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The Effects of Data Security and Perceived Benefits on Mobile Phone Recycling Behaviour and the Recycling Intention Mediation Role

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Abstract: Mobile phones are the most heavily utilised electronic devices on a global scale. Since they are relatively smaller than other electronic devices, unlike other electronic waste (e-waste), they are not disposed of properly. Hence, this study examines the factors influencing mobile phone users' overall intention to recycle their mobile phones. The factors used originate from the theory of planned behaviour (TPB), but additional factors were also included, namely, perceived benefits and data security, to allow for a more in-depth analysis of customer behaviour. Partial least squares structural equation modelling (PLS-SEM) was employed to analyse 601 results from the United Arab Emirates (UAE) through a self-administered online survey. The results demonstrate that perceived benefits (whether environmental or financial) and perceived behavioural control possess the most statistically significant positive effects on the UAE mobile phone users' intention to participate in reverse supply chain (RSC) processes such as refurbishing or recycling. The impacts of attitude and subjective norms were the second most positive influences. Meanwhile, only 7% of UAE mobile phone users were significantly impacted by data security in participating in RSC processes. Additionally, recycling intention had no noticeable mediation effect on the relationship among the TPB variables and the extended variables (namely, data security and perceived benefits) and mobile phone recycling behaviour. The study offers confidence to industrial players in implementing these particular factors in their reverse supply chain management (RSCM) systems to influence more users to return end-of-life (EOL) or end-of-use (EOU) mobile phones, which could, in return, assist in resource preservation and environmental protection.

Keywords: reverse supply chain management; mobile phone recycling; theory of planned behaviour; perceived benefits; data security; customer recycling behaviour

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1. Introduction

In today's contemporary world, mobile phones have surpassed computers as the most widely used electronic gadget due to the expansion in the global economy, which encouraged the rapid developments in mobile phone technology. The rapid growth in digital business and the competition between smartphone manufacturers to introduce new mobile phones every year have shortened the life cycle of these devices. Additionally, the technology development in smartphones has raised the demand for such devices. Meanwhile, storing unwanted mobile phones at home or the workplace results in the generation of a massive amount of electronic waste (e-waste) [1–4]. In 2018, global e-waste production was estimated at 50 million tonnes according to the United Nations Environment Programme (UNEP). Therefore, if no worldwide effort is taken to address and resolve this problem, the volume of e-waste is predicted to exceed 120 million tonnes by 2050. Currently, less than 20% of global e-waste is recycled [5]. In 2016, approximately 435,000 tonnes of smartphones/phones were discarded. This e-waste presented an opportunity to save billions of dollars by recycling the materials [5]. According to the World Bank statistics,

the United Arab Emirates (UAE) recorded the highest economic growth in the Middle East (ME) [6], with a population of 9.89 million in 2020. Additionally, the International Telecommunication Union (ITU) stated that the number of mobile phone subscriptions in the UAE (per 100 people) was 186 in 2020, with 18,374,332 mobile cellular subscribers. In 2020, the UAE ranked first in the ME region and third worldwide after China and Hong Kong in mobile device penetration [7]. Among the countries around the world, China has the most publications on electronic waste recycling while the UAE is the least [8]. Moreover, the UAE is considered as a country with the most rapid economic growth in the ME [6], as its gross domestic product (GDP) was recorded at US $358.87 billion in 2020, and the life expectancy at birth is 77.6 years [7]. Therefore, it is important to determine the factors that are vital in influencing mobile phone users' behaviours to participate in mobile phone recycling to allow companies working in the UAE to build an adaptable framework. E-waste that is not disposed of efficiently could lead to catastrophic effects on the environment as it can release harmful toxins. Many businesses are now using reverse supply chain (RSC) as a main method for collecting end-of-life (EOL) or end-of-use (EOU) items from environmentally concerned consumers through the four primary RSC processes, namely repair, reuse, remanufacturing, and recycling [9].

The existing literature does not comprehensively or accurately concentrate on consumer behaviour in the UAE, particularly on mobile repair, reuse, and recycling (3Rs). This study was unable to access data related to the number of mobile phones collected for recycling in the UAE from the government sectors under the recycling wing. According to TechSci Research, the UAE smartphone market reached $9.32 billion in 2019 due to the introduction of the latest technology and extraordinary data speed such as 5G in all cities of UAE by telecommunication companies [10]. Technology and the high standard of living are the key factors driving the high demand for new smartphones annually in the UAE. As such, factors such as data and information security might play a vital role in influencing consumer intention to recycle mobile devices because data security is a priority preventing the public from recycling their used mobile phones/smartphones [11]. However, data security and benefits factors that examine customer behaviour in recycling and refurbishing old mobile phones have never been studied in the UAE.

Aboelmaged [12] highlighted that research on e-waste has expanded since 2004 in response to the concerns about the cost and benefits of mobile phone waste, besides consumer behaviour. Furthermore, there is a need to focus on the benefits as a factor and determine whether this factor is vital in influencing consumer behaviour toward participating in mobile recycling—especially so for customers living in a well-developed country such as the UAE. Recycling's perceived benefits might take two forms, depending on the individual's perspective: financial or environmental. Several studies have shown that financial incentives may be used to influence actions and behaviours [13,14], as well as minimising adverse effects on the environment and human life might be considered as a benefit [15,16]. Hence, associating mobile recycling activity with green behaviour might provide consumers with a clear perspective on the benefits of saving the environment. Regrettably, the literature on green supply chain management (GSCM) in the UAE is primarily insignificant [17], as it only focuses on construction sectors.

A successful and effective reverse supply chain management (RSCM) system is contingent upon customer engagement and their willingness to participate in RSC processes. Nevertheless, consumers frequently retain used, outdated, or broken devices, particularly mobile phones, for an extended time before discarding or recycling them. Numerous factors influence their decision to not participate in recycling, including attitude, sociodemographic characteristics, lifestyle, environmental sensitivity, product features, technology, and societal pressure [8,18]. Therefore, once people understand the factors contributing to the mobile phone hoarding behaviour, customers can be effectively encouraged to recycle or refurbish their EOL phones. However, the key factors influencing mobile phone users, in particular, to participate in mobile phone recycling have not been highlighted, especially factors related to data security and perceived benefits [11,19–21].

The theory of planned behaviour (TPB) consists of three factors: attitude, subjective norms, and perceived behavioural control. It is one of the main theories used to understand and analyse consumer intention in recycling activities [20,22–26]. Despite the widespread acceptance of the TPB model, its implementation in RSC requires incorporating additional factors because consumer behaviour differs based on the nature of the product or the socio-demographics of the consumer [25]. Researchers have also extended this theory using variables that might influence consumer intention to return the EOL or EOU devices or products. However, several researchers argued that the TPB variables or additional factors could not entirely describe consumer intention and behaviour towards recycling [27,28]. Therefore, this paper proposes variables that might positively impact the customer intention on mobile phone recycling including data security and perceived benefits. Moreover, the paper will examine whether intention mediates the relationship between the TPB variables as well as the newly acquired variables and recycling behaviour.

The Aim of the Study

This study aims to answer the following research questions:

1. Do TPB factors (attitude, subjective norms, and perceived behavioural control) positively influence the intention of UAE mobile phone users to participate in RSC processes?
2. Is data security a significant factor influencing UAE mobile phone users' intention to recycle their EOL or EOU mobiles through the RSCM processes?
3. Are perceived benefits significant drivers of UAE mobile phone users' intention to participate in RSCM processes?
4. Does the intention of mobile phone users mediate the relationship between attitude, subjective norms, perceived behavioural control, data security, and perceived benefits and the behaviour of mobile phone users?
5. Does the intention of UAE mobile phone users positively and directly affect the actual behaviour toward mobile phone recycling?

Following the introduction section, the paper is organised as follows. Section 2 discusses the research framework, TPB, and new factors extended to TPB, while Section 3 examines the formulation of the research hypotheses and the literature related to each factor. Section 4 summarises the research methodology and the demography of the results. Data analysis and results are presented in Section 5. Section 6 discusses the results. Finally, Section 7 explains the research conclusion and limitations and provides some salient recommendations for future work.

2. Proposed Research Framework

The scope of this study covers the examination of factors influencing consumer intention in participating in mobile phone recycling or refurbishing. The factors include TPB model constructs, data security, and perceived benefits. The study emphasises that mobile phone recycling cannot be compared to e-waste recycling due to data security concerns. It is also assumed that mobile phone users are more inclined to recycle when assured of complete disposal of personal information and data from the devices before recycling. Moreover, there is a need to focus on the benefits as a factor and determine whether this factor is vital in influencing consumer behaviour towards participating in mobile phone recycling.

