An Innovation Resistance Perspective on Seller Resistance to Digital Device Recycling Platform

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Abstract

In the resale commerce (reCommerce) movement, the digital device recycling platform (DDRP), which allows users to sell, trade-in, and recycle used digital devices online, is growing in popularity and significance globally. Although DDRPs offer new opportunities for commerce and sustainability, challenges exist to usher in their wide adoption. This study attempts to develop a deeper understanding of the reasons underlying seller resistance to the DDRP. Grounded in the innovation resistance theory (IRT), the research model of this study is validated using data collected from 307 potential sellers of used digital devices.

1. Introduction

As an integral part of the reCommerce movement, the digital device recycling platform (DDRP) focuses on the resale of small digital devices such as laptops, smart phones, and wearables. The past two decades witnessed the rapid proliferation of consumer digital devices globally. As a result, approximately half of the world's population is estimated to own a smartphone by the end of 2020. However, the increased penetration rate and upgrade frequency of digital devices are also inducing a growing number of used or obsolete digital devices around the world. According to a recent report, Americans are retiring over 142,000 computers and 416,000 smartphones daily. If not properly handled, those electronic wastes (e-wastes) would lead to severe waste of natural resources, hazard to human and animal health, and harm to the ecological environment (Wang et al., 2016; Bai et al., 2018).

Enabled by e-business tools, the digital device recycling platform has evolved and grown rapidly in the recent years globally (Hahler & Fleischmann, 2017). For most DDRPs, their recycling process starts with the evaluation of an online offer, followed by the delivery as well as inspection of the retrieved digital device, payment to the seller, and ends with the resale or proper recycling of the device to maximize its economic value and/or minimize damage to the environment (Hahler & Fleischmann, 2017; Wang et al., 2018). Established in 2007, Gazelle, the world's first DDRP, processed 4.1 million phones through its facility in 2017. Globally, DDRPs are emerging and gaining popularity rapidly. For example, a China-based DDRP, Aihuishou, launched in 2011, was reselling and recycling about 1 million digital devices every month on its platform by the end of 2019.

Despite the proliferation of DDRPs, studies have suggested that the majority of consumers still choose to hoard their used or obsolete digital devices at home (e.g., Bai et al., 2018; Tan et al., 2018). One study estimates that an average US household has three to six obsolete digital devices that have been kept for more than six years and terms this phenomenon "tech-hoarding" (Crothers and Pepper, 2019). China alone has over one billion obsolete smartphones, and 65.4% of them remain idle at homes of their owners. Unlike the channels for traditional recyclables, DDRPs have experienced high consumer resistance and low participation rate. According to the World Economic Forum (WEF), 50 million metric tons of e-wastes are created globally each year, 9 percent of which come from small IT devices, yet only less than 20% of the e-wastes are formally recycled creating an enormous sustainability issue for the environment and loss of economic opportunities through recycling and reuse (Ryder and Zhao, 2019). Moreover, the unregulated DDRP industry has seen widespread financial loss, unfair pricing, and data breach. Rather limited effort has been devoted to understanding the factors that affect consumers' resistance to DDRPs. The gaps in the existing literature and the practical problems faced by DDRPs serve as the motivations behind our study. Furthermore, we realize that two types of consumers participate in the DDRP: the seller and buyer of previously used digital devices. The two types of consumers have very different motivations to participate in the reCommerce process; therefore their attitudes toward DDRPs and behavioral intention should be examined separately. In this study, we choose to focus on understanding the resistance of the

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seller to DDRPs as sellers are the initiators of the reCommerce process. The aim of this study is, therefore, to shed light on the above issue by exploring the following research question, "What are the factors that influence seller resistance to DDRPs?" We ground our research on innovation resistance theory (IRT) (Ram, 1987; Ram & Sheth, 1989) to develop a research model that would enhance our understanding of the drivers of resistance to DDRP.

