Empirical Study on the Diffusion of Smartphones and Consumer Behaviour

F. Isada, Y. Isada

Abstract—In this research, the diffusion of innovation regarding smartphone usage is analysed through a consumer behaviour theory. This research aims to determine whether a pattern surrounding the diffusion of innovation exists. As a methodology, an empirical study of the switch from a conventional cell phone to a smartphone was performed. Specifically, a questionnaire survey was completed by general consumers, and the situational and behavioural characteristics of switching from a cell phone to a smartphone were analysed. In conclusion, we found that the speed of the diffusion of innovation, the consumer behaviour characteristics, and the utilities of the product vary according to the stage of the product life cycle.

Keywords—Diffusion of innovation, consumer behaviour, product life cycle, smartphone, empirical study, questionnaire survey.

I. INTRODUCTION

THE diffusion of smartphones today is remarkable. Cell phone makers, communications carriers, and a large number of application developers have come to occupy this market, and smartphone products and services continue to evolve every day. Nevertheless, not all consumers are eager to switch to a smartphone, and many consumers still choose to use a conventional cell phone. Currently, one barrier to switching to a smartphone is the high cost of data plans. If a smartphone plan includes a cell phone plan and a data plan, the cost increases. In Japan, the monthly cost of having a fixed amount data usage added to a smartphone plan is almost six thousand yen. As such, it is thought that consumers will switch to a smartphone only the when increased utility of a smartphone justifies the increased cost of the smartphone. Additionally, it is thought that the increased utility from a conventional cell phone to a smartphone tend to vary by consumers, which may be one reason why the conversion to smartphones has not occurred rapidly.

In this research, the diffusion of innovation regarding smartphone usage is analysed through a consumer behaviour theory. This research aims to determine whether a pattern surrounding the diffusion of innovation exists. The survey design in this research is based on well-known prior research. Specifically, a questionnaire survey was completed by general consumers, and the situational and behavioural characteristics of switching from a cell phone to a smartphone were analysed.

F. Isada is with Kansai University, Osaka, Japan (phone: +81 (0)72 690 2151; fax: +81 (0)72 690 2491; e-mail: isada@kansai.ac.jp).

Y. Isada was with Kwansei University, Hyogo, Japan (e-mail: yuriko@kwansei.ac.jp).

II. SURVEY OF PRIOR RESEARCH

A. Switching Cost Approach

In the field of research related to consumer behaviour in changing cell phones, previous research has evaluated the switching costs of changing cell phones through a transaction cost approach [1]. This approach evaluates the cost associated with changing a cell phone, and it is believed that the cost influences consumer behaviour. The transaction cost approach considers various kinds of moral and material costs, not merely the price of cellphone, including the time of migrating data, such as a list of contacts, and other necessary information to the new telephone.

For example, Kitano et al. [2] studied consumer behaviour quantitatively in Japan when the Mobile Number Portability (MNP) system was introduced in 2006. The MNP system decreases the switching costs associated with changing a mobile phone carrier thus allowing consumers to easily switch cell phones. Kitano et al. [2] quantitatively evaluated this decrease in switching costs associated with the introduction of the MNP system. In their analysis, a disintegration selection model regarding the choice of the MNP system was formulated and was verified through a web survey of consumer preferences related to particular cell phones. The analysis revealed that the switching costs decreased with the introduction of the MNP system and that the percentage of people changing their mobile phone carrier increased. According to this research, at a point, there is a quantitative value of changing a mobile phone carrier, and it is thought that consumers may weigh the cost against the utility of changing a cell phone. However, in this research, the value of this utility is not clear.

B. Diffusion of Innovation Theories

In addition to research on the utility of new products and services, previous research has examined the diffusion of innovation process. The classic innovator theory concerns the diffusion of innovation, which Everett Rogers proposed in the 1962 book "Diffusion of Innovations"[3]. Rogers classified consumers purchasing a new product into five types:

Innovator (2.5%), Opinion leader (Early adapter) (13.5%), Early majority (34%), Rate majority (34%), and Laggard (16%) [3].

The distribution of consumers among these five types follows a Bell Curve. Rogers expressed this Bell Curve in the S bend, a cumulative frequency distribution curve of the product diffusion [3]. He discovered that the S bend suddenly increased by 16% for those products that added innovators and opinion leaders to their consumer base. Furthermore, Rogers insisted that the tipping point of product diffusion was the inclusion of

an opinion leader [3].