2.1. Theory of Planned Behaviour (TPB)

Understanding human behaviour is not an easy process, which requires understanding psychological processes [26,29]. Knowing consumer intention is important in applying successful RSCM [26,30]. Therefore, many researchers have studied different theories discussing and analysing customer behaviour, such as the theory of reasoned action (TRA), the theory of planned behaviour (TPB), the decomposed theory of planned behaviour (DTPB), which is one of the famous extended theories of TPB [9,31], and the Integrated Behavioural Model (IBM). TPB allows for incorporating additional variables for a better

understanding of consumer behaviour. Researchers studying consumer behaviour in recycling have adopted TPB as a basis for their studies [22,25,26,32,33].

To understand the TPB model, we need to first understand the changes brought by behavioural intervention according to the theory (i.e., how the theory can predict behaviour). Planned or unplanned behaviours can be determined by an individual who intends to perform a specific behavioural belief. Positive or negative behavioural beliefs influence behaviour [29]. Apart from the ability to adopt an optimistic view, this belief can be impacted by social pressure. These behavioural beliefs will emerge as an intention dependent on three factors: one's attitude towards a particular behaviour (what do I believe?), subjective norms (what do others believe?), and perceived behavioural control (the ability and having the tools to perform a given behaviour). In general, the more favourable, positive, or beneficial the attitude and subjective standards are, the greater the perceived control, or the degree to which an individual's intention to conduct the desired behaviour is increased. According to Davis et al. [34], this theory is effective in a large body of published works, as it was essential in understanding consumer behaviour.

Furthermore, in the context of this study, the original TPB model fails to address key factors that influence mobile phone users to participate in mobile phone recycling, especially those related to data security and the perceived benefits of recycling [11,19–21]. Therefore, the current paper addresses this theoretical gap by proposing independent variables that may positively impact customer behaviour regarding mobile phone recycling. These new variables include data security and the perceived benefits of mobile phone recycling.

Moreover, most scholars conclude that intention is mediated by three variables: attitude, subjective norms, and the perceived behavioural control of the actual behaviour [35–40]. However, prior studies have neglected to examine the intention-to-behavioural-action timeframe. Individuals cannot be said to always act on their intentions, especially if there is a gap between the time they experience an intention to perform a behaviour and the time they actually perform that behaviour [41]. The paper will thus investigate whether intention mediates the association between the TPB factors and the newly obtained variables and recycling behaviour.

2.2. Data Security and Its Impact on Consumers' Behaviour

Issues pertaining to data security are usually raised during the recycling of mobile phones [42]. Data security can be perceived as the main concern during mobile phone recycling or refurbishing because data that are transferred to a digital format could be exposed to unauthorised access through various techniques developed over the years, including recovering lost files and decrypting encrypted files. With the existence of the best encryption strategies for securing personal data stored in mobile phones, there are also ways to breach layers of security to gain unauthorised access to the stored data. Several strategies have been developed to permanently erase and declare that the data are unrecoverable by using special equipment or an overwriting scheme. Degaussing (returning media to its original state) and physical destruction are additional techniques to destroy the drive using specialised equipment to render it impossible for data recovery [43]. Therefore, companies recycling EOL mobile phones should acquire data-destroying equipment to overwrite the data in the devices.

Data security and confidentiality are the primary concerns for individuals and businesses. Although businesses can permanently delete confidential data, the concern remains with individuals as their deleted data can be restored by others using simple software available on the market. Thus, handling e-waste data before disposal is critical for mobile phone users as it can significantly impact their privacy and data protection. Chen et al. [44] reported that data protection intention is influenced by self-efficacy to discard e-waste and optimism bias.

Individuals' privacy is jeopardised by the privacy and protection of sensitive data saved in a mobile device's memory. This concern impacts mobile phone customers, which affects their inclination to discard EOU/EOL mobile phones through authorised recycling

channels [45]. Individuals are afraid of the exposure of the data stored in their mobile phones such as private content or financial records [46]. The UAE's recycling channels, such as Abu Dhabi Municipality or the telecommunications companies in the UAE (Etisalat and du), do not provide information on protecting or formatting the mobile phones' data during the recycling process, especially when the mobile device set is still viable for donation or reselling. Therefore, this study also explores the willingness of UAE mobile phone users to participate in recycling their EOL and EOU mobile devices if they are assured of data cleaning by relevant channels.

2.3. The Influence of Perceived Benefits on Recycling Behaviour

Several studies analysed the benefit factors and the effects of these factors on consumer behaviour [13,14]. A financial incentive is a form of benefit presented as a factor influencing behaviour. Benefits include free services, vouchers, upgrades, and environmental health. Thus, an accurate evaluation of mobile phone users' expectations regarding the financial return from participating in RSC to return EOL or EOU mobile devices may provide significant information on their behavioural intention towards recycling.

Kumar [27] adopted the benefit factor to TPB and evaluated consumer intention as additional factors towards selling their used mobile phones. The author also defined the benefits as the expected social or personal objective or motivation driving mobile phone users to sell their used and old mobile phones [27]. Social benefits are associated with environmental awareness, while personal benefits included financial incentives offered for selling old devices. The study by Kumar [27], which was conducted in India, revealed that benefits and subjective norms had less influence on mobile phone recycling compared to perceived control and sense of duty. Thus, it is crucial to suggest the right incentives or benefits to mobile phone users to enhance the impact exacted by these factors.

On the other hand, Cao and Liu [13] identified perceived benefits and perceived trust as factors influencing express packaging recycling, in addition to the subjective norms, which yielded a significant positive impact on consumer readiness to participate in packaging recycling. The authors also added that the benefits gained by consumers from packaging recycling included the sense of satisfaction or pleasure from undertaking the action itself [13]. Nevertheless, companies should explain and promote the benefits to consumers to gain their trust. Knickmeyer [21] discussed economic factors as a form of benefit to motivate households in urban areas to undertake recycling behaviour. Furthermore, the author demonstrated that people can be more motivated towards recycling if they receive financial benefits or incentives and that they might not pay attention to recycling if no benefit can be gained from it.

Contrarily, a study by Safitri and Kusumastuti [47] in Jakarta did not support the findings presented by other studies that applied TPB and the benefit factor. The study demonstrated that an individual's intention to recycle was unaffected by their attitude towards the recycling behaviour and was not influenced by any form of incentives or benefits rewarded. The results from Safitri and Kusumastuti [47] may not provide a proper observation, as the benefits discussed were related to social and personal benefits predicted from selling mobile phones only. When enterprises focus on recycling mobile phones as part of their green effort, consumers will be encouraged to support their cause with high conscientiousness about recycling as part of their concern for the environment. Therefore, this study aims to predict whether saving the environment can be used to encourage consumers' participation in recycling their old mobiles. Additionally, this study highlights that financial gain from engaging in RSC to return/recycle EOL or EOU mobile devices can significantly influence consumers' behavioural intention towards recycling.

2.4. The Recycling Intention

The intention in TPB is a motivational concept that indicates the amount of commitment a person is willing to invest in the future to engage in the behaviour. The majority of the literature found that intention worked as a mediated effect in TPB for three vari-

ables: attitude, subjective norms, and perceived behavioural control [35,40]. Dixit and Badgaiyan [40] investigated the mediating effect of return intention in TPB. The research focused on mobile phone users in an attempt to understand return behaviour predictors. The results found that return intention had a significant impact on return behaviour, as the results emphasised the importance of intention in shaping the behaviour. Return intention worked as a mediator between the psychological constructs and return behaviour. The psychological constructs studied were perceived behavioural control, subjective norms, moral norms, and willingness to sacrifice.

Lv et al. [36] presented a design of a chain mediation model to investigate the mechanism of influence between public environmental awareness and the appropriate return behaviour of unused or expired medications. They examined two mediators, return intention and personal norms. The study found that only return intention had a significant effect on medicine return behaviour, and personal norms were insignificant. Return intention showed a favourable and strong mediation influence between the public environment, consequence awareness, and return behaviour. Residents with great awareness of the public environment are more likely to return medications properly. Residents will make greater attempts to return medications to the usual channels due to their high return intention.

