

An examination of the development of a system for recommending a cellphone carrier using a classifier

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Abstract

From the moment cellphones first appeared in Japan 30 years ago, their sales have been growing at a dramatic pace. However, Japan's cellphone market is now saturated. It is monopolized by three major cellphone carriers: NTT DoCoMo, KDDI, and SoftBank Mobile. These three companies are competing fiercely for market share, offering a wide range of products and services, including phone models with an ever greater number of features and a wide variety of price plans. From the consumer's standpoint, this has led to increased purchasing costs. In response to this situation, this paper focuses on the creation of a system designed to enable consumers to choose a cellphone carrier relatively easily, using a classifier. The system is intended to help reduce purchasing costs by offering a relatively effective and convenient selection method to consumers faced with having to choose among the three cellphone carriers.

Key words

consumer behavior, cellphone carriers, recommended system, classifier, decision tree

1. Introduction

Since cellphones first appearance in Japan 30 years ago, their sales have grown at a dramatic pace. Today, they are an integral part of people's everyday lives. The number of cellphone owners has increased each year, even among elementary school pupils and the elderly. According to statistics provided by the Ministry of Internal Affairs and Communications, their diffusion rate had reached 104.5 % at the end of FY2014 (Ministry of Internal Affairs and Communications, 2015). Japan's cellphone market is already saturated. It is currently monopolized by three major cellphone carriers: NTT DoCoMo, KDDI, and SoftBank Mobile. These three companies are competing fiercely for market share and currently offer a wide range of products and services, including phone models with a vast array of functions and a wide variety of price plans. Although increased choice is a great benefit for consumers, the products and services offered by the three companies are similar. As a result, consumers are becoming increasingly confused when making a purchase, which is increasing the so-called "purchasing cost."

This situation prompted the development of a system that enables consumers to make selections from among the three cellphone carriers relatively easily. Because virtually no similar studies exist, we will firstly summarize the history and current status of the cellphone market in Japan is summarized and the theories and concepts that have attempted to describe consumers' buying behavior when making a selection from among the three cellphone carriers are examined. Then, mar-

ket survey is described, formulated on the above considerations, asking consumers about their criteria for selecting one of the three cellphone carriers, and designed to identify the characteristics of each carrier and the characteristics of each company's users. Next, describe an attempt to develop a system that uses a classifier to recommend a suitable cellphone carrier is described. By presenting a relatively effective and convenient method of choosing among the three cellphone carriers, it can be believed that the system can contribute to reducing consumers' purchasing costs.

2. The cellphone market in Japan

This chapter summarizes the history and current status of cellphones in Japan. The Japanese cellphone was invented in 1979 as an in-vehicle phone by Nippon Telegraph and Telephone (the predecessor of NTT). In 1985, a shoulder phone was released. Cellphones became widespread after the 1990s, and liquid crystal displays began to be used in the phone's main body. After 2000, third-generation cellphones were launched, and TV phones became possible with Japan's first 3G services. Since 2007, smartphones almost identical to personal computers have