2. Literature review

2.1 Digital devices recycling platform (DDRP)

In the past few years, DDRPs have gained notable attention as a new recycling channel that leverages eCommerce to facilitate the trading of previously-used digital devices. DDRPs serve as an important component of the electronics resale and recycling ecosystem by providing a platform for the stakeholders to connect and create value. The technical and business capabilities of the platform not only enable the interaction and value creation, but enhance the resilience of the ecosystem; therefore, they are key to the sustainable growth and the creation of the network effect of the platform (Tan et al., 2015). The process of recycling and reselling used devices on a DDRP is simple and efficient. Take Gazelle as an example, a customer initiates the process by first selecting the model of the device and answering a few questions about its condition (e.g., age, wear and tear, etc.). Gazelle prices the resale value of the device instantaneously without the need for negotiation as with classified ads platforms such as Craigslist (Seamans & Zhu, 2014). If the seller accepts the offering price, Gazelle delivers the seller a box with a pre-paid shipping label to ship the device to a Gazelle facility. Upon receiving the device, a Gazelle technician inspects the device to verify if its condition warrants the initially quoted resale price. In some cases, the price may be negotiated up or down based on the actual condition of the device. Once the device passes the inspection or a new quote is negotiated successfully, Gazelle distributes the payment to the seller in the form of a check, Amazon gift card, or electronic fund transfer (EFT). In addition, Gazelle guarantees that all personal information that remain in the devices will be removed completely to ease any security and privacy concerns the seller may have.

While reselling or recycling are not completely novel ideas, the DDRP acts as the intermediary between the sellers and buyers from different parts of the world to facilitate an efficient and fluid marketplace for online transactions involving used digital devices. It is a continuous innovation (Ram and Sheth, 1989) that improves on the traditional resale and recycling channels in its ability to connect buyers and sellers, promote sustainability and create economic benefits for all parties through operations cost reduction and market efficiency. Whereas discontinuous innovations tend to be resisted due to the high degree of discontinuity they bring, continuous innovations often need to overcome conflict with potential adopters' belief structure (Corso and Pellegrini, 2007), for example, in the case of the DDRP, the tech-hoarding tendency and attitude toward sustainability of consumers. While most literature on innovation tends to focus on acceptance and adoption, prior studies have suggested that understanding users' unwillingness to adopt innovations is as important as understanding their willingness to adopt as it assists organizations in their efforts to improve innovations and their adoption processes (Dedehayir et al., 2017). Therefore, understanding the sources of user resistance to DDRPs helps pave the way for wider adoption of DDRPs.

Research on the DDRP phenomenon is still in its infancy and appears to be very limited. Most extant studies are primarily conceptual and qualitative in nature. Some studies focus on introducing the DDRP phenomenon and identifying the business models of current DDRPs (e.g., Sun et al., 2018; Tong et al., 2018; Wang et al., 2018; Sun et al., 2020). For instance, using case analysis, Wang et al., (2018) credit DDRPs for their contributions to reducing information asymmetry, lowering transaction costs, expanding the scope of collection, and improving the collection standard and efficiency, and at the same time, identify the current challenges faced by DDRPs and summarize their typical revenue models. In another study, Sun et al., (2020) contend that current DDRPs can be grouped into two categories: platforms derived from an Internet company (PDIC) and platforms derived from a recycling company (PDRC). Other studies focus on the design of the unique reverse supply chain management systems or pricing strategy for DDRPs (e.g., Hahler & Fleischmann, 2017; Xu et al., 2019).

In conclusion, while the aforementioned studies provide valuable insights on the DDRP phenomenon, research effort in this area remains in its nascent stage. Very little research has been devoted to understanding why some consumers fail to participate in DDRPs when they have devices that are no longer in use. We reiterate that in order to develop a sustainable reCommerce ecosystem, DDRPs must first understand the factors that influence individuals' resistance to this technology-enabled, novel business model. To partially fill this gap, this study proposes a model of seller resistance to DDRPs through the lens of IRT.

2.2 Innovation Resistance

Innovation resistance is the resistance offered by potential users to changes imposed by the innovation. As a special version of resistance to change, it has been found to be one of the main causes of new product or service failure on the market (Ram & Shet, 1989). The two ends of the continuum of user reaction to innovations are resistance and adoption, and adoption would only begin after the initial resistance is overcome (Ram, 1987; Lapointe et al., 2002); therefore, study innovation resistance at the early stages of innovation diffusion is both appropriate and important.