It is important to mention that Zheng et al. [48] reviewed ten studies from 2011 to 2020 on e-waste recycling. They recommended paying greater attention to the environmental factors that influence the intention to dispose of mobile phones. They also proposed a predictive framework for a better understanding of customer behaviour, which is one of the aims this paper is trying to achieve.

As a conclusion, the relationship between intention and actual behaviour has been demonstrated not only via numerous theoretical contributions but also through several empirical studies on various topics.

3. Development of Research Hypotheses

3.1. Attitude towards Mobile Phone Recycling

Attitude refers to the positive or negative assessment for recycling mobile phones in the light of customer predictions of their intention to recycle EOL/EOU mobile phones. Researchers discovered that an individual's attitude towards recycling is positively related to their recycling behaviour. Kianpour et al. [9] stated that consumers' perceptions of the danger associated with EOL electronic devices, their eco-friendly knowledge, and relative benefits associated with the 3Rs (reduce, reuse, and recycle) can affect their willingness to return EOL electronic products to the manufacturer for reuse, repair, and recycling. Wang et al. [49] added that consumers' attitudes can influence their intention to recycle e-waste. Moreover, Zhang et al. [20] investigated the reasons for conscientious people who are more likely to recycle their used and old smartphones. The findings indicated that conscientiousness did not directly affect consumers' behavioural intentions on mobile phone recycling. However, it may have an indirect effect through two mediating variables, namely subjective norms and recycling attitude. Thus, attitude can be regarded as a critical influential factor of behavioural intention. According to Wang et al. [50], attitude determines the pro-environmental and energy-saving intentions. According to the literature review and the context of this paper, attitude is considered an important variable with a significant positive effect on intention in most of the studies discussed. Therefore, based on the discussion above, the following hypothesis is proposed:

Hypothesis 1 (H1). *Attitude has a significant positive influence on UAE mobile phone users' intention towards mobile phone repair, reuse, and recycling.*

3.2. Subjective Norms towards Mobile Phone Recycling

Subjective norms refer to the expectation of a community whether they would approve and endorse a particular action. Echegaray and Hansstein [25] postulated that social norms can significantly influence the behavioural intention of Brazilians to engage in recycling

e-waste based on the TPB model. Meanwhile, Wang et al. [49] suggested that all TPB variables can influence the recycling attitude. However, the impact of subjective norms on recycling intention was considered negligible. In spite of that, questions related to the subjective norms used in Wang et al.'s (2018) study were adopted and re-measured in this study.

Kumar [27] also added that attitude and perceived control could strongly influence the recycling behaviour more than subjective norms and benefits. Kumar [27] justified that respondents were unaware of recycling centres' existence as questions associated with subjective norms were omitted from the scale during the analysis. However, many academics [20,25,40,51,52] found that subjective norms were positively and significantly related to recycling intention. The findings of the literature discussed the subjective norms in most studies which are an essential factor that has a significant and positive influence on intention. Therefore, the researcher offers the following hypothesis:

Hypothesis 2 (H2). *Subjective norms have a significant positive influence on UAE mobile phone users' intention towards mobile phone repair, reuse, and recycling.*

3.3. Perceived Behavioural Control (PBC) towards Mobile Phone Recycling

Perceived behavioural control (PBC) is TPB's third independent factor. It refers to the assessment of whether individuals find it easy or difficult to perform a particular activity or react to certain situations. Moreover, PBC includes the resource availability or methods that facilitate the completion of an action [53]. Therefore, it is vital to study behavioural control in the field of recycling because PBC could be used as a tool or infrastructure to facilitate the intention [54–56].

According to Sultan et al. [57], who examined PBC using the TPB model, TPB could "explain 39% of the variance in behavioural intention and 27% of the variance in reported behaviour" [58]. Individuals may be unmotivated to make the final decision despite their delight and happiness associated with a certain behaviour or action. Sultan et al. [57] focused on the behaviours associated with food purchasing using three factors, namely communication, trust, and satisfaction, for the TPB model. They then examined PBC again only to discover a reduction in the gap between intention and PBC. In the context of recycling, the ability to act is considered an important variable because it assesses a consumer's desire to recycle an old unused mobile phone. Therefore, the following hypothesis was proposed based on the discussion above:

Hypothesis 3 (H3). *PBC has a significant positive influence on UAE mobile phone users' intention towards mobile phone repair, reuse, and recycling.*

3.4. Data Security towards Mobile Phone Recycling

Mobile phones are used not only for answering calls or sending SMS, but also as a device used to access the Internet, send emails, access social media, and pay for products or services through a broad range of online financial applications. Therefore, data security becomes a huge concern among consumers, as sensitive data are stored on their mobile phones. According to Alghazo and Ouda [45], forecasting the data volume of recycled e-waste devices becomes difficult due to the lack of statistical data in the Gulf countries and the UAE regarding e-waste. Alghazo et al. [59] also mentioned that there is no regulation in the UAE or Gulf countries that governs or mandates a method for the disposal of sensitive information. However, the UAE government announced several laws on data and privacy protection in the past five years. For instance, "Federal Law No. 5 on Combatting Cybercrimes makes it illegal to disclose any information obtained by electronic means if such information was obtained in an unauthorised manner." No statistics or studies are currently available on whether mobile phone users in the UAE are aware of such laws or are confident with such laws to protect their data during the recycling process. This study aims to measure this level of confidence among consumers in the UAE.

Zhang et al. [20] highlighted the importance of dealing with data security when recycling mobile phones. The study recommended the government to establish a law that governs data security during mobile phone recycling. Therefore, customers can be assured of a customer satisfaction guarantee with the disposal of personal information stored on their old mobiles, which should be carried out in their presence. Although data security was part of the recommendation, Zhang et al. [20] did not discuss information security and the appropriate data cleaning process in detail. Moreover, the authors did not examine data security as a factor and its impact on consumer intention towards recycling. However, they discussed the perceived risk, whereby they identified that consumers are less inclined to adopt the recycling behaviour when the risk is high.

This paper, on the other hand, emphasises that mobile phone recycling should not be compared with e-waste recycling due to the concern over data security in the former. The study also assumed that mobile phone users are more likely to engage in recycling when assured of complete disposal of personal information and data from the devices before recycling. Therefore, the following hypothesis was formed:

Hypothesis 4 (H4). *Data security has a significant positive influence on UAE mobile phone users' intention towards mobile phone repair, reuse, and recycling.*

3.5. Perceived Benefits towards Mobile Phone Recycling

Mobile phone waste is considered dangerous due to the negative impact of exposure to cytotoxic metals on the environment and humans [4]. Therefore, before labelling mobile phones as a product of green innovation by convincing a consumer to participate in mobile phone recycling, the public needs to be educated about a safe environment and good health. Such perceived benefits may encourage mobile phone users to participate in recycling EOL mobiles [60].

Many companies in the UAE are trying to collect EOU mobile devices to generate extra profit by selling the devices in a second market to support the environment. Companies such as Apple, Samsung, and Etisalat have announced different programmes to encourage customers living in the UAE to give away their EOU or EOL devices in exchange for incentives such as gift vouchers (Apple) or cash-back vouchers (Etisalat). The continuous offering of benefits could promote continuous adoption of recycling behaviour among mobile phone users, as most devices have a life cycle of around two to three years [2,61]. Based on the above discussion, the following hypothesis was formed:

Hypothesis 5 (H5). *Perceived benefits have a significant positive influence on UAE mobile phone users' intention towards mobile phone repair, reuse, and recycling.*

3.6. Mobile Phone User Intention (Mediator)

The literature regarding data security concluded that if mobile phone users, during the recycling process, are ensured of protection of their data security and privacy by erasing the data by any technology or governed by the law, they would have more intention to participate in RSC to recycle or resell their EOL/EOU devices. Moreover, the literature supported by Chen et al. [44] found that data protection intention is influenced by self-efficacy to discard e-waste. Similarly, for perceived benefits, Knickmeyer [21] showed that individuals might have more recycling intention if they obtain financial rewards or advantages from the exercise. However, individuals can avoid or have no intention of recycling if they receive no benefit from the recycling activity. Moreover, Khan et al. [26] tested the TPB and other external factors (norms, consequences awareness, and convenience) and found that customer intention worked as a mediator between the recycling behaviour and those external factors. The above findings indicate that intention mediates the relationship between data security and recycling behaviour. According to the topic above and the literature discussed, most studies showed that intention mediates the relationship between

behaviour and external variables. However, this assumption must be validated and proven. As a result, the following hypotheses are proposed:

Hypothesis 6a1 (H6a1). *Mobile phone users' intention mediates the relationship between attitude and UAE mobile phone users' recycling behaviour.*

Hypothesis 6a2 (H6a2). *Mobile phone users' intention mediates the relationship between subjective norms and UAE mobile phone users' recycling behaviour.*

Hypothesis 6a3 (H6a3). *Mobile phone users' intention mediates the relationship between perceived behavioural control and UAE mobile phone users' recycling behaviour.*

Hypothesis 6b (H6b). *Mobile phone users' intention mediates the relationship between data security and UAE mobile phone users' recycling behaviour.*

Hypothesis 6c (H6c). *Mobile phone users' intention mediates the relationship between perceived benefits and UAE mobile phone users' recycling behaviour.*

3.7. The Behaviour of Mobile Phone Users

According to a study conducted by Khalil et al. [62], TPB predicts household recycling intentions in Nigeria. The study discovered that when the personal norms aspect is included in the expanded TPB model, it comprehensively explains households' recycling intentions. Strydom [53] analysed the recycling behaviour in South Africa and found that TPB revealed 26.4% of the change in recycling behaviour and 46.4% of the change in intention to recycle. Thus, extending the TPB with data security and perceived benefits might explain mobile phone recycling intention better, leading to a stronger inclination to recycling behaviour. The literature discussed by Knickmeyer [21], Khan et al. [26], Sharma and Foropon [39], Wang et al. [49], Lee et al. [63] demonstrated that greater attitude, subjective norms, and PBC would lead to stronger intention to execute a behaviour for individuals. Furthermore, Bashir et al. [64] investigated the factors affecting consumers' intention towards purchasing halal food in South Africa. Similarly, Kianpour et al. [9] investigated the factors influencing consumers' intention towards recycling in Malaysia, and both indicated that intention would lead to the actual behaviour. A strong influence of attitude, subjective norms, PBC, data security, and perceived benefits on consumer intention to recycle their mobile phones might result in a more substantial influence of intention on consumer behaviour. Therefore, to answer the seventh research question in this study, it is expected that the stronger the mobile phone users' intention towards mobile phones recycling, repair, or reuse, the stronger they will perform this behaviour. Accordingly, the below hypothesis is proposed:

Hypothesis 7 (H7). *UAE mobile phone users' intention positively and directly affects their actual behaviour towards mobile phone recycling.*

Figure 1 illustrates the conceptual framework proposed in this research.

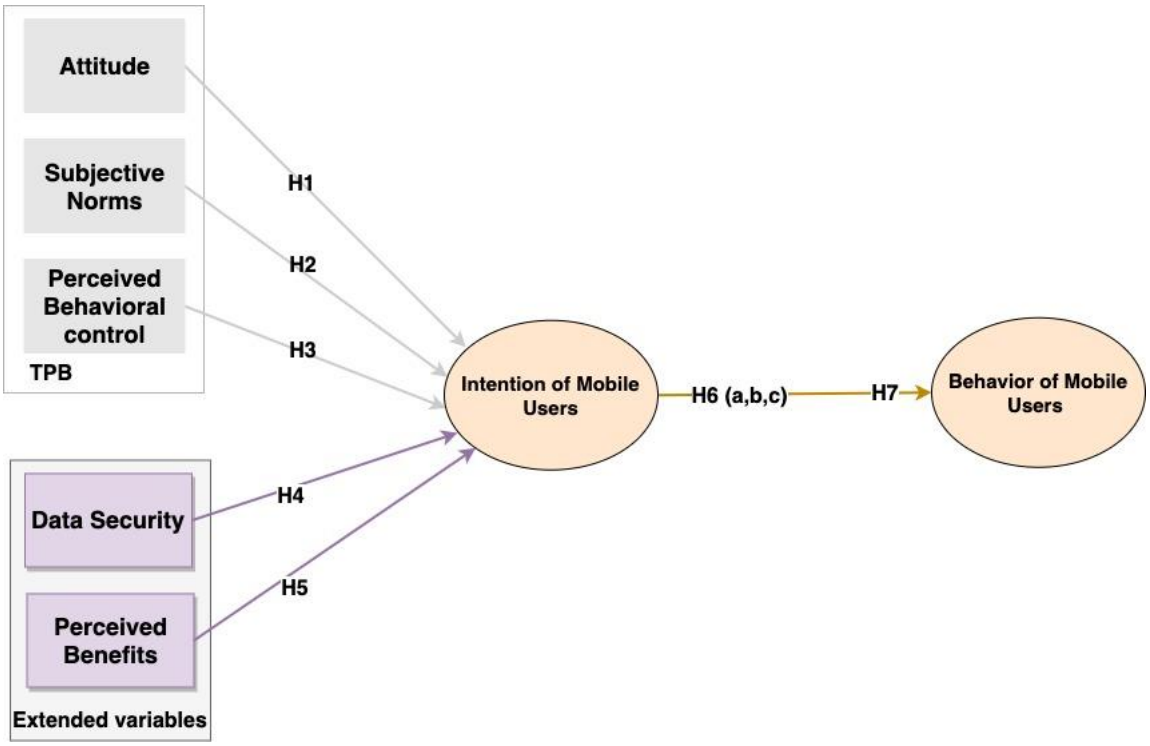

Figure 1. Conceptual model with hypotheses.

4. Research Data and Methodology

This paper adopted a quantitative approach as a choice of research and a survey method as a research strategy. Data collection was conducted via a self-administrated five-point Likert scale questionnaire using the non-probability self-selection sampling technique [65,66]. The sample size was determined using the Cochran (1977) formula [67] by calculating the population's characteristics with a confidence level of 95% and a margin of error of plus or minus 4%, resulting in 601 questionnaires required for the UAE population of 9.89 million [7]. A self-administered questionnaire survey was dispatched to the respondents with the plan of collecting 601 completed feedbacks. Additionally, this sample size complied with the ten times rule [68,69], which stipulates that the sample size for the most complicated partial least squares regression (PLS) model should be ten times the number of independent variables. The questionnaire consisted of closed-ended questions, using a five-point Likert scale ranging from (5) for strongly agree to (1) strongly disagree. This study used the five-point scale because it is sufficient to represent respondents' actual evaluation, data accuracy, and convenience. The five-point Likert scale provides enough options to respondents, sufficient for the analysis of their behaviour [70]. The use of the five-point Likert scale in the TPB questionnaire was also suggested by Ajzen [71]. The closed-ended questions were divided into three parts. The first part highlighted the consent along with survey keywords, while the second part contained a set of 35 core questions regarding the factors illustrated in the research framework. The final part collected the respondents' general demographic information (gender, age, education, income, and city) along with a general inquiry on mobile phone treatment possibilities. The questionnaire was designed based on an extensive literature review, as all the survey questions were adapted from other proven studies. The self-design questions were suggested only for the data security part. The questionnaire was reviewed by a panel of two academic experts in supply chain management (SCM) and three SCM industry experts, which met the content validity recommendations by Yusoff [72]. The pilot test to validate the survey questions involved 35 individuals, who confirmed that the items were clear and relevant. Following the pilot test, the number of questions was reduced from 37 to 35. Table 1 presents a list of

studies that were reviewed for the adaption of survey questions (see Appendix A Table A1 for the questionnaire items).

Table 1. List of studies used for the survey questionnaire.

Constructs	Source	Items No.
General Information about the Users (gender, city, income . . . etc.) and mobile phone treatment	–	11
Attitude (AT_MU)	Echegaray and Hansstein [25], Kianpour et al. [9]	5
Subjective Norms (SN_MU)	Echegaray and Hansstein [25], Kianpour et al. [9]	5
Perceived Behavioural Control (PBC_MU)	Echegaray and Hansstein [25], Kianpour et al. [9], Wang et al. [49]	5
Data Security (DS_MU)	Giwah et al. [73] and Self-design	5
Perceived Benefits (PB_MU)	[9,27,74]	5
Intention of Mobile Phone Users (IMU)	Echegaray and Hansstein [25], Wang et al. [49]	5
Behaviour of Mobile Phone Users (BMU)	Echegaray and Hansstein [25], Kumar [27]	5

The data collection was conducted for six weeks. The questionnaire was distributed online to participants from around the UAE (Emirates). A total of 1983 responses were collected, of which only 630 responses were complete. The incomplete questionnaires were removed. Table 2 exhibits the descriptive analyses of the respondents.

