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STUDY OF CURRENT TRADE-IN PROGRAMS AVAILABLE FOR USED CONSUMER ELECTRONICS: INVESTIGATION OF CELLPHONES DESIGN FEATURES

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ABSTRACT

This paper carries out an analysis of various trade-in programs available for cellphones in the United States. Product trade-in is one of the methods to recover End-of-Life (EoL) products from consumers. Currently, there is a lack of knowledge amongst consumers about such programs. The study aims to determine the factors which influence the product trade-in price. Cell phone trade-in programs of the following types of companies are studied: Phone network operator, online retailer and recycler, and educational institution. Apple's iPhone was selected to carry out a case study to analyze various features of the trade-in programs. Age of the cell phone model, memory size of the phone, cellphone condition and phone carrier were found to be the most significant factors of a cell phone trade-in program. Newer phone models and higher memory size capacity phones were found to be offered higher price to the consumer. Cellphones of one particular phone carrier and unlocked cell phones were found to obtain the highest price quote. An attempt is made to evaluate and discuss the prospect of trade-in programs as an effective end of life recovery method. Product recovery by trade-in programs and conventional methods is compared based on factors drawn from consumer behavior studies. Improvements in trade-in programs are suggested, followed by a discussion on ways in which data from trade-in programs can benefit product designers.

1. INTRODUCTION

The emergence of new technologies in the consumer electronics market increases consumer tendency to discard their old products and replace them with newer options, contributing to the growing electronic waste (e-waste). Cell phones are one of the biggest contributors to e-waste. In 2010, 152 million cellphones had reached their end-of-life and only 11% of them were recycled and the rest ended up in landfills. The estimated production of cellphones for 2014 was 1.89 billion and 150.2 million of them were iPhones [1]. Rapid technological advancement has led to decrease in the number of mobile use phase to around 3 years, which has led to an alarming increase in the production of cellphones [2]. Cellphones are made up of hazardous metals such as Arsenic, Cadmium, Beryllium, Copper, Lead, Nickel and Zinc [3]. These metals are carcinogenic and persistent bio-accumulative toxins. When incinerating the cellphone parts for recycling, dioxins and furans are obtained as a byproduct. These toxins make their way through the eco-system through water bodies, plants and air and creating an unhealthy atmosphere for habitats [3][4]. They also contain valuable metals such as gold, silver, and platinum. Hence recycling cellphones would reduce the need for mining of these metals. Moreover 50-80% of the cellphones from US at their end-of-life are exported to other developing countries polluting their land [1][5].

A systematic and sustainable End-of-Life (EoL) recovery management system should be designed taking into account both environmental and economic outcomes. Behdad et al. [6] developed a stochastic optimization model based on chance constrained programing to determine the best upgrade level for a received EoL product with certain quality level with the aim of maximizing profit. When the product reaches its EoL, consumer deciphers the available options by analyzing the cost of return, functionality of the product, or ease of recycling the product. Due to lack of knowledge associated with EoL options most of the product end up in the household or in the hands of informal recyclers, who do not have suitable facilities to carry out the recycling process.

2. END OF LIFE STRATERGIES AND SUSTAINABLE POLICIES

The existence of the product becomes obsolete when it reaches its EoL. Despite Original Equipment Manufacturers (OEMs) implementing take back programs, only 10% of these

obsolete products were collected back for recycling [7]. Sustainable design of an electronic product will ensure suitable end-of-life management of the e-waste generated by the product. For example, Xerox incorporated product design with EoL management and reduced the use of resources and reduced the waste generated [8]. There are several incentive-based environmental policies which promote pro-environmental behavior and spread awareness to the masses. A thorough research was conducted on the available sustainable policies and EoL strategies.

Waste Electrical and Electronic Equipment (WEEE) directive and Restriction of Hazardous Substance (RoHS) directive were formulated by European council to increase the rate of recycling of electronic equipment at their EoL [9]. The directive dictates that the manufacturers and distributors are responsible for recycling of the e-waste and should take full responsibility for paying the recycling fee [10]. Extended product responsibility (EPR) is a derivative of WEEE directives. It ensures that the manufacturer takes full responsibility of the ownership of the product throughout its life cycle making the manufactures liable for environmental damage caused by the product [4][11]. The responsibility of recycling the obsolete product is shared between the consumer-responsible to drop off the e-waste at designated locations, municipality - responsible to store the e-waste and manufacturer - responsible to ship the e-waste to certified recycling facility. The policy is not globally followed yet. The first EPR policy was successfully incorporated in US in the state of Maine in 2004 and the rate of e-waste collection for recycling has been increasing since [12]. US Environmental Protection Agency (EPA) in collaboration with various non-government organizations has taken the following initiatives:

National Electronic Product Stewardship Incentive (NEPSI) is an initiative that compares various available recycling programs throughout US, Green Procurement workshops are conducted to train the officials to decide environmentally sound electronic devices, Toxicity testing of electronic equipment, Promoting green electronic equipment [13].