Originally designed in marketing and consumer research literature, the innovation resistance theory (IRT) is a comprehensive model to understand consumer's resistance to a new product or service (Ram, 1987; Ram & Sheth, 1989). The IRT does not take a pro-innovation bias as seen in earlier innovation models (e.g. Rogers, 1983), instead, it views user resistance to innovation as a normal response to the changes that innovations bring and suggests that understanding user psychology behind resistance can be beneficial to the development and promotion of the innovation (Ram, 1987). Essentially, the IRT suggests that the factors that cause resistance tend to fall into the following three categories: perceived innovation characteristics (e.g., perceived risks, relative advantages, compatibility, trialability, and communicability), user characteristics (e.g., personality, attitudes, values, and previous experience), and the characteristics of the propagation mechanisms (e.g., word of mouth, credibility, and clarity) (Ram, 1987; Ram & Sheth, 1989). These three categories of factors collectively drive innovation resistance. If the consumer's resistance exceeds her level of tolerance, then the innovation will be resisted.

Ram and Sheth (1989) also point out the two categories of barriers that may paralyze consumers' willingness to adopt innovation: functional and psychological barriers. Functional barriers include usage barriers, which refer to the innovation's lack of compatibility with existing workflow and practice, value barriers, which refer to low performance-to-price value the innovation offers, and risk barriers, which are pertinent to the added uncertainty and side effects associated with the innovation. Psychological barriers, on the other hand, include tradition barriers, which increase when the innovation deviates from the user's values and social norms, and image barriers, which result from unfavorable associations that the innovation makes. The accurate identification of these barriers would lead to the implementation of product, communication, pricing, market or coping strategies to reduce resistance. The resistance factors and barriers recognized by IRT offer a comprehensive topology of reasons why users resist certain innovations. Usage, value and risk barriers result from the perceived characteristics of the innovation, whereas traditional barriers and image barriers tend to originate from the characteristics of the user and propagation mechanisms, respectively.

In this study, we choose IRT as the theoretical underpinning for the following reasons. First, previous studies have validated the use of IRT to explain and predict users' resistance to various information systems (e.g. Kim et al., 2017; Mani & Chouk, 2016). Therefore, we expect that a similar level of explanatory power can be achieved when the framework is appropriately adapted to the DDRP context. Second, the elements proposed by IRT are largely applicable to explain users' resistance to DDRP. The topology of factors of resistance and barriers to innovation proposed by IRT offers a solid sensitizing framework to guide our search for reasons behind seller resistance to DDRPs. Third, IRT does not take a pro-innovation bias and focuses on understanding the reasons behind resistance from the users' perspective. Finally, IRT offers various strategies for overcoming adoption barriers, which would be helpful in developing guidelines for DDRP operators.

3. Research model and hypothesis

Using the sensitizing framework provided by previous literature on IRT, we identify factors that are salient to the DDRP context that fall into the various resistance factors and innovation barrier categories of IRT. Three perceived characteristics of the DDRP are considered in this study: perceived convenience, perceived price unfairness, and perceived security and privacy concerns. These three characteristics correspond to the three innovation barriers (i.e. usage, value, and risk barriers). The seller characteristic is attitude toward sustainability, which evaluates the tradition barriers of how using the DDRP contradicts the user's established values and social norms. Finally, as a characteristic of the propagation mechanism, negative word-of-mouth is deemed as an image barrier to the DDRP. The model also hypothesize that a key IS construct, personal innovativeness, would influence the innovation barriers that increase resistance. Finally, the model controls for demographic traits including gender, age, education level and income. A schematic diagram of the research model is shown in Figure 1. We discuss the constructs and hypotheses in the next section.