Table 2. Demographic analyses of respondents.

Demography	Details	Frequency	% of Respondents
Age	18–24 Years	141	23.5
	25–35 Years	224	37.3
	36–45 Years	171	28.5
	46–60 Years	59	9.8
	61+ Years	6	1
Gender	Female	280	46.6
	Male	321	53.4
Education level	Less than high school	21	3.5
	High school	203	33.8
	Bachelor's degree	292	48.6
	Master's degree	76	12.6
	Doctorate	9	1.5
Average Income	0–4999 AED	355	59.1
	5000–9999 AED	100	16.6
	10,000–29,999 AED	87	14.5
	30,000–49,999 AED	33	5.5
	50,000 or above AED	26	4.3
Occupation	Student	90	15
	Employed for wages	380	63.2
	Self-employed	59	9.8
	Retired	6	1
	Unemployed	66	11

The first aspect that was analysed was the respondents' general background, including gender, age, education level, income, occupation, and their current residential city. According to Table 2, a majority of the respondents (37.3%) were aged between 25 and 35. A total of 53.4% of the respondents were males, and 46.6% were females. This data approximately represented the actual population in the UAE, where 66.35% of the UAE population are between 25 and 54 years old, while 63.9% of the total population are males and 36.1% are females [75]. Most respondents had a Bachelor's degree and a high school degree (48.6% and 33.8%, respectively). Only 12.6% and 1.5%, respectively, were Master's and doctoral degree holders. In terms of income, most respondents (59.1%) earned between 0 and 4999 AED per month (according to [76], 1 AED is equal to 0.27 USD). Approximately 63.2% were employed on a wage basis. A majority of the respondents (41.1%) were from

Dubai, followed by Abu Dhabi (34.6%), as these cities have the highest population in the UAE.

According to Hair, Jr. et al. [69], suspicious responses should be removed from the data such as straight-lining, which refers to a respondent marking the same response for all the questions. Twenty-nine responses provided the same scale response for all the questions. Thus, they were removed from the collection as such data indicate that respondents just filled out the questionnaire without reading the questions. Finally, a total of 601 final responses were retained for the analyses. To test the common method bias (CMB), the author used the full collinearity test [77]. The Harman on-factor test was not used as it is no longer a proper test according to [78]. The full collinearity test was tested using SPSS v28.0 through a regression method against one common variable, generating the variance inflation factor (VIF) for the framework variables: (AT_MU = 2.388), (SN_MU = 2.501), (PBC_MU = 2.236), (DS_MU = 1.794), (PB_MU = 2.923), (IMU = 3.445), and (BMU = 1.230). The VIF was less than 5, indicating that single-source bias was not a significant problem with the data.

5. Data Analysis and Results

Partial least squares structural equation modelling (PLS-SEM) was used to perform the statistical analysis of the proposed hypotheses. The convergent and discriminant validity, besides the outer and inner model measurements, were examined using the Smart PLS 4.0.8.4 software. The bootstrapping procedure was set to 10,000 bootstrap samples, and the complete bootstrapping option was selected to test the hypotheses as suggested by [69].

5.1. Measurement Model Evaluation (Outer Model)

The measuring of the outer model refers to the relationship between the constructs and their associated items. Thus, the first stage in the PLS analysis is to evaluate the validity and reliability of the measurement model. The reflective measurement models were evaluated using internal consistency reliability, convergent validity, and discriminant validity. These measurements ensure that the items are measuring the intended constructs accurately.

The evaluation of a reflecting measurement model examines the indicators' outer loading. According to Hair, Jr. et al. [69], outer loading should be 0.708 or higher. However, 0.70 is also commonly considered to be close enough to 0.708 and is acceptable. Commonly, indicators with an outer loading of 0.40 to 0.70 can be removed to enhance internal consistency, reliability, or convergent validity. Indicators with an outer loading of less than 0.40 should permanently be excluded from the construct [69]. Thus, referring to Table 3, the outer loading for indicator DS5 with a loading value of 0.486 was deleted, as well as BMU1 and BMU1 as the value was negative, and DS_MU average variance extracted (AVE) increased from 0.478 to 0.548. Meanwhile, the remaining outer loadings that were less than 0.7 (PBC4 = 0.656. DS1 = 0.501, PB1 = 0.657, PB2 = 0.698) were retained in the dataset for further analyses as deleting them would not improve the internal consistency, reliability, or convergent validity. Table 3 summarises the outer loadings and the eliminated items, while Figure 2 illustrates the model summary with the accepted items' loading value. The PLS-SEM analysis presented in Table 3 revealed that the composite reliability and Cronbach's alpha values for the constructs were within the acceptable value, ranging between 0.739 and 0.857. Consequently, the internal consistency of the framework was established. The AVE values of the constructs were also higher than 0.5, confirming convergent validity, as suggested by [69].

Table 3. Summary for the measurement model.

Latent Variable	Indicators	Convergent Validity		Internal Consistency Reliability Validity		Discriminant Validity
		Loading >0.70	AVE >0.50	Cronbach's Alpha 0.60–0.90	Reliability 0.60–0.90	HTMT Significantly <0.85
Attitude of Mobile Phone Users (AT_MU)	AT1	0.773	0.612	0.841	0.887	YES
	AT2	0.817				
	AT3	0.773				
	AT4	0.763				
	AT5	0.783				
Subjective Norms of Mobile Phone Users (SN_MU)	SN1	0.750	0.626	0.850	0.893	YES
	SN2	0.808				
	SN3	0.727				
	SN4	0.836				
	SN5	0.830				
PBC of Mobile Phone Users (PBC_MU)	PBC1	0.747	0.554	0.798	0.861	YES
	PBC2	0.734				
	PBC3	0.807				
	PBC4	0.656				
	PBC5	0.771				
Data Security of Mobile Phone Users (DS_MU)	DS1	0.501	0.548	0.739	0.824	YES
	DS2	0.834				
	DS3	0.716				
	DS4	0.857				
	DS5	0.486				
Perceived Benefits of Mobile Phone Users (PB_Mu)	PB1	0.657	0.574	0.817	0.870	YES
	PB2	0.698				
	PB3	0.822				
	PB4	0.808				
	PB5	0.790				
Intention of Mobile Phone Users (IMU)	IMU1	0.738	0.637	0.857	0.898	YES
	IMU2	0.815				
	IMU3	0.832				
	IMU4	0.818				
	IMU5	0.784				
Behaviour of Mobile Phone Users (IMU)	BMU1	−0.608	0.706	0.821	0.877	YES
	BMU2	−0.358				
	BMU3	0.751				
	BMU4	0.963				
	BMU5	0.791				

The Fornell–Larcker criterion was used to assess the discriminant validity. Therefore, the square root of each construct's AVE should be greater than its highest correlation with any other construct [69,79,80]. Based on Table 4, the square root of the AVEs was higher than the corresponding row and column values (correlations between constructs), confirming the discriminant validity through the Fornell–Larcker criterion. Another method in PLS-SEM called the Heterotrait–Monotrait ratio (HTMT) of the correlations accurately assesses the discriminant validity. HTMT indicates the best balance between high detection and low false-positive rates by determining the discriminant validity of a construct [81]. The HTMT approach is an estimate of what the true correlation between two constructs would be. The HTMT values (Table 5) for all constructs did not exceed 0.85, indicating the presence of no discriminant validity [69]. Once the measurement analyses confirmed the reliability and validity of the construct measures, the structural model outcomes were assessed.