3. RESEARCH MOTIVATION AND OBJECTIVES

3.1. Motivation

Increase in the production of cellphones calls for an effective EoL recovery method to collect outdated and used cellphones from the consumers. Existing literatures on EoL recovery management point out shortcomings of current recovery methods. Several companies these days have developed trade-in programs offering consumers financial incentives in exchange of returning their used product. A study of such trade-in programs becomes necessary to evaluate their effectiveness compared to conventional recovery methods.

3.2. Objectives

This study aims to analyze product trade-in as an EoL recovery method, with case study of a cellphone. The main objectives of this study are to:

1. Research available trade in programs for cellphones and categorize them.
2. Study the various cell phone design features influencing the trade-in price.
3. Compare the take back prices offered for the cellphones by different organizations.
4. Determine factors that may motivate a consumer positively towards product trade-in.

4. TRADE-IN PROGRAMS FOR CELL PHONES

This section provides an introduction to cell phone trade-in programs and information on the trade-in programs selected for carrying out a case study. Companies offering cell phone trade-in service were selected for this study. Cell phone was selected as the preferred trade-in product as it is one of the most widely used electronic products worldwide**.** There are numerous cellphone trade-in programs available to consumers to choose from. Cell phone trade-in programs are offered by OEMs, online retailers, recyclers and by phone carriers, each one of them offering financial incentives to the consumers based on a number of factors.

4.1 Data Collection

Based on adequate availability of data seven trade-in programs were researched for this study. They were classified based on the type of company offering the program as follows: Phone network operator – 2 (Companies B and C), Online buyback, resale and recyclers – 4 (Companies A, D, E and F) and Recycling Collection Centre – 1 (Company G). Companies B and C are leading US phone network operators and company D is an internet-based retailer giant in the US. On the other hand, companies A, E and F are relatively smaller and G is a US state university, where the university's bookstore runs an electronic devices trade-in program. Table 1 summarizes the information on the seven cell phone trade-in programs studied, including the companies' business, products offered by them for trade-in and the incentives offered to the customers.

The required data was obtained from the company websites. Various models of Apple's iPhone have been selected for the case study. All the trade-in programs studied are restricted to those offered in the US. For the ease of discussion, a company and its program both have been designated with an English alphabet letter. Also, the words 'Company' and 'Program' are interchangeably used as per need. For example Company A would also correspond to Trade-in Program A. The letter designations are also used, and not actual names of companies and their trade-in programs to ensure their confidentiality.

5. CASE STUDY

To get an understanding of the working of trade-in programs of cellphones a detailed case study was conducted. The case study was restricted to a single OEM (Apple). The central objective of this case study was to analyze the factors influencing the trade-in prices of the cellphones. The structure of each

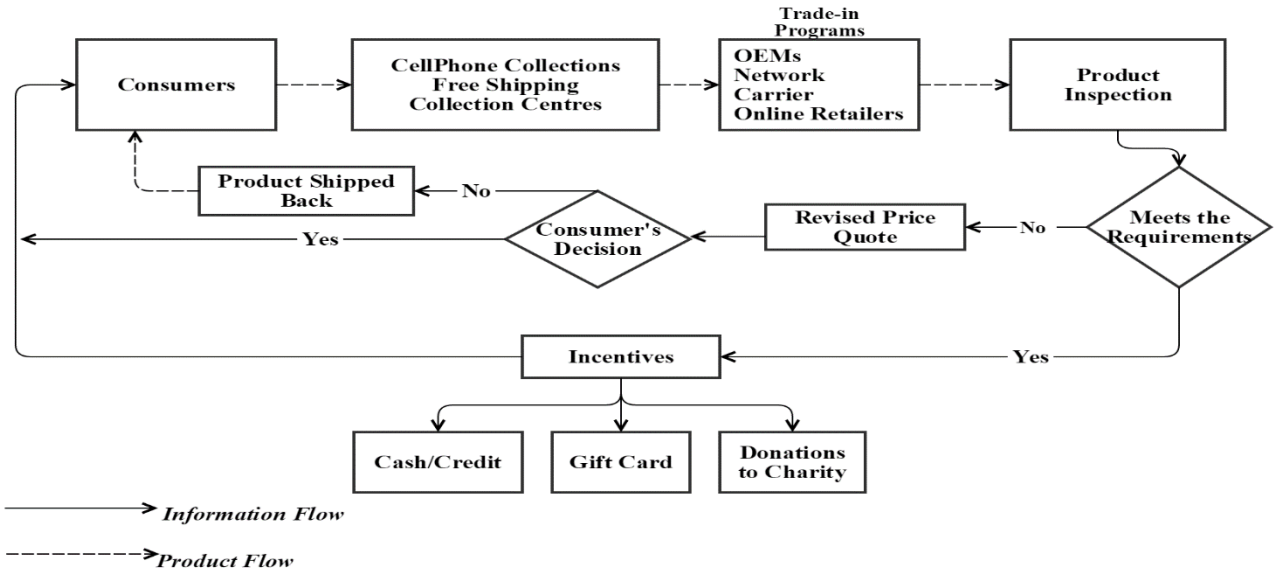


Figure 1. Flow of information and product in Trade- in Process.