One of the key advantages pointed out by DDRP advocates is convenience, which has been found to be a key determinant of consumer use of self-service technologies such as the DDRP (Collier & Sherrel, 2010). In the present study, perceived convenience reflects the extent to which potential sellers believe that they can use DDRP to resell and recycle used digital devices with the least amount of time and effort. In prior studies, convenience perception has been conceptualized as the opposite of effort perception, which is influenced by the physical location, operating hours, and overall availability of a service (Berry et al., 2002). In other words, the level of convenience perception can be measured by whether the transaction can be performed at a place and time and in a way that are convenient to the seller (Collier & Sherrell, 2010; Liu et al., 2015; Teo et al., 2015). Collier & Sherrell (2010) find in their study that convenience perception leads to a customer's perception of speed and desire to explore in a self-service setting; therefore, it is reasonable to presume that low convenience perception would result in resistance to a service. This is consistent with the previous studies that suggest one of the key drivers of sustainable behaviors such as recycling and composting is convenience (e.g., Wagner, 2011; DiGiacomo et al., 2018). Furthermore, the usage barriers to innovation adoption refer to the extent to which the use of the innovation is incompatible with existing workflow, practices, or habits (Ram and Sheth, 1989). While DDRPs claim to save sellers significant time and effort in disposing used digital devices by allowing them to facilitate the transaction from home, at any time, and in a few simple steps, whether potential sellers feel that DDRP offers superior convenience to alternative ways of dealing with used digital devices, such as collection by street "guerrillas" in some countries (Gu et al., 2016), direct sale through consumer-to-consumer (C2C) platforms, or simply hoarding the devices at home, is an individualistic belief. If the DDRP is deemed inconvenient, the seller is likely to experience heightened usage barrier to the innovation. Therefore, the research model proposes the following hypothesis:

H1. Perceived convenience of the DDRP has a negative effect on the seller's resistance to the DDRP.

If an innovation does not offer strong value proposition compared to the status quo, the user has little to no incentive to adopt it. This is refered to as the value barrier that erodes innovation adoption (Ram & Sheth, 1989). A seller may expect the DDRP's e-commerce platform to result in lower operating costs thus higher resale values compared to traditional recycling channels; therefore, the seller may anticipate a price premium for the used digital device. Perceived price unfairness captures the extent to which the seller perceives the resale value offered by the DDRP as inconsistent with the device's value (Grewal et al., 2004; Lee et al., 2020). Naturally, high perceived price unfairness by the seller would increase the value barrier and lead to a high level of resistance to DDRP. The marketing literature has repeatedly demonstrated that price fairness or unfairness as an important determinant of consumer's purchase decisions across a variety of product types (e.g., Grewal et al., 2004; Sanchez et al., 2016). Similarly, IS researchers have also claimed that price fairness was significant in explaining users' online purchasing behaviors (e.g., Turel et al., 2010; Lee et al., 2020). Furthermore, according to Liu et al., (2019), providing a high recycling price is critical to improving the collection rate of used mobile phones. Thus, the following hypothesis is proposed:

H2. Perceived price unfairness has a positive effect on the seller's resistance to the DDRP.

We define perceived security and privacy risk in this study as the seller's perception of potential loss of personal information as the result of reselling and recycling digital devices using the DDRP (Featherman & Pavlou, 2003). Studies have found that wiping information from a digital devices is not a trivial process, and data may still be harvested with sophisticated forensic tools even after a factory reset (Armerding, 2015). IS researchers have repeatedly established that perceived security and privacy risk harms the user's willingness to conduct online transactions or accept a new information system (e.g., Featherman & Pavlou, 2003; Liu et al., 2015). Today, consumers store tremendous amount of personal data in their digital devices such as smartphones or tablets for productivity and transaction purposes. Despite DDRPs claims that multi-level security measures are taken to erase personal information on used devices, 63.7% of the participants of a recent study still claim that they tend to store their smartphones at home due to the concerns for personal information disclosure and lack of trust for the recycling parties (Bai et al., 2018; Tan et al., 2018). Thus, we propose the following hypothesis:

H3. Perceived security and privacy risk has a positive effect on the seller's resistance to the DDRP.