Rogers' innovator theory considers the cognitive limit of the utility of innovation [3]. The first consumer to purchase a new product is the innovator, who values and notices the novelty of the product. The innovator does not pay attention to the utility of the product, an attribute that many other consumers value highly. The next consumer to follow innovator is the opinion leader, who values the utility of the new product over the conventional product. With a new product, the ultimate use of the product is often different from the developer's original intention. Typically, the opinion leader determines the real use of the product, and the opinion leader generally has a high amount of influence on other consumers. A network of the word-of-mouth communication is led by the opinion leader, and accordingly, the product diffusion begins to advance greatly. Through this word-of-mouth communication, the product spreads to the early adapter, early majority, and rate majority sequentially, all from the influence of the opinion leader.

On the other hand, Geoffrey Moore opposed the common view of innovation diffusion through his belief of how an opinion leader holds the key to product diffusion [4]. Like Rogers, Moore focuses on the utility of the innovation but makes a new claim that there is a split in how the utility of the innovation is valued [4].

Moore described a large gap (Chasm) of product diffusion into the market pertaining to the hi-tech industry in the frequency distribution curve of the innovator theory [4]. Lying between an early adapter (the initial market) and the early majority (the mainstream market), there is "Chasm" (a deep ditch) that is not crossed easily. If a new product does not cross this Chasm produced by the different preferences of the customer segment, the product disappears without entering the mainstream market. One cause of the Chasm is that the utility of the product after adoption by the early majority is different from the utility before adoption by the early adapter. The early adapter wants to be the first to use the product before anyone else. The early majority does not want to purchase the product after the majority of consumers have adopted the product. For the early majority, when other people use the product, it is a validation of their decision to purchase the product. If a product is adopted only by few early adapters, the early majority does not follow the early adapters in purchasing the product. Thus, creating utilities for the early majority unlike those of the early adapter (an opinion leader) is necessary in order for the product to cross the Chasm and enter the mainstream market.

III. Derivation of the Hypothesis and Validation Methodology

The purpose of this research is to analyse consumer behaviour surrounding the shift from a conventional cell phone to a smartphone. Based on prior research about the diffusion of innovation, the following hypotheses were derived:

1) The speed of the diffusion of innovation (the smartphone in this research) varies according to the stage of the product life cycle.

2) Consumer behaviour characteristics and the product utility of consumers vary according to the stage of the product life cycle.

To verify these hypotheses, a consumer survey was conducted. The questions in the survey were designed to understand each consumer's cell phone ownership situation and their behavioural characteristics. With regard to behavioural characteristics, explanations and factors for grouping axes vary according to the previously explained research. Differences such as target products and environmental factors may influence consumer behaviour characteristics as a result of this grouping. Therefore, the questions were chosen to represent as many viewpoints and utilities of a smartphone as possible while continuing to be based on the abovementioned prior research. For example, the smartphone is both a means of communication and an information-processing tool for most consumers. In addition, the uses of the smartphone were assumed to encompass both business and pleasure.

IV. Results

The questionnaire survey was carried out from December 2011 to January 2012. The questionnaires were distributed to graduate students of the business school and their acquaintances by hand. The number of respondents who completed the questionnaire was 192. The number of the respondents who held either of a conventional cell-phone or the smartphone was 129. For the effective responses, the following analyses were performed. The statistical package software SPSS for Windows was used for the analysis.

A. Basic Statistics

Among the 129 cell phone users, 68 had smartphones. According to a November 2011 kakaku.com Co., Ltd. investigation, the ratio of cell phone users with smartphones in Japan was approximately 55.5%. These results are very similar to that of our survey [5].

The average cost of service for conventional cell phone users was approximately six thousand yen per month. The average cost of service for smartphone users was approximately ten thousand yen per month, confirming that smartphone users pay a relatively higher cost than conventional cell phone users.

B. Time Series Analysis

The timing of when a respondent who had a smartphone switched to a smartphone from a conventional cell phone was investigated (see Fig. 1).
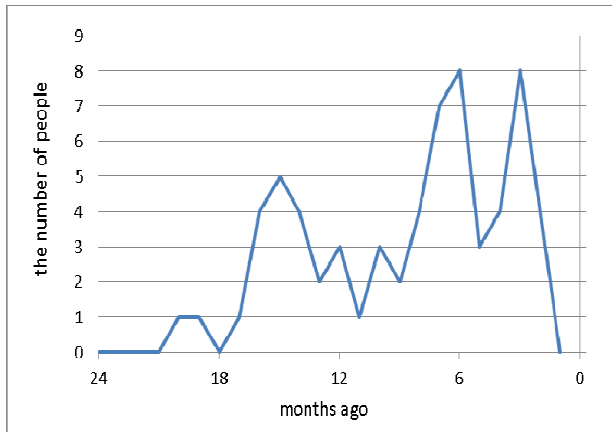
Fig. 1 The timing switched to a smartphone

The X-axis of Fig. 1 represents the number of months prior to the survey in which the switch to a smartphone occurred and the Y-axis of Fig. 1 represents the number of people who switched. The results show that there were three peak times of changing to a smartphone. The first peak is 15 months ago (one year and three months ago), the second peak is six months ago, and the third peak is three months ago. It should be noted that there is an interval of 9 months from the first peak to the second peak.