program was studied meticulously. Following sections include description of trade-in process and factors influencing trade-in price. An analysis of four key factors affecting trade-in price has been presented in the subsequent section.

5.1. Trade-In process

Figure 1 depicts the basic process of an online product trade-in, and the flow of information and product between consumers and trade-in companies. Figure 2 provides detailed steps a consumer goes through to successfully complete a trade-in process.

The first step is to select the make and model and is the same in all the programs, requiring the brand, model and memory size to be selected. The second step involves determining cellphone condition. The methods to determine cell phone condition vary from one program to another.

Table 1 provides details on cell phone condition parameters used by each program to determine the trade-in price. It is interesting to note that Program B and C involve a lot of questions on the functioning of a cell phone's features and on the integrity of its design aspects to determine the condition of the cell phone. Whereas in all other programs the classification of a cell phone's condition is made quite broad; for e.g. like new, good and acceptable in Program D and broken, good and flawless in Program E. The criteria for a cell phone to be eligible for either of the categories is also given separately and the user is expected to determine what condition the cell phone is in and thus in which category. Thus in Programs B and C, the user is expected to answer more, but simple and more conclusive questions to determine the cell phone trade-in price as compared to other Programs.

Table 2 enlists the credit options available, if the trade-in price offer is accepted by the customer. Programs A, B and C include a donation option as well along with the regular credit payment options. Also, all the above programs encourage the option to recycle the cell phone if it is not eligible to receive any trade-in credit.

All Programs except Program G provide free shipping to the customer's address to ship the product back to the company. Program G requires the device to be brought along with a copy of the order to the campus bookstore for trade-in.

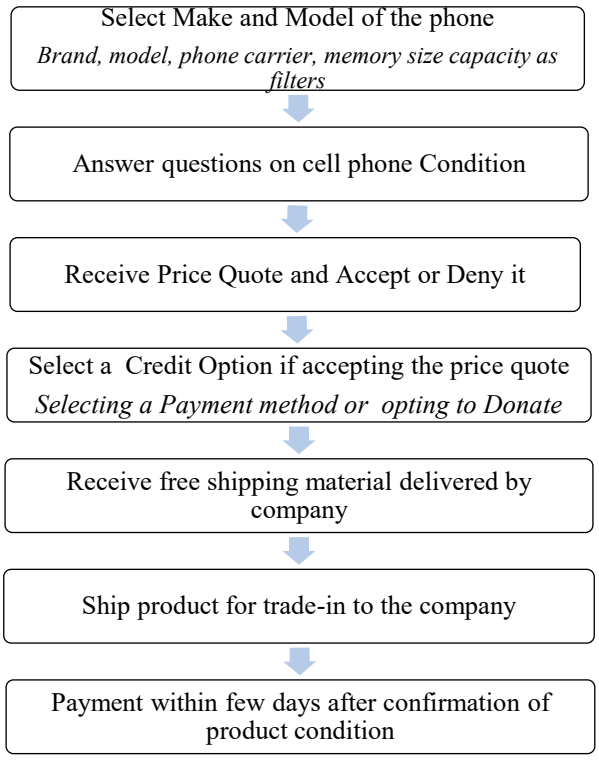


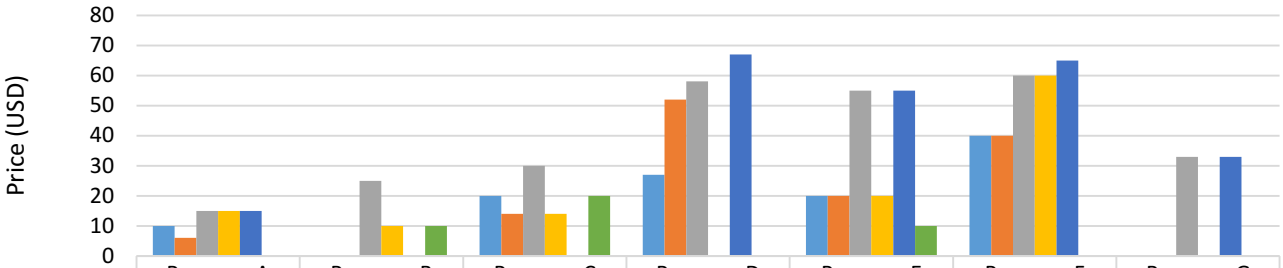
Figure 2. Trade- in Process.