Tradition barriers to innovation stem from the individual's values and accepted social norms. In this study, we identify one tradition barrier that would affect seller resistance to DDRPs, attitude toward

sustainability. Salient to the business model of DDRPs is its focus on sustainability. The past decades have witnessed tremendous growth in green consumerism and increased consumer awareness of the impact of our choices on the environment (Gupta & Oden, 2009). However, studies have found that personal attitude toward sustainability varies greatly ranging from passionate advocates to dismissing the issue as frivolous (Kearins and Springett, 2003). One's attitude toward sustainability is largely formed through the influence of his or her environment including family, friends and media (Swaim et al., 2014). Attitude is defined as one's positive or negative evaluations of certain behavior or idea (Ajzen, 1991; Davis et al., 1989). The more positive one evaluates a specific behavior or idea, the more likely he or she intends to engage in it and vice versa (Wang et al., 2011; Gao et al., 2017). Multiple studies have acknowledged that attitude is the most influential antecedent of pro-environmental behaviors such as energy-saving within the company (Gao et al., 2017; Tang et al., 2019), recycling used batteries (Wang et al., 2011), green traveling (Abrahamse et al., 2009), and towel reuse (Han et al., 2018). Similar findings have also been widely reported in the context of new information technology adoption (Chen et al., 2002; Gefen et al., 2003). DDRPs tackle the growing concerns about the environmental impact of e-wastes head on and have been credited for their efficient and standardized processes and broad scope and scale of e-waste collection (Sun et al., 2020). Thus, the following hypothesis is proposed:

H4. Positive attitude toward sustainability has a negative effect on the seller's resistance to the DDRP.

Ram (1987) suggests that the propagation mechanisms play an important role in the adoption and diffusion of innovations, and ineffective propagation mechanisms that lack clarity, credibility, informativeness and source similarity would cause users to resist the innovation. He also pointed out that word-of-mouth, which involves direct and personal contact with the potential adopter, is a more effective propagation mechanism. Word-of-mouth has been credited with high level of credibility and persuasiveness in this age of social media and online review systems. It is an especially important propagation mechanism for systems that involve online transactions because of the level of risk involved (Cheung & Thadani, 2012; Balaji et al., 2016). Many potential users choose to wait and observe the experiences of others who have tried service before considering adopting it as the word-of-mouth reviews tend to enhance or reduce individuals' confidence in a positive experience with the service (Zhang et al., 2014). Negative word-of-mouth refers to negative statements made by potential, actual, or former customers about a product, service, platform, or company either online or offline (Cheung & Thadani, 2012; Balaji et al., 2016). According to the concept of "negativity bias", negative and unfavorable information tend to have a greater effect on one's behavior and cognition than positive and favorable information do (Rozin & Royzman 2001). A negative comment by a verified user of the DDRP would likely carry much more weight than a positive comment as a pleasant experience is often considered a given by the user. Negative word-of-mouth creates an unfavorable association and causes the user to develop a negative image of the DDRP, which increases the image barrier of the innovation. We posit that exposure to negative word-of-mouth leads to a higher resistance to the DDRP, thus the following hypothesis:

H5. Negative word of mouth has a positive effect on the seller's resistance to the DDRP.

Personal innovativeness refers to the natural tendency of an individual to try out a new information technology or system (Agarwal & Prasad, 1998, Lu, 2014). It has be well-established that innovative individuals are able to cope with high levels of uncertainty and develop positive beliefs about new ideas or technologies (Rogers, 1995). As an internal motivation stimulus, personal innovativeness is a personal trait of the user and deeply rooted in the individual's personality and values. Prior research has found that individuals with higher levels of personal innovativeness are willing to adopt a new IS/IT despite high perceptions of risks. They are also more like to adopt an innovation sooner than others (Agarwal & Prasad, 1998, Lu, 2014; Jin et al., 2017). Studies have also found that personal innovativeness tends to heighten the perceived usefulness and ease of use of a new technology (Lewis et al., 2003). Accordingly, personal innovativeness is likely to amplify the seller's confidence in his or her abilities to perform and benefit from the transaction with the DDRP and downplay any potential risks, both technological and monetary; therefore, the innovative disposition will likely influence the aforementioned factors that affect seller's resistance to the DDRP. Thus, we posit the following hypotheses:

H6. Personal innovativeness has a positive effect on the seller's perceived convenience of the DDRP.

H7. Personal innovativeness has a negative effect on the seller's perceived price unfairness of the DDRP.

H8. Personal innovativeness has a negative effect on the seller's perceived security and privacy risk of the DDRP.

H9. Personal innovativeness has a positive effect on the seller's attitude toward sustainability.

H10. Personal innovativeness has a negative effect on the negative word-of-mouth.

