted from the consumers who carry out for the first time an important purchase and wants to thoroughly evaluate all the available alternatives to define pros and cons. It follows that the decision to purchase a refurbished smartphone by a technologically educated consumer, as the student of Engineering, is comparable to the decision to purchase a technological good, of which there are several models or versions on the market, such as a car or a computer. The type of consumer examined proved to be emotionally detached during the purchase process, as confirmed by the uninfluenced of the construct Environmental concern on the degree of Green purchase intention of the individual. Although the selected consumer is aware of the threats to the environment and is informed about the issues related to the environmentalism, as suggested by the discrete discriminating power of the construct Environmental knowledge, he does not feel the need to buy a refurbished smartphone because emotionally touched by such concern. On the contrary, what determines a high green purchase intention is mainly the need to satisfy the consumer's desire to have a product that can meet his sustainable expectations and environmental desires, since the type of consumer in question is, on average, informed about environmental issues.

As far as theoretical implications are concerned, the results of our paper allow to extend the research regarding consumer purchase intention into the field of green marketing. In particular, they partially confirm what has been reported by various scholars regarding the determinants of green purchase intention. Khaola et al. (2014) showed that the construct environmental concern is not significantly correlated with green purchase intention, but rather substantially influences an individual's attitude. Our findings complement this framework, confirming the irrelevance of the environmental concern construct in explaining the motivations behind high or low green purchase intention. In contrast,

the results concerning the role of society, represented by the constructs collectivism and social norms, do not confirm those previously found by scholars. Kim and Choi (2005) argue that pro-environmental behaviours are group-oriented in nature, thus the influence of social norms and collectivist pressure encourages the adoption of environmentally-conscious behaviours. However, our study shows that for the specific case of refurbished smartphones, this relationship does not hold, and the role of social norms and collectivism is irrelevant in driving green purchase intention. The interpretation of the results through Vaugh's model (1980) motivates it with the technological nature of the object under study, the purchase of which requires careful gathering of information on its performance and characteristics.

6. Conclusions

This research is part of the literature that aims to investigate the purchase intention of refurbished smartphones. In order to advance the literature on the topic, this study aims to identify the determinants of green purchase intention through a two-step methodology: a Delphi technique applied to constructs identified from literature and a subsequent Discriminant Analysis. The Delphi technique allowed us to identify the constructs to be used for Discriminant Analysis through their evaluation by academic experts in the field. The resulting constructs are: perceived value (i.e. green perceived value), environmental concern, environmental knowledge, collectivism and subjective norms.

In the second stage of the research, a discriminant analysis was performed using the green purchase intention construct as the discriminant factor. Specifically, the sample of respondents was divided into two distinct groups, characterized respectively by low and high scores in terms of green purchase intention. At this point, the Discriminant Analysis shown which constructs, from the five selected through the Delphi technique, most influenced this division. The outcome of the analysis suggested that psychological constructs, such as green perceived value and environmental knowledge, are the most powerful predictors of green purchase intention of refurbished smartphones, while social and emotional constructs, i.e. collectivism, subjective norms and environmental concern respectively, do not influence the clusteriation.

Such result was interpreted using a consumer behaviour model, i.e. the FCB model proposed by Vaughn (1980), which allowed to trace the purchase of a refurbished smartphone by technologically educated subjects to a cognitive approach. According to the model, the level of involvement for the refurbished smartphone product is high, but not high enough to emotionally involve the consumer, as evidenced by the uninfluence of the construct environmental concern.

This paper is built upon theoretical models of consumer behaviour (including TPB, TRA, ABC theory, NAT) that have detected the antecedents of purchase intention. These theories have been contextualized by several authors (e.g., Dhir et al., 2021; Corrado et al., 2021) in the field of green product purchasing, e.g., products resulting from the implementation of one of the nine circular strategies previously presented. They contributed to the literature by identifying which factors intervene during the purchase process and testing their degree of relevance in influencing the end consumer's purchase intention, which may subsequently translate into actual purchase. Our paper fits into this line of research by taking a slightly different approach. In fact, previous works on the topic were aimed to identify factors and test their influence on the purchase intention of green products. Ours, on the other hand, focuses not only on detecting the determinants of green purchase intention of a refurbished product, but also on interpreting the results obtained by providing an objective rationale for such behaviour. Compared to earlier studies on the topic, this paper provides a solid basis for guiding managers' decisions, pointing out the aspects to focus on in order to design an effective marketing campaign. Indeed, the results found highlight the need to leverage the individual's rationality, by providing detailed information about the refurbished product, rather than his or her emotional concern.