Table 1. Cellphone Condition Parameters

Program	Product condition parameters and features to be selected to determine Trade-in price	Selection Options
A	1. New, Used or Broken 2. Water Damage	To select any 1 Yes or No
B	1. Power on and off 2. Disabled Activation Lock 3. LCD intact 4. Free of Breaks / Cracks	Yes or No
C	1. Turn on and off 2. LCD screen free of cracks and functioning correctly 3. Device and connecting ports free of visible corrosion and water damage 4. Device and charging port free of cracks, dents, and not missing any pieces/chunks 5. Activation Lock turned off (e.g. Find My iPhone)	Yes or No
D	Like New, Good or Acceptable	To select any 1
E	Broken, Good or Flawless	To select any 1
F	1. Broken, Poor, Good, Excellent or New 2. Cell phone accessories: AC Charger, Box, Battery, USB charger	To select any 1 To select all that apply
G	Like New, Good or Busted	To select any 1

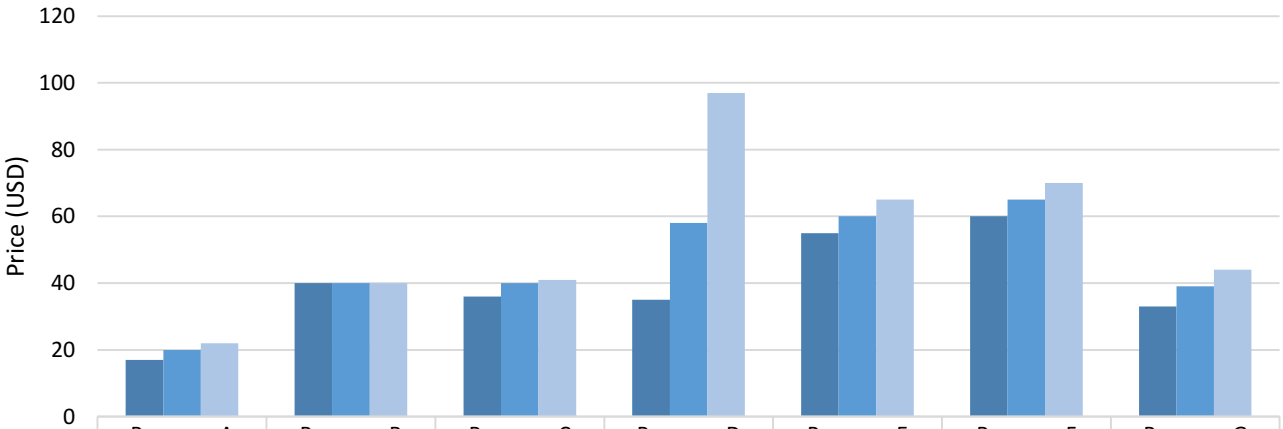
Table 2. Details of Trade-in Programs

Program	Business	Trade-in Product Categories	Customer Incentives and Credit Options
A	Cell phone buyback and reuse	Cell phone	• Free shipping • Payment via Paypal or check • Suggestions on tax-deductible donation to any registered U.S. non-profit organization or charity
B	Phone network operator	Cell phone, Tablet, Notebook	• Free shipping • Payment in form of company's Promotion Card good towards the purchase of its products and services • Donation to a charity supported by the company to support soldiers and veterans.
C	Phone network operator	Electronic devices	• Free shipping • Payment in form of Wireless Virtual Gift Card • Donation to a program by the company that provides support to victims and survivors of domestic violence
D	Electronic commerce	Books, video games, movies & TV, electronics, music.	• Free shipping • Payment in form of an e-shopping gift card
E	Online recommerce	Electronic devices	• Free shipping • Payment by check or Paypal, or in form of Amazon.com Gift Cards
F	Online cell phone recycling price comparison	Cell phone recycler and reseller	• Free shipping • Provision of comparing prices and payment methods from a list of phone buyers
G	Educational Institution Bookstore	Electronic devices	• Payment in the form of a Campus Bookstore Gift Card



	Program A	Program B	Program C	Program D	Program E	Program F	Program G
C1	10	0	20	27	20	40	0
C2	6	0	14	52	20	40	0
C3	15	25	30	58	55	60	33
C4	15	10	14	0	20	60	0
Unlocked	15	0	0	67	55	65	33
Other C	0	10	20	0	10	0	0

Figure 3. Comparison of Trade-in Prices of Different Phone Carriers



	Program A	Program B	Program C	Program D	Program E	Program F	Program G
8GB	17	40	36	35	55	60	33
16GB	20	40	40	58	60	65	39
32GB	22	40	41	97	65	70	44