Finally, we are interested in examining the direct impact of personal innovativeness on the seller's resistance to the DDRP; therefore, we hypothesize:

H11. Personal innovativeness has a negative effect on the seller's resistance to the DDRP.

4. Research methodology

An online survey was utilized to collect data to empirically validate the proposed research model. To ensure content validity and consistency of the responses, Aihuishou, a prominent DDRP in China, was selected as our research context for the survey due to its broad brand recognition and consumer-focused business model. To ensure the reliability and validity of the measurement scales used in this study, whenever possible, existing measurements were adapted from previously validated instruments and slightly modified to fit the DDRP context. The measurements for perceived convenience were adapted from Collier & Sherrell, (2010). The items for the price unfairness construct were adapted from Turel et al., (2010). The scale for security and privacy risk were adapted from Featherman & Pavlou (2003). Personal innovativeness was assessed using the well-established items from Agarwal & Prasad (1998). Attitude toward sustainability was measured using the three items developed by Dickinger et al., (2008). To measure negative word-of-mouth, an existing scale developed by Balaji et al., (2016) was adapted to the DDRP context. Customer resistance was measured using items adapted from Dickinger et al., (2008) and Mani & Chouk (2016). All items are scored on a seven-point Likert scale ranging from (1) Strongly Disagree to (7) Strongly Agree. The questionnaire was translated into Chinese using the back-translation method recommended by Brislin (1970) to avoid the impact of cultural and linguistic differences.

The target subjects of our study are individuals who have retired at least one digital device, such as a smartphone, tablet, and laptop, within the past three months and have heard of the DDRP, Aihuishou. Digital invitations that contain the link to the questionnaire were distributed via multiple channels including the online forums of several major Chinese universities and the authors' social media personal and professional networks. The data collection process was conducted in the spring of 2020 and lasted for two weeks. As a result, 323 responses were received. A total of 16 incomplete or invalid responses were removed resulting in 307 complete and usable responses for analysis. Among the respondents, 65.47% are female and 34.53% are male. The majority of the respondents (85.02%) are between 18 and 30 years old, and 56.68% of the respondents have at least an undergraduate degree.

5. Data analysis and results

Covariance-based structural equation modeling (CB-SEM) was chosen to analyze the data. This research applied the two-step procedure to evaluate our research model as recommended by Anderson & Gerbing (1988).

5.1. Measurement model

The measurement model was evaluated by performing the confirmatory factor analysis (CFA) on the 26-item scale. The reliability was assessed by examining the factor loadings of the measurement items on the constructs they were designed to measure. The result shows that the loadings of all measurement items are either higher or very close to the suggested 0.70 threshold of acceptability, which confirms the reliability of the measurement items in the model. Convergent validity was evaluated using two criteria of all constructs: (1) the composite reliability (CR) should be at least 0.70 (Chin, 1998), and (2) the average variance extracted (AVE) should be at least 0.50 (Fornell & Larcker, 1981). All the constructs meet the recommended levels of CR and AVE, indicating a high level of convergent validity. In order to demonstrate satisfactory discriminant validity of the constructs, the square root of AVE for each construct is found be greater than its correlations with other constructs in the model suggesting satisfactory level of discriminant validity of the measurement model.

Various fit indexes (Table 1) of the measurement model, suggest favorable general fitness of the measurement model with the data (Bentler and Bonett 1980; Segars and Grover 1993).

Table 1. Overall fit of research models

Fit indexes	CFA	Structural model	Recommendation
X^2/d.f.	1.45	1.82	<3.00 (Bentler & Bonett, 1980)
GFI	0.91	0.87	>= 0.90 (Segars & Grover, 1993)
AGFI	0.88	0.84	>= 0.80 (Segars & Grover, 1993)
CFI	0.97	0.94	>= 0.90 (Bentler & Bonett, 1980)
IFI	0.97	0.94	>= 0.90 (Bentler & Bonett, 1980)
TLI	0.97	0.93	>= 0.90 (Bentler & Bonett, 1980)
RMSEA	0.04	0.05	<=0.08 (Hair et al., 2017)

5.2. Structural model

Various general fit indices are examined and displayed in Table 1. A comparison of fit indices with their corresponding recommended values provides evidence of an acceptable model fit. Hence, we could proceed to examine the R-square value, which shows the percentage of variance in seller resistance that is explained by the factors, and path coefficients, which represent the strength of the impact of the factors on the dependent variable. The proposed hypotheses about the relationships between the factors and seller resistance are tested through the significance of the structural coefficients.