7. Implications, limitations and future research directions

In the light of the results obtained, it is possible to define the main managerial implications of this study for managers and policymakers.

From a managerial point of view, our study provides several implications. At first, having identified the determinants of the purchase intention of a refurbished smartphone, allows to ease the definition of companies' marketing strategies, as anticipated in the previous section. The FCB matrix, in fact, can also be used to outline the most suitable advertising strategy for each type of product as each purchase approach, or each quadrant of the matrix, can be associated with a different strategy (Ratchford, 1987). In particular, a cognitive purchasing approach, as in the case understudy, requires a strategy defined as informative. Such advertising strategy, in fact, leverages on the consumer's need to gather as much information as possible about the product to be purchased to act in an informed manner. Since the results suggest that consumers choose a refurbished smartphone on the basis of a careful evaluation of the alternatives offered and after having done some research about them, the advertising for this particular type of product should be informative. Since the consumer is aware of environmental issues, the marketing campaign of a refurbished smartphone can push on the exposure of the green features of this product, outlining in detail the functionality and the green opportunities that the consumer can take advantage of by choosing this type of smartphone.

Policymakers could use our results to define specific measures and policies able to improve the Environmental concern of the end consumers as this could strongly impact not only on the consumers' choices about the purchase of a refurbished smartphone, but also on tout-court consumers' behaviours with positive effects on the environmental protection and awareness. To reach an effective and just transition toward a circular economy, the development of an environmental awareness and consciousness of consumers is very critical. Policymakers can facilitate such process by promoting educational awareness programmes, spread through different media outlets, such as social networks, television, online newspapers and so on. In this way, consumers' attitude towards environmental issues can be modified, which in turn might affect specific green consumption patterns and, more in general, environmentally-conscious purchases. Indeed, according to Hobson (2021) a just and effective transition toward circular economy paradigm requires not only novel business models and consumption practices, but especially novel consumption behaviours and a higher emotional and motivational engagements of end-users.

Replicating the study on non-technological products would enable to verify whether the results obtained are different and in line with those found by Kim and Choi (2005). Following this considerations, further researches could also investigate if there are other reasons which can explain customers' behaviours towards the purchase of refurbished smartphone. For instance, the issue of high speed of technological change could be tackled, assessing if refurbished smartphones are still less chosen by consumers compared to new ones because they do not rapidly keep up with the technology pace.

Regarding the limitations, this study uses a small sample of individuals, used to represent the slice of the population able to consciously use high-tech products, such as smartphones. This decision led to poorly generalizable results but open up for promising avenues of future research. Thus, a potential one could be broadening the sample of respondents (e.g. including students coming from different universities, different university programmes) in order to test whether the same considerations apply to an inhomogeneous sample as to the technologically educated one considered in this work. Another relevant limitation regards the typology of consumers considered. In particular, our methodological approach should also be replicated with different samples in

order to identify possible differences among different customer segments and, as consequence, to define customized policies which are expected to be more effective. Moreover, it could be interesting to consider also consumers coming from different countries to verify if cultural and social aspect matter.

Another limitation regards the type of product under study. Specifically, the choice of the refurbished smartphone depended on the evidence found in the literature, which suggests a tendency of scholars in recent years to study the acceptance by the final consumer of high-tech products. Although the present study focuses solely on the smartphone product, reconditioning is applicable to other electronic devices, such as tablets and PCs. For this reason, a potential line of future research may include the study of towards electronic products other than smartphones, to assess whether there are substantial differences between the types of products or whether, on the contrary, the results of the present study may be generalizable and applicable to a wide range of electrical and electronic products that lend themselves to reprocessing.

Finally, different statistical approaches could be adopted to investigate how diverse constructs affect the consumers' green purchase intention. In fact, through the discriminant analysis we identified a linear combination of features (identified constructs) that characterizes two or more homogeneous groups of consumers respect to the consumers' green purchase intention, but we cannot investigate how these constructs affect this last.

Uncited references

, , Thomas, 2011, ,

CRediT authorship contribution statement

Barbara Bigliardi : Writing – original draft, Writing – review & editing. **Serena Filippelli :** Conceptualization, Methodology, Software, Writing – original draft, Writing – review & editing. **Ivana Quinto :** Conceptualization, Methodology, Software, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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