Rogers' research states that diffusion advances rapidly when the threshold level is surpassed [3]. If the number of innovation adopters increases, it is thought that a great number of consumers will recognize the utility of a technology. It is, so to speak, thought that the network effects actions. However, there is an interval of slightly less than one year until the next diffusion begins after diffusion between the initial launch of the innovation and the result of this questionnaire survey. The process of switching to a smartphone is different from the model of diffusion that Rogers assumed, and the behavioural characteristics and utility that consumer's value in a smartphone may change depending on the product life cycle of the smartphone.

C. Correlation Analysis

A correlation analysis was performed to examine the association of consumer behaviour characteristics and switching to a smartphone. At first, questions related to switching to a smartphone were extracted by a correlation analysis (less than 1% of significant probability), and after performing a factor analysis on these questions, four following factors were determined:

1. Originality Factor

This factor is the behavioural characteristic related to originality. It is thought that the consumers with this behavioural characteristic consider switching to a smartphone to be an original way of thinking.

2. Social Factor

This factor is the behavioural characteristic related to conforming behaviour with another person. One important characteristic of the smartphone is that it is a means of communication and socialization. Consumers with this behavioural characteristic may attach a fair amount of importance to a connection with another person in deciding whether to switch to a smartphone.

3. Impulsivity Factor

This factor is the behavioural characteristic related to a strong interest in new products and/or services. Consumers with this behavioural characteristic likely make the decision to purchase a smartphone without considering its utility or cost heavily.

4. Well-Informed Person Factor

This factor is the behavioural characteristic related to a high level of sensitivity for various sources of information, such as news and current events or trends. Consumers with this behavioural characteristic may attach considerable importance to the ability to acquire additional information and intelligence through switching to a smartphone.

D. Cluster Analysis

Based on the results of the survey and the four abovementioned criteria, the respondents who switched to a smartphone were classified, through a cluster analysis (the Ward method), into five clusters related to the various stages of the product life cycle reported in past research. The mean of the four abovementioned factors was calculated for respondents classified in each cluster, thus indicating the characteristics of each cluster. The following clusters are ordered from the most common amongst those switching to smartphones to the least.

1. The First Cluster

The first cluster includes the respondents with the highest smartphone possession rate, 77%. Among the respondents of the questionnaire, 27% were included in this cluster. Among the four factors discussed above, the defining characteristic of this cluster was a high impulsivity factor. Members of this cluster likely value the newness of the phone and, as a result, switch to a smartphone earlier than respondents in other clusters. This result coincides with the findings of prior research.

2. The Second Cluster

The second cluster includes the respondents with the second highest smartphone possession rate, 63%. Among the respondents of the questionnaire, 21% were included in this cluster. Among the four factors discussed above, the defining characteristic of this cluster was a high social factor. Respondents in this cluster likely consider a smartphone to be a communication tool. Past research suggests that consumers with sociability and conformity behavioural characteristics purchase products in the latter half of the product life cycle. However, our findings contradict the prior research.

3. The Third Cluster

The third cluster the respondents with the third highest smartphone possession rate, 45%. Among the respondents of the questionnaire, 16% were included in this cluster. Among the four factors discussed above, the defining characteristic of this cluster was the well-informed person factor. Respondents

in this cluster likely consider a smartphone to be an information terminal or a small laptop computer. Previous research suggests that the consumers with this behavioural characteristic purchase products in the comparative first half of the product life cycle. However, our findings contradict the prior research.

4. The Fourth Cluster

The smartphone possession rate of the fourth cluster is 43%, which is approximately equal to the third cluster. Among the respondents of the questionnaire, 11% were included in this cluster. Among the four factors discussed above, the defining characteristic of this cluster was the originality factor. Respondent in this cluster, likely determine the value of smartphones independently without the influence of others. On the basis of the results of the survey, we estimate that about half of the respondents in this cluster determine the need for a smartphone from their own needs. Prior research suggests that these consumers purchase products in the comparative first half of the product life cycle. However, our findings contradict the prior research.