As illustrated in Figure 1, seven of the eleven hypotheses are supported due to the statistically significant path coefficients. The R-square value suggests that 56% of the variance in seller resistance to the DDRP is explained by the proposed research model. Perceived security and privacy risk, attitude toward sustainability, and negative word-of-mouth are found to influence the seller's resistance to the DDRP strongly and significantly; therefore, H3, H4, and H5 are supported. Personal innovativeness significantly influences perceived convenience, perceived security and privacy risk, attitude toward sustainability, and negative word-of-mouth as hypothesized; hence H6, H8, H9, and H10 are supported by the data. However, personal innovativeness was found to influence perceived price unfairness (β=0.72, $p<0.001$) positively instead of negatively as hypothesized, so H7 is rejected. Contrary to our expectation, the impact of perceived convenience, perceived price unfairness, and personal innovativeness on seller resistance is not statistically significant; therefore, H1, H2, and H11 are also rejected. Furthermore, the results suggest that all paths between the control variables and user resistance are found to be non-significant, except education (β=-0.14, $p<0.05$), suggesting that a higher level of education leads to lower seller resistance. The empirical results are illustrated in Table 2.

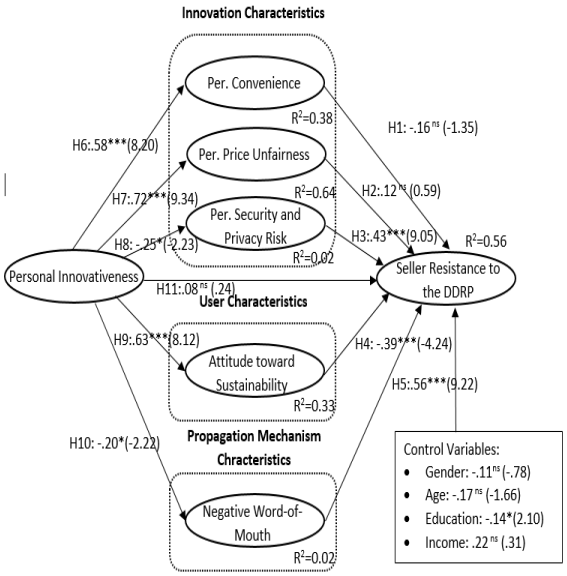

Figure 1. Results

Table 2. Results of the structural model

Path	Path coefficient	T value	Cohen's d	Supported	Effect size
H1	$\beta = -0.16^{ns}$	-1.35	0.13	No	Very Small
H2	$\beta = 0.12^{ns}$	0.59	0.06	No	Very Small
H3	$\beta = 0.43^{***}$	9.05	0.92	Yes	Large
H4	$\beta = -0.39^{***}$	-4.24	0.43	Yes	Medium
H5	$\beta = 0.56^{***}$	9.22	0.94	Yes	Large
H6	$\beta = 0.58^{***}$	8.20	0.84	Yes	Large
H7	$\beta = 0.72^{***}$	9.34	0.95	No	Large
H8	$\beta = -0.25^{*}$	-2.23	0.23	Yes	Small
H9	$\beta = 0.63^{***}$	8.12	0.83	Yes	Large
H10	$\beta = -0.20^{*}$	-2.22	0.23	Yes	Small
H11	$\beta = 0.08^{ns}$	0.24	0.02	No	Very-Small