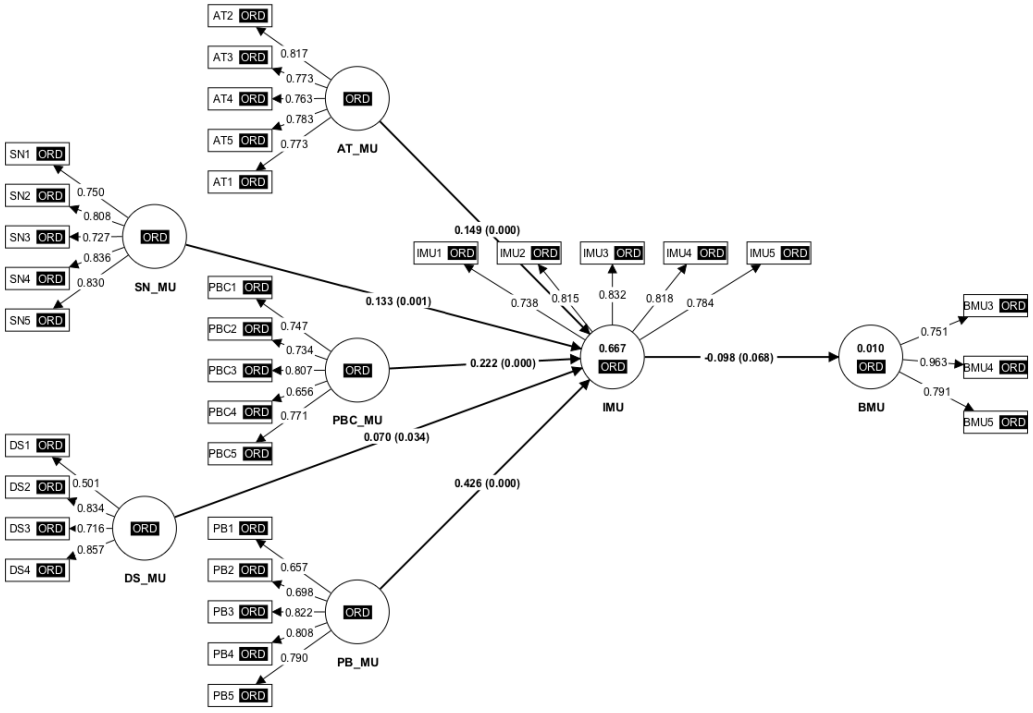

Figure 2. Outer model with factor loading value and R square.

Table 4. Fornell–Larcker criterion.

	AT_MU	BMU	DS_MU	IMU	PBC_MU	PB_MU	SN_MU
AT_MU	0.782						
BMU	−0.163	0.840					
DS_MU	0.510	−0.195	0.741				
IMU	0.653	−0.098	0.549	0.798			
PBC_MU	0.500	0.096	0.385	0.602	0.745		
PB_MU	0.633	−0.230	0.605	0.735	0.456	0.758	
SN_MU	0.654	−0.004	0.442	0.627	0.626	0.530	0.791

Table 5. Heterotrait–Monotrait Ratio (HTMT).

	AT_MU	BMU	DS_MU	IMU	PBC_MU	PB_MU	SN_MU
AT_MU							
BMU	0.180						
DS_MU	0.595	0.252					
IMU	0.765	0.118	0.621				
PBC_MU	0.596	0.222	0.432	0.716			
PB_MU	0.745	0.272	0.724	0.850	0.528		
SN_MU	0.769	0.084	0.521	0.731	0.760	0.613	

5.2. Structural Model Evaluation (Inner Model)

The first stage in evaluating the structural model was examining the potential collinearity issues between each set of the structural model constructs separately. VIF values of less than 3 indicate that collinearity has no significant effect on the structural model estimation [69]. The AT_MU (VIF = 2.237), SN_MU (VIF = 2.247), PBC_MU (VIF = 1.721), DS_MU (VIF = 1.669), and PB_MU (VIF = 2.090) as predictors of the intention of mobile phone users (IMU) yielded VIF values less than 3. Therefore, it was concluded that the collinearity among the predictor constructs was not an issue in the structural model. The second step assessed the significance and relevance of the structural model relationships by measuring

the path coefficients' beta values (β). Figure 2 illustrates the path coefficients (with *p*-values) related to the constructs connected to the mobile phone users' intention for the structural model relationships. It was discovered that perceived benefits (PB_MU) yielded the highest path coefficient (β = 0.426; $p < 0.000$), followed by perceived behavioural control (PBC_MU) (β = 0.222; $p < 0.000$) on (IMU), followed by attitude (AT_MU) = (β = 0.149; $p < 0.000$) and subjective norms (SN_MU) = (β = 0.133; $p < 0.001$), respectively. Data security (DS_MU) bore minimal bearing on (IMU) (β = 0.07; $p < 0.05$), the lowest value among all the constructs. Based on these values, all the hypotheses in this framework, i.e., H1, H2, H3, H4, and H5, were statistically significant. However, H7 (IMU) -> (BMU) was statistically insignificant (β = 0.098; $p > 0.05$). The rejection of this hypothesis was supported by the *p*-value that was > 0.05.

Table 6 summarises the significant testing results of the structural model path coefficients based on the bootstrapping technique. This table provides a summary of the path coefficient estimates, t-values, *p*-values, and confidence intervals. Assuming a 5% significance level, this study focused on the 95% bootstrap confidence interval obtained through the percentile approach. All relationships for the first five hypotheses in the structural model were significant with $p < 0.001$, except for (DS_MU) with $p < 0.5$.

Table 6. Significant testing results of the structural model path coefficients.

Hyp	Structural Path	(β)	STDEV	*t* Values	*p* Value	95% CI	f^2	VIF
H1	AT_MU −> IMU	0.149	0.043	3.491	$p < 0.001$	[0.078, 0.218]	0.030	2.237
H2	SN_MU −> IMU	0.134	0.042	3.166	$p < 0.001$	[0.067, 0.205]	0.024	2.247
H3	PBC_MU −> IMU	0.223	0.039	5.679	$p < 0.001$	[0.157, 0.287]	0.087	1.721
H4	DS_MU −> IMU	0.070	0.039	1.817	$p < 0.050$	[0.010, 0.137]	0.009	1.669
H5	PB_MU −> IMU	0.426	0.043	9.893	$p < 0.001$	[0.353, 0.493]	0.258	2.090
H7	IMU −> BMU	−0.098	0.066	1.492	$p > 0.050$	[−0.180, 0.074]	0.010	1.000

H7 was rejected as the *p*-value was > 0.05. The results for the bootstrapping output for the total effects (H6), as summarised in Table 7, showed that all the total effects for the exogenous constructs to BMU had insignificant *p*-values of > 0.05.

Table 7. Significant testing results of the total effects.

Structural Path	(β)	STDEV	T Values	*p*-Values	95% CI	Conclusion
AT −> IMU −> BMU	−0.013	0.010	1.340	0.090	[−0.029, 0.002]	H6a_1, Not Supported
SN −> IMU −> BMU	−0.012	0.010	1.219	0.111	[−0.029, 0.002]	H6a_2, Not Supported
PBC −> IMU −> BMU	−0.020	0.014	1.353	0.088	[−0.044, 0.003]	H6a_3, Not Supported
DS −> IMU −> BMU	−0.006	0.006	0.994	0.160	[−0.018, 0.001]	H6b, Not Supported
PB −> IMU −> BMU	−0.037	0.028	1.356	0.088	[−0.084, 0.006]	H6c, Not Supported

To assess the model's explanatory power, the coefficient of determination (R^2) value was determined. The larger the value, the larger the percentage of variance explained. Figure 2 illustrates that the R^2 value for the endogenous constructs (IMU) was 0.667 and (BMU) was 0.01. By computing the predictive relevance Q^2 value using the blindfolding procedure in SmartPLS, Q^2 was greater than zero for both endogenous constructs (IMU = 0.418 and BMU = 0.075) with all relationships with the other constructs. This value indicated that the Q^2 statistics revealed a high predictive relevance for the indicators of the endogenous construct in the structural models. Furthermore, as suggested by Shmueli et al. [82], the $PLS_{predict}$, a holdout sample-based procedure, generates case-level predictions for an item or a construct level using the PLS-Predict with a 10-fold procedure to determine the predictive relevance as the sample size was more than 200. Besides that, Shmueli et al. [82] suggested that if a majority of indicators in the PLS-SEM analysis yielded lower root mean square error (RMSE) compared to the linear regression model (LM), the model possesses medium predictive power. Based on Table 8, all the errors of the PLS

model were higher than the LM model. Thus, it can be concluded that this paper model had lakes predictive power.

Table 8. $PLS_{predict}$, results report.

Item	PLS RMSE	LM RMSE	PLS–LM	Q^2_Predict	Difference Using RMSE Value
BMU3	1.217	1.170	0.047	0.005	PLS -SEM values > LM
BMU4	1.125	1.104	0.021	0.014	PLS -SEM values > LM
BMU5	1.197	1.182	0.014	0.007	PLS -SEM values > LM

5.3. Mediation Analysis

This study used the PLS-SEM bootstrap method to test the mediating effect. To start the mediation analysis, the significance of the path coefficients was tested to measure the direct effect and then measure the indirect effect for the constructs (AT, SN, PBC, DS, and PB) via (IMU) to (BMU). Table 9 summarises the significance analysis of the direct and indirect effects, which showed that the AT, SN, PBC, DS, and PB had insignificant direct effects (β = −0.013, −0.012, −0.020, −0.006, and −0.037), respectively, and the *p*-value was >0.05. The indirect effect was also insignificant, and the *p*-value was >0.05. This result meant that there was a direct only non-mediation effect [69].