Figure 4. Variation of Trade-in Prices with different memory size capacities

5.2. Analysis of Factors affecting Trade-in Price

Based on the questionnaire in all the programs, it can be concluded that following factors play a vital role in determining trade-in price of a cell phone:

1. OEM of cell phone
2. Cell phone model
3. Phone network carrier
4. Cell phone memory size capacity
5. Cell phone condition with respect to design features

An analysis is done to determine the relationship between the following four following factors on trade-in price independently: phone carrier, memory size capacity, model age and cell phone condition with respect to design features. It is to be noted that the effects of former three factors is observed on the highest trade-in price offered for a cell phone model. In other words, the trade-in price offered for any model in its best condition and fully functional design features was selected to simplify the analysis. A zero as a data value represents no price being offered by a program.

5.2.1. Price v/s Phone carrier

Phone carrier plays an essential role in trade-in price of the cellphone. The analysis of price v/s phone carrier is done by keeping other factors, i.e. memory size capacity and phone

model constant. The study revealed that same cell phone model with same memory size capacity, but of different phone carriers are offered different trade-in prices. This analysis represents the variation of trade-in price for iPhone 4 offered by various phone carriers with constant memory size capacity as 8GB. The specifications are as follows:

Model (constant): Apple A1349 iPhone 4 (CDMA)
Memory size capacity (constant): 8GB
Phone carrier (Varying): C1, C2, C3, C4, U, Others

It should be noted that considering different choices of phone carriers in a Trade-in Program, there are four major phone carriers C1, C2, C3 and C4 as options in Programs A to Programs G. The fifth option for phone carrier is 'Unlocked' and the sixth option as any other phone carrier referred here as 'Others'. Also, two of the phone carriers in this group, namely C1 and C3 have their own trade-in program as well, which are represented as Companies C and B respectively.

The graph in Figure 3 represents the highest trade-in price offered by each program for each phone carrier, keeping cell phone model and memory size capacity constant. An important observation here is that the maximum trade-in prices are offered to cell phones -'Unlocked' and those of network carrier C3.

5.2.2. Price v/s Memory size capacity

In this case study the effect of memory size capacity of the phone on trade-in price is studied. The study was carried out for an iPhone 4s with AT&T as the phone carrier. Memory size capacity is one of the important features of the cell phone design that influence the trade-in price. The study was carried out for the following specifications of the phone:

Model (constant): Apple A1332 iPhone 4S
Memory size capacity (Varying): 8GB, 16 GB, 32 GB
Phone Carrier (constant): AT&T

Figure 4 represents the highest trade-in price offered by each Program for three different memory size capacities, when cell phone model and phone network carrier remained the same. The relationship between phone memory size and trade-in price is consistent in all the Programs studied. The graph depicts that for a certain cell phone model of a particular phone carrier, the higher the memory size, higher is the trade-in price offered. Program B was found to have no effect of memory size on its trade-in prices for the particular cell phone model and carrier selected. In other programs, the price is observed to increase by around 18% from the lowest memory size capacity (8GB) to the highest (32GB) and by 178% in Program D.

5.2.3 Price v/s Model Age

In this case the age of the model represents model's first manufactured or launched year. In other words, newer the technology lesser the cell phone model age. It is expected that lesser the model age, more would be the trade-in price offered, given other price determinants remain the same. This trend was validated with this case study. Variation of price with cellphone model age of a 16GB iPhone with AT&T phone carrier is analyzed in this case study. Also iPhone 4, 4s, 5, 5c were manufactured in the years 2010, 2011, 2012, 2013 respectively. iPhone 6 and 6s were manufactured in 2014.

Model (Variation): Apple iPhone 4, 4S, 5, 5C, 5S, 6, 6S
Memory size capacity: 16GB
Phone carrier: AT&T

Table 3. Trade-in Price Range of different models in Program E

Model No.	iPhone Model (Launch Year)	Price Range (USD)
1	4 (2010)	**0**
2	4S (2011)	**5-60**
3	5 (2012)	**10-95**
4	5C (2013)	**20-70**
5	5S (2013)	**25-190**
6	6 (2014)	**50-400**
7	6Plus (2014)	**50-450**

Table 3 compares the price of 7 different iPhone models over the years from Program E. The table lists the price range offered for each model, i.e. the lowest and the highest price offered depending on the cell phone condition. The graph shown in Figure 5 compares the maximum prices offered for each model.