6. Discussion

The research findings are summarized as follows. First, overall, the research model is supported by the data and explains a large portion of the variability (62%) in seller resistance to the DDRP; seven of the eleven proposed hypotheses are supported by the empirical findings. Therefore, IRT is found to be a useful theory in explaining and predicting seller resistance to the DDRP and possibly other green IT phenomena. Second, one innovation characteristic, perceived security and privacy risk, is found to influence seller resistance significantly. In othere words, individuals who believe that dealing with DDRPs increases their susceptibility to risking personal data are more likely to resist the DDRP for reselling and recycling their used digital devices. This finding is in line with the previous literature that highlights the negative relationships between security and privacy risk and information systems adoption and usage (e.g., Xu et al., 2011). One user characteristic, attitude toward sustainability is reported to influence

seller resistance negatively. Therefore, individuals who are more sustainability conscious are less likely to resist DDRPs. This finding is consistent with earlier studies which emphasize the role of attitude toward sustainability plays in pro-environmental behaviors (e.g. Wang et al., 2016). The propagation mechanism characteristic, negative word-of-mouth, is also found to influence seller resistance positively suggesting that one's decision to resist DDRPs is impacted by other users' experiences and opinion. Word-of-mouth serves as an especially important propagation mechanism for services that involve online transactions because of the higher perceived risk involved (Zhang et al., 2014; Balaji et al., 2016).

While personal innovativeness, a psychological construct consistently found to influence one's adoption and use behaviors by IS research, is not found to influence resistance directly, it seems to impact all the proposed innovation barriers including perceived convenience, perceived price unfairness, perceived security and privacy risk, attitude toward sustainability, and negative word-of-mouth. However, its influence on perceived price unfairness is opposite to the direction hypothesized. The result suggests that individuals with high personal innovativeness tend to perceive the resale prices offered by DDRPs as unfair. This finding is surprising because prior studies have suggested that higher personal innovativeness leads to a more positive outlook on the benefits of the innovation. One posibble explanation of this finding is that individuals with high personal innovativeness, who upgrade their own devices frequently, tend to be more aware of the quick obsoletion and value loss of used digital devices and expect DDRPs to drastically undercut resale values offered to sellers in order to remain profitable. Nevertheless, personal innovativeness appears to be an important indirect influencer of seller resistance according to this study. One of the demographic variables, education, was found to be a control variable that negatively impacts seller resistance. This is consistent with Gao et al. (2017) which point out that educated people are more inclined to save energy and display eco-friendly behaviors compared with others.

6.2. Theoretical and practical contributions

This study makes several important theoretical contributions. First, research on DDRPs is still in its infancy. Unlike previous studies that are primarily qualitative or conceptual in nature, this study employs an empirical approach to enhance our understanding of the reCommerce phenomenon. A theoretically sound research model is validated and helps explain why some sellers resist DDRPs. Very little attention has been paid to reCommerce technologies such as DDRP. Moreover, extant studies tend to take the innovation adoption or technology acceptance perspective, and none of them has taken the resistance approach as this research does. Our study enriches the current literature on green IT by studying a less explored context, DDRP, and by employing an innovation resistance perspective as adoption can only begin after initial resistance is overcome (Ram, 1987).Third, this study further extends the IRT by developing a research model that embodies constructs salient to the DDRP context yet theoretically justified by the tenets of IRT. Our findings further demonstrate that while innovation characters are important, the characteristics of the potential adopters and propagation mechanisms tend to offer bigger challenges to reducing resistance.

The research findings can also provide implications for practitioners. First, this study highlights the important role DDRPs that play in the reCommerce value chain and e-waste recycling practices and the challenges they face to reduce user resistance. Government agencies and policymakers should consider policies that help support this integral part of the reCommerce value chain to achieve their sustainability goals. Second, our findings offer important strategic guidelines for DDRP operators. DDRP operators are recommended to tackle the innovation barriers identified in this study. Perceived security and privacy risk appears to be the key innovation characteristic that cause resistance suggesting that DDRPs should strive to make technical innovations in and commitment to protecting seller personal data a top priority and competitive advantage. Building an image and brand that potential sellers can trust would go a long way to reduce resistance. In addition to building their internal capabilities, DDRPs should partner with like-minded companies and non-profit organizations to promote the importance of sustainability as attitude toward sustainability would likely determine one's resale and recycling decisions. Ongoing environmental protection training programs and lectures can be launched by DDRP operators to reinforce the social desirability and ethical rightness of adopting DDRPs. Finally, developing online and offline communities that spread the positive word-of-mouth will be effective in reducing resistance. Finally, DDRPs should target well-educated consumers with high personal innovativeness levels to achieve early success as they are more readily to adopt. Turning early adopters into energized promoters of DDRPs will likely lead to broader adoption of the reCommerce movement.

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