Table 9. Significance analysis of the direct and indirect effects (mediation analysis).

Construct	Direct Effect	95% Confidence Intervals	$p < 0.05$	Indirect Effect	95% Confidence Intervals	$p < 0.05$	Mediation/Mediation Type
AT −> BMU	0.149	[0.079, 0.219]	YES	−0.013	[−0.029, 0.002]	NO	No mediation/Direct only
SN −> BMU	0.133	[0.068, 0.204]	YES	−0.012	[−0.029, 0.002]	NO	No mediation/Direct only
PBC −> BMU	0.222	[0.158, 0.287]	YES	−0.020	[−0.044, 0.003]	NO	No mediation/Direct only
DS −> BMU	0.070	[0.010, 0.137]	YES	−0.006	[−0.018, 0.001]	NO	No mediation/Direct only
PB −> BMU	0.426	[0.353, 0.494]	YES	−0.037	[−0.084, 0.006]	NO	No mediation/Direct only

6. Discussion

Based on the questions related to the mobile phone treatment behaviour (Table 10), a majority of respondents (32.9%) maintained their devices for three years. This result was consistent with that of Yin et al. [2], who revealed that the average life cycle for mobile phones in China was three years. Attia et al. (2021) discovered a similar mobile phone life cycle period of three years in the UAE. However, the research was limited to Dubai. A total of 42.3% of the respondents stored their old mobile phones at home [1–4,83]. Previous studies pointed to the same behaviour, demonstrating the vital nature of this behaviour and the urgency with which it must be handled.

One of the paper's objectives was to examine if attitude could positively influence the intention of UAE mobile phone users to participate in RSCM processes. The study demonstrated that mobile phone users' attitude (H1) positively influenced their take on the repair, reuse, or recycling of EOL/EOU mobile phones. This result was consistent with the findings by Aboelmaged [12], Echegaray and Hansstein [25], Jain et al. [84], Kianpour et al. [9], Kumar [27], and Zhang et al. [20]. The attitude explained only 15% of the variance in the mobile phone users' intention to recycle their mobile phones. The results demonstrated that mobile phone users in the UAE favoured reusing, repairing, and recycling EOL mobile phone devices, which was a positive sign with the actions adopted by the government towards waste management overall [4,85,86]. As for H2, the effects of subjective norms on mobile phone recycling or refurbishing were smaller compared to the other factors (β = 0.134; $p < 0.001$). The results were consistent with previous studies conducted by Echegaray and Hansstein [25], Kumar [27], and Zhang et al. [20]. However, Kianpour et al. [9], and Wang et al. [49] reported that the effects of subjective norms on recycling attitudes were deemed insignificant. This observation could be due to mobile phone users who are unconcerned with other people's feedback, particularly when it comes to recycling or refurbishing old mobile devices.

Table 10. Responses to mobile phone treatment questions.

Question	Details	*n*	%
Mobile phone average life cycle	Less than a year	30	5
	1 year	58	9.7
	2 years	134	22.3
	3 years	198	32.9
	4 years	167	27.8
	More than 4 years	14	2.3
Old mobile phone treating ways	Store it at home	254	42.3
	Throw it away as ordinary garbage	19	3.2
	Give it to a friend or relative	173	28.8
	Resell it	69	11.5
	Recycle it through proper channels provided by the UAE government or organisations	85	14.1
The best statement that is preventing participation in mobile phone recycling	I would rather give the phone to family or friends than recycle it at a low price	227	37.8
	I do not know where to send the phone for recycling	183	30.4
	I am afraid of disclosure of privacy (data security/privacy reasons)	145	24.1
	There is no benefit that I would gain from recycling my phone	32	5.3
	It is expensive to recycle my phone	10	1.7

A strong influence was discovered for mobile phone users' perceived behaviour control (H3) and mobile phone users' perceived benefits (H5). These two factors explained that there was around a 65% variance in mobile phone users' intention to recycle their mobile phones. It is encouraging to compare H3 results with the previous research by Echegaray and Hansstein [25], Kianpour et al. [9], and Zhang et al. [20], which stated that perceived behavioural influence had a significant impact on recycling or refurbishing intentions through RSC processes, particularly mobile phone users who are familiar with recycling channels. Table 10 indicates that approximately 30.4% of the respondents who did not know the existing recycling channels did not participate in mobile phone recycling or refurbishing. Although the UAE government placed recycling bins in the most accessible locations, mobile phone users could be looking for specific mobile phone recycling centres. Previous studies by Dhir et al. [87] and Jain et al. [84] also discovered that waste recycling was mainly driven by perceived benefits (H5). The current findings were also consistent with those of Kumar [27], who found that recycling could lead to expected personal and social benefits that motivated an individual's engagement in recycling mobile phones, considering saving the environment is a benefit. This study focused on including three questions in the questionnaire on whether mobile phone users would consider saving the environment by reducing the landfill waste volume through returning EOL mobile phones for repair, reuse, or recycling purposes. The results were similar to the findings of Echegaray and Hansstein [25], where they postulated that the elevated recycling intention rested on the higher awareness of environmental issues and recognition that recycling can contribute to climate conservation.

Moreover, the results suggested that companies should concentrate on enhancing their benefits programmes as part of their marketing efforts. Meanwhile, H4 related to data security yielded a *p*-value of less than 0.05 but with a low effect. This factor only recorded a 7% variance in the mobile phone users' intention towards recycling. This low effect was in line with the findings of Baxter and Gram-Hanssen [42], who reported that the concern over data security was usually not significant for individuals compared to businesses. Contrarily, Bai et al. [11] revealed that data security was the number one concern for consumers participating in mobile phone recycling. They also reported that several individuals were concerned about the possibility of deleted data being retrieved illegally. A

possible explanation of the low influence value of data security towards recycling intention found by this study might be related to two reasons. First, the respondents had a low ranking for data security in comparison to other variables in the survey, and this assumption was in alignment with the results found in Table 10. Only 24% chose data security as a reason for preventing them to recycle their old mobile phones. Second, there is a relation to the strong law in the UAE, which governs and protects the privacy of UAE residents. The UAE has announced several laws on data and privacy protection. Federal Law No. 5 of 2012 on Combatting Cybercrimes makes it illegal to disclose any information obtained by electronic means. Additionally, the UAE Data Protection Law, number 45 of 2021, regulates the handling of personal data. Any information that may be used to identify an individual is considered personal data. The UAE law does not tolerate punishment for those who violate these laws.

The objective of the sub-hypotheses of H6 is to investigate whether the mobile phone users' intention in this study is mediating the relationship between attitudes (H6a1), subjective norms (H6a2), perceived behavioural control (H6a3), data security (H6b), and perceived benefits (H6c), and the mobile phone users' behaviour. As presented in Table 7, the study's results did not agree with the studies by Lee et al. [38] and Wang et al. [49], which focused mainly on the recycling behaviour. The current study found that the intention did not mediate the relationship between all the independent variables proposed and the mobile phone users' behaviour. Furthermore, the study was not in agreement with Dixit and Badgaiyan [40] who proposed a similar model to this study but examined moral norms, willingness to sacrifice, and anticipated positive emotions factors in addition to the TPB factors. The study pointed that that return intention had a significant impact on return behaviour. Moreover, this study's results contradicted the results by Lwin et al. [37] that focused on understanding the mediation role of TPB on fruits and vegetable consumption. However, Lwin et al. [37] focused on food purchases where the time gap was small between the intention and the actual behaviour. The study found significant indirect effects that occurred through PBC and intention and only for attitude and intention. However, for subjective norms, the results matched this study, where there was a significant direct effect and no mediation. This paper's result was fully consistent with Wicaksono et al. [88], who examined the variables underlying the tendency of higher education members to execute sustainable behaviour by adopting TPB. The results indicated that the TPB variables did not mediate the relationship between three independent factors and sustainable behaviour. Although the research did not concentrate on the recycling behaviour, it did correspond to the similar principle of employing TPB.