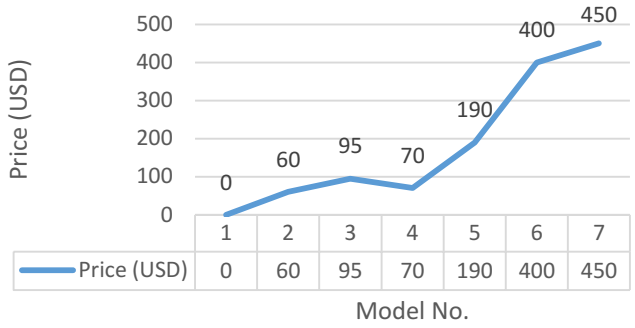


Figure 5. Variation in trade-in price with Model age

It is quite clear that barring the trade-in price for model no. 4, trade-in prices for each newer model keeps on increasing. Model no. 4 and 5 launched in the same year have the same technical specifications. It is interesting to note that the only design feature added in model no. 4 as compared to the previous model no. 3 was the availability of 5 different phone color options as opposed to 2 colors in all the previous phone models and the change in the back casing to plastic from aluminum in the previous model. Also, model no. 4 was perceived as a low budget model when launched.

Model no. 6 and 7, launched in the same year had the addition of a technology called Touch ID offering access to the cell phone contents through user's finger print detection.

Besides both being offered a higher trade-in price as compared to older models, model no. 7 is offered a higher price than model no. 6. It is interesting to note that model no. 7 has the same technological features as model no. 6, but a larger screen size as the only different design feature.

5.2.4 Price v/s Cellphone Condition with respect to Design Features

A major price determinant in all trade-in programs was observed to be cell phone condition. It is interesting to note that cell phone condition determinants are based on the functionality of phone's design features. To gain an insight on this factor, Program C is selected. Table 1 enlists the product condition parameters to determine trade-in price for Program C.

The effect of one parameter independently is taken into account. It is observed that parameter 3 has no effect on trade-in price when all other condition parameters are fully satisfied. The effect of other factors is displayed in Fig. 6. It can be concluded that damage in charging port (parameter 4) has relatively a lesser impact, i.e. lesser decrease in price than other factors.

Also, role of parameter 5 (activation lock turned off) in determining trade-in price is not discussed as it is not essentially a design feature, but more of a phone software application.

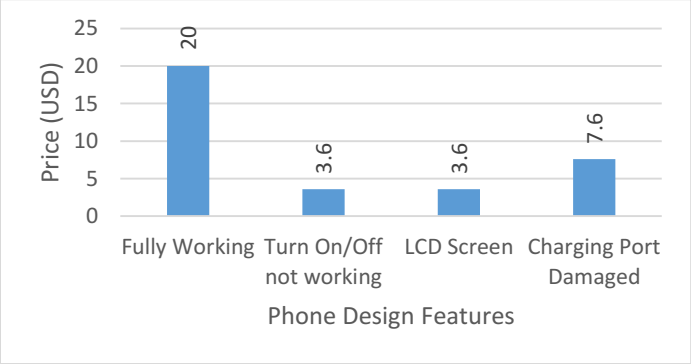


Figure 6. Variation in trade-in price with cellphone Condition w.r.t. Design Features

One of the limitations of this case study arose when condition parameters were no longer considered independently. An exhaustive run of all possible combinations of condition determinants was carried out to obtain the corresponding trade-in prices respectively. But the exact nature of price change due to condition parameters could not be defined when more than one parameter was changed simultaneously.

It is also interesting to observe the nature of questionnaire regarding cell phone condition determinants in Program B and C. A change in answer (Yes or No) in each of the determinants' questions changes the trade-in price. The change in the price is quite easier to observe in case of other programs where the selection is only to be made amongst three broad cell phone categories (e.g. broken, good and flawless in Program E). Since programs other than B and C do not involve any design feature directly into their questionnaires, the change in trade-in price with their condition parameters is not discussed here.

Influence of Cell Phone Color on Trade-in Prices

An interesting observation made on a design aspect of a cell phone in all the exchange programs is that except Program D, none of the programs show any variation in the trade-in price for the same cell phone with a different color. Program D lacked any consistency with respect to variation in trade-in price with phone color and was inconclusive in establishing any relationship between phone color and trade-in price offered.

6. DISCUSSION

6.1. Product recovery by conventional methods v/s trade-in program product recovery

This section is aimed to determine the ease of recovering an EOL product from consumers via trade-in programs. First, an attempt was made to identify shortcomings of current methods of recovering an EOL product from consumers. This was achieved through analysis of studies on consumer intention, motivation and behavior towards pro-environmental activities like recycling. Subsequently, advantages that trade-in programs offer that may ease product recovery were determined.