5. The Fifth Cluster

The fifth cluster includes the respondents with the least smartphone possession rate, 25%. Among the respondents of the questionnaire, 25% were included in this cluster. Among the four factors discussed above, all values were low in this cluster. The behavioural characteristics of the five clusters discussed above are summarized in Figs. 2 and 3.
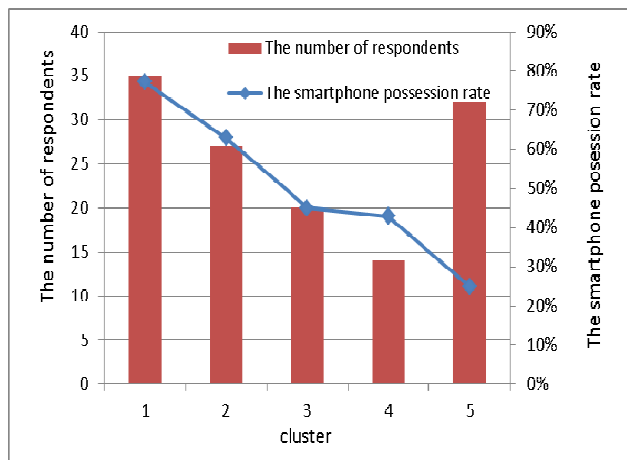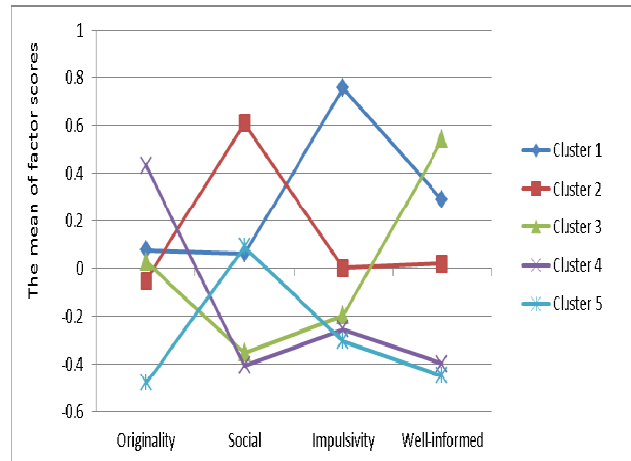

Fig. 2 The respondents of each cluster

Fig. 3 The behavioural characteristics of each cluster

V. CONCLUSION

The purpose of this research was to clarify the diffusion of innovation related to consumer behaviour characteristics when switching to a smartphone. Therefore, an empirical study of the switch from a conventional cell phone to a smartphone was performed. Two hypotheses based on previous research were verified through the empirical study.

The first hypothesis is that the speed of the diffusion of innovation (in this case the smartphone) varies according to the stage of the product life cycle. A previous study suggests that such diffusion speed continuously increases halfway through the product life cycle. Another study suggests that the change of the diffusion speed is discontinuous. In our study, the change was confirmed to be discontinuous with multiple peaks.

The second hypothesis is that the consumer behaviour characteristics and the utility of the product vary according to the stage of the product life cycle. For the behavioural characteristics of the consumers in each stage of the product life cycle, our grouping axes were different than research. The results of our study thus show a pattern of change that differs from that of previous research. The key grouping axes were the behavioural characteristics of impulsivity, sociability, well-informed person and originality. The results of this research indicate that the change of consumer behaviour characteristics through the stages of the product life cycle vary according to the product.

One notable characteristic of smartphone users is sociability. A smartphone is a tool that promotes a variety of means of communication with other people through social network service applications. We believe that our findings demonstrate the particular characteristics of the smartphone user.

On the other hand, of consumers demonstrating the well-informed person and originality behavioural characteristics, we believe that various macro environment conditions influence smartphone buying behaviour. For example, with the improvement of communication networks, contents and various applications accessible with a smartphone, each consumer seems to value these levels of enhancement uniquely, and thus, these consumers may ultimately gradually

shift toward smartphone use.

Therefore, the future subject of this research is a combination of research surrounding the application of smartphones and/or the network environment. It is thought that the results of this research may be developed more by studying smartphones in combination with their application and/or the network environment. In addition, this research focuses on Japan, but network environments and fee structures vary by country. A difference in the conditions of a country may influence the diffusion of innovation. Going forward, we intend to focus on country-by-country comparison research.

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