The study findings are noteworthy since this study found that mobile phone users' intention is not a significant predictor of mobile phone recycling behaviour (H7). However, it negatively impacts mobile phone recycling behaviour. This study showed that mobile phone users still consider the perceived financial or environmental benefits as fundamental factors for decision-making. This study revealed that mobile phone users believed that it is easy to conduct mobile phone recycling or refurbishing behaviour directly if the individuals' attitudes, people's opinions, perceived control, data security, and perceived benefits are substantial. Nevertheless, the reference to the intent will not add anything to the behaviour. For instance, if mobile phone users engage in mobile recycling, there are neither financial incentives nor data security guarantees. Although the intention has been formed, the behaviour will not happen. Similarly, the absence of social pressure and accessible channels to recycle mobile phones will result in the intention being abandoned.

The most critical point is that the preceding research neglected to examine the intention and behavioural action time frame. Individuals do not always follow their intentions. According to Ajzen [41], on average, intention accounts for just approximately 25% of the diversity in behaviour, as intention does not always predict actual behaviour, and a change in intentions does not always result in a change in behaviour that has been confirmed by H7 in the current study. The major question is how intention and behaviour are linked. The context and time are vital factors in increasing or decreasing the intention–behaviour gap,

especially in mobile phone recycling, as mobile phone users might have the intention to recycle. However, when it reaches the mobile phone EOL stage (approximately three years), the behaviour might change. Usually, the intention–behaviour gap is small for immediate actions, such as eating, fighting, etc. Ajzen [41], supported this argument and summarised several situations that might jeopardise the correlation between intention and behaviour. One of these conditions is the change in mind over time. When individuals have established their intentions, new knowledge and information may change their behaviour, normative, or control beliefs. The initial intentions would consequently be irrelevant in predicting their subsequent behaviour. This suggests that the highest link between intention and behaviour will exist when intentions are evaluated shortly before observing the behaviour.

6.1. Theoretical Implications

This study contributes a new conceptual framework to the TPB model by addressing four main contributions: (1) it extends TPB with data security and perception of benefits; (2) it will enable academics and researchers to extend the application of TPB in mobile 3Rs; (3) it offers empirical evidence to support the recycling behaviours; and (4) it narrows the gap in the number of studies examining the recycling behaviour of mobile phones in the UAE.

This study focused on mobile phone waste that is considered one of the dangerous wastes among e-wastes due to four reasons: (1) it increases the manufacturing of mobile devices; (2) some of the elements used in the design of a mobile phone are hazardous to human health and the environment; (3) the small-sized mobile phones can be easily kept by a consumer at home beyond its lifespan; and (4) if the information and data security cause a real sense of fear among consumers, then that will prevent them from participating in RSC processes. The results would contribute to the body of knowledge in the education sector on e-waste recycling, especially mobile phone devices.

6.2. Practical Implications

The current study has significant practical implications in two aspects. Firstly, this study focused on protecting the environment and preserving natural resources by promoting materials reuse to manufacture new devices. Increased environmental awareness and pollution have become the main concerns for academics, individuals, and companies. A study on the mobile 3Rs, particularly in the context of saving the environment, is important for two reasons: (1) a mobile phone contains toxic materials that harm the environment, and (2) some materials in the mobile phone can be reused to manufacture other devices. However, it is important to optimise natural resources. Secondly, this study could help provide a model for businesses and companies, especially managers who are working in the mobile devices industry (in the UAE, as well as other countries), to understand the factors influencing the intention of mobile phone users in recycling their unused mobile devices. This step allows companies to explore renewable resources to manufacture and produce new devices. Moreover, since the 3R concept could help reduce mobile phone waste, the management needs to promote an awareness programme by offering a buyback option to encourage consumer engagement in the 3R activities. The material and instruments extracted from recycled mobile phones can be used to manufacture new mobiles. Therefore, policymakers can formulate effective policies to drive mobile phone users' engagement in responsible mobile phone recycling behaviour.

7. Conclusions

The collecting of mobile phone waste has emerged as a significant bottleneck in the management of e-waste in recent years. This study gathered a representative sample of respondents via an online survey to examine the factors that influence a mobile phone user's intention to participate in the RSCM process (repairing, refurbishing, or recycling their EOL or EOU mobile phones) by examining the impact of TPB factors along with additional factors that primarily affect the mobile phone specifications, namely data security and

perceived benefits. The study provides confidence to the industrial players to implement the new factors of data security solutions or benefits (either financial or environmental) in their returning system to influence more users to return the EOL/EOU devices. This step could dramatically reduce mobile phone waste and optimise natural resources. The paper's findings have made the results towards recycling intention to be more logical as intention changes over time. New information that becomes accessible after people have expressed their intentions may change some of their behaviour. Thus, future studies could focus on enhancing mobile phone collecting systems and environmental awareness including behaviour sustainability. Future studies could also be conducted in different locations or countries. The limitations of this study include redesigning the questions related to data security by considering a qualitative method through interviews to ensure that the respondents understand the questions and obtain in-depth information about mobile phone security and data privacy before answering the questions. Aside from that, data collection from enterprises involved in e-waste or telecommunications is challenging in the UAE. Therefore, it is necessary to investigate the government's supervisory obligations.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. The questionnaire items.

Indicator	Questions	Scale
Attitude	I think that taking my old mobile phone for recycling is good for the environment or my health. I think that I would have a good feeling towards returning end-of-life/end-of-use mobile phones for reuse, refurbishment, or recycling. I like the idea of returning end-of-life/end-of-use mobile phones to the manufacturer or municipality for reuse, refurbishment, or recycling. I feel responsible for doing whatever I can to contribute to society's reduction of mobile phone waste. When I intend to recycle, it makes me feel good about myself.	1 = Fully disagree To 5 = Fully agree
Subjective Norms	My friends think that I should return my end-of-life mobile phones for reuse, refurbishment, or recycling. Some of my peers take mobile devices for recycling because it is the right thing to do. I want others to consider me to be environmentally conscious. My family expects me to engage in mobile phone recycling behaviour. My social media groups expect me to engage in mobile phone recycling behaviour.	
Perceived Behavioural Control	I can return my end-of-life mobile phones for reuse, refurbishment, or recycling to their producers without help from others. My city municipality provides satisfactory collection sites for electronic waste near to my home or work. I have plenty of opportunities to recycle my end-of-life/end-of-use mobile phones. It is entirely up to me to recycle my end-of-life/end-of-use mobile phones. It is not difficult for me to find information on mobile phone recycling.	
Data Security	The data and private information stored in my mobile phone prevented me from sending my end-of-life mobile phone for recycling or refurbishment. I can return my end-of-life mobile phone for reuse, refurbishment, or recycling if the producer or recycler ensures deleting my data from my phone. I am concerned about my sensitive personal data (e.g., bank account details, my social accounts, etc.) being stolen from my mobile device when I intend to recycle. I will participate in mobile phone recycling if the government provides security software to delete or encrypt my data. I do not think there is a software or method that will clear my mobile data that can be breached or stolen during recycling.	

Table A1. *Cont.*

Indicator	Questions	Scale
Perceived Benefits	I like to receive cash/bonus points when I return my end-of-life mobile phones to their producers. I like to receive a gift card for returning end-of-life mobile phones to producers. I would like to help reduce the landfill waste volume (i.e., toxic waste volume) by returning end-of-life mobile phones for repair, reuse, or recycling purposes. I would like to help producers to use recyclable materials, which, in turn, will reduce the consumption of raw materials (i.e., saving resources). I want to help reduce mobile phone prices through reusing materials or products (i.e., cost reduction).	1 = Never To 5 = Always
Intention of mobile phone users	In the future when dealing with mobile phone waste, I would like to try to contact the manufacturer or professional recycling agencies. I intend to return my end-of-life/end-of-use mobile phone to its producer in the future. I am willing to spend some time taking my old mobile phones for recycling. I am willing to speak to my friends/family about appropriate disposal modes of mobile phones. I am willing to obtain more information about appropriate disposal modes of mobile phones.	
Behaviour of Mobile Phone Users	I used to separate recyclable items from general waste. During the previous month, I have done more recycling than I usually do. During the last three months, I have recycled my old mobile phone at a collection point specific to electronic waste. During the last three months, I have recycled my old mobile phone after receiving cash incentives from the phone producer or municipality. I discarded my previous mobile phone three months ago after the phone manufacturer/municipality deleted my data.	

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