Consumer behavior models are based on psychological and behavioral theories like the Theory of Planned Behavior (TPB) and the Theory of Reasoned Action (TRA). Xu et al. [14] utilized the TPB to identify the driving forces behind recycling intention. Comparison between product recovery by conventional methods and trade-in programs is made based on the following factors found to have an effect on consumers' participation in EOL product recycling:

1. Perceived convenience:

Darby et al. [15] in their study on e-waste recycling motivation found that perceived inconvenience of the recycling process was a huge barrier for consumers. Trade-in process as depicted in Figure 1 can be carried out online, resembling e-shopping and thus has a potential to attract consumers looking for an easy product recycling method.

2. Availability of information on product recycling:

Garcia [5] argues that lack of knowledge about proper disposal is the biggest barrier to cell phone recycling. Also, convenience in shaping consumer decisions is stressed as a positive factor affecting pro-environmental behavior, and not just environmental awareness. Lack of information was cited more times as the main reason of not recycling a cell phone, suggesting that inconvenience is less of barrier than the lack of enough information to promote action. Availability of information on trade-in program websites is convenient for consumers. The ability to compare price quote of different cell phones with respect to various factors aids in consumers' decision making process as well.

3. Financial incentive in recycling:

Garcia [5] also indicated that a lot of people retained their phone after use since it was still functional and was kept with them as a backup or for sale in the future, suggesting that the perceived latent value of the phone in addition to sentimental and emotional value is the main barrier in cell phone recycling for some people. Koga et al. [15] evaluated that lack of financial gain in recycling a cell phone was one of the reasons behind its low recycling rate. Behdad et al. [17] pointed out that high initial purchase price is also one of the factors that consumer store the obsolete product instead of recycling. Trade-in programs studied in the case study were found to provide financial gain in the form of gift cards or credit which may positively impact consumers' motivation. Consumers thus may be motivated to recycle their cell phones via trade-in programs if the financial gain is attractive enough, and not retain it as a back-up.

Table 4. EoL Recovery: Conventional Methods v/s Trade-in

Factors	Conventional Method	Trade-in
Perceived Convenience	Inconvenience is a barrier in recycling products.	Can be Carried out online.
Lack of Knowledge	No knowledge about product disposal.	Detailed information available on the program's website.
Financial Incentives	No Incentives.	Incentives provided (Cash, Gift cards, donations)

4. Convenience of collection centers :

Koga et al. also evaluated the convenience of the collection points for receiving the cell phones to be recycled and concludes that respondents in the research claimed supermarket, followed by stores in the mall and the carrier as the most convenient. This was justified by the fact that supermarkets are visited weekly or monthly and malls have become major areas for shopping, entertainment and services. The method of shipping used cell phone to the company in some of the programs eliminates the need of collection centers. The collection center in Program G is located in an educational institution. Thus such trade-in programs target a specific community of consumers providing them more options of collection centers than regular recycling collection centers. Table 4 summarizes key differences between EoL recovery by conventional methods and trade-in programs based on factors discussed above.

6.2. Scope of Improvement in Trade-in Programs

6.2.1 Limitations

Based on the nature of trade-in process and on basis of research conducted on consumer behavior and motivational factors affecting product recovery, certain limitations of trade-in programs are observed and discussed in this section.

1. Consumers possessing insufficient computer and internet operating skills:

Since a major part of the trade-in process is completed on respective companies' websites, consumers lacking sufficient computer and internet operating skills are at a disadvantage. Thus such consumers would perceive recycling their product by trade-in programs inconvenient.

2. Lack of advertisement:

It is interesting to note that there is a lack of advertisement of trade-in programs to make consumers aware of trade-in programs and their process. Thus only consumers specifically looking for services to recycle their products on internet are most likely to find information on these programs. Other consumers may not be aware of existence of these programs due to lack of information through advertisements in daily life, e.g. print media, social networking websites etc.

3. Shipment Restrictions:

Though trade-in process eliminates the need of visiting to recollection sites, it requires the product to be shipped to the trade-in program company. The convenience in doing so is subjected to the ease of access to shipment services, its proximity to one's location, speed and reliability of shipping service and any other factor that limits the consumer's ability to ensure an effective shipment to the company.

4. Ambiguous product condition determinants:

Programs A, D, E, F and G involve broad classifications of cell phone with respect to its physical condition, e.g. broken, good and flawless in case of Program E. The consumer is expected to read a complete description of each classification of cell phone and determine which one does his cell phone belong to. The description is also not specific in some cases and can be interpreted incorrectly by the consumer. For example, following are the criteria for cell phone to be eligible as 'good' in Program D: Item shows wear from normal use, has a flawless display (i.e. no dead spots or scratches) and may have light scratches on the body. An incorrect interpretation by the consumer may lead to a difference in expected price quote and price quote received after inspection by Trade-in Company.

6.2.2 Suggestions

Based on the limitations of current recycling and EOL product collection programs, suggestions for companies to increase the engagement of consumers in their trade-in programs is suggested. Table 4 enlists barriers in effective collection of EoL products from consumers by conventional methods. Besides these factors, other factors based on consumer behavior studies can be taken into account to determine factors that have a positive effect on consumer motivation to recycle. Valle et al. [18] successfully validated

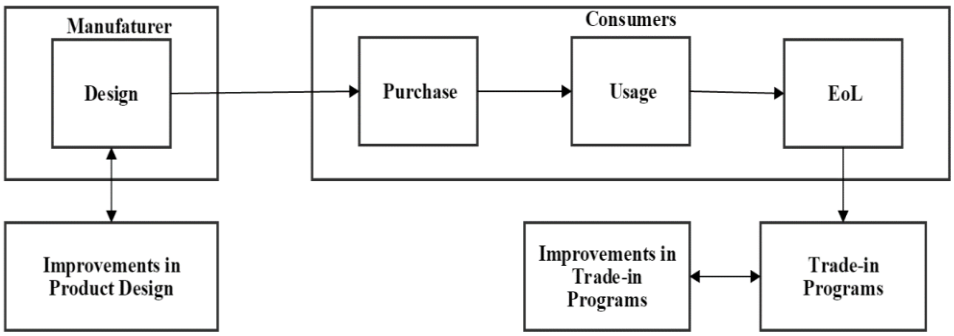


Figure 7. Product life cycle stages: Consumer perspective

the hypothesis suggesting that consumers with a stronger social conscience report a higher awareness level toward environmental problems, sense greater responsibility in participating in pro-environmental behavior and give less importance to difficulties associated with recycling. According to Mida et al. [19]environmental consciousness is determined by extrinsic determinants such as media, family, and culture. Koga et al. [15] concludes that lack of knowledge about final destination of their cell phones and a fear of data theft is a major reason behind low rate of cell phone recycling.

Based on the discussion in this section, following factors can be concluded to play a role one or more at a time in shaping consumers' decision to recycle their product:

1. Convenience in recycling
2. Detailed information on recycling process
3. Convenience of recollection centers and shipment services
4. Financial incentives in recycling
5. Specific product condition determinants
6. Social consciousness
7. Extrinsic factors: media, family and culture
8. Knowledge about final destination of product
9. Data security

All the trade-in programs studied in this research offer the consumer free data deletion which eliminate the risk of data theft. Programs like B and C with easier cell phone condition determinants in their questionnaire would encourage consumers more towards recycling their product, as they make consumer decision lot easier than the programs with broader and less clear determinants about cell phone condition and functionality. Certain programs, like programs A, B and C supporting a social cause would attract consumers looking to make a social contribution.

Companies offering trade-in programs can thus improve their trade-in service and marketing in a lot of ways, targeting factors discussed above. Raising awareness about product trade-in amongst consumers is a must since extrinsic factors, like media, family and culture are key factors in encouraging a consumer towards green behavior. Companies offering trade-in programs must ensure that all the aspects of their program are well highlighted and marketed, i.e. environmental benefits, final destination of products collected, credit payment methods and incentives, aid to social causes, convenience of submitting a trade-in etc. This would target and attract a wide range of consumers who would get motivated by one or more of these factors to participate in the program.

6.3. Scope of Improvement in Product Design

Purchase, usage and EoL have been assumed to be the three main product life cycle stages considered from a consumer's perspective in this research, as shown in Fig. 7. Trade-in programs and their scope of improvement discussed would target usage and EoL stages of a product. The product can be said to be out of control of product designers and OEMs and in the hands of consumers at these stages of product life cycle. Consumers are the decision makers at this stage and efforts can be made to ease product recovery from them. On the other hand, product designers are the decision makers while the product is still in the design phase and it may be easier and a better solution to modify product design as compared to improve trade-in programs. This section discusses ways in which this research and its results can help designers.

Identification of important product components and design features

Cell phone trade-in programs research reveals higher preference being given to some design features and phone components. Thus designers can utilize this information while designing products by identifying such design features and components and design them to be more durable. It would also improve functional lives of products.

Modifications in design to prevent data theft

Designers can improve features related to data security facilitating easy transfer or deletion of personal information and other data stored in the cell phones. It is interesting to observe that earlier models of cell phones possessed a physical memory chip or card that could be removed from the cell phone. Weight limitations and advancements in technology of storing data like online cloud storage have made the earlier data storage technique obsolete. Thus designers need to come up with newer designs with the correct balance between technological advancement, structural integrity and data security.

Information on product usage or storage period

An important observation noted from the trade-in processes studied in this research is that product usage time is not a criteria in determining the trade-in price. Cell phone model age discussed earlier represents only the type of cell phone model of a particular brand of cell phone based on when it was launched in the market. Thus if trade-in programs involve retrieval of product usage or storage time information from the consumers recycling their product, it can provide some insights, e.g. product durability that can act as an important criteria for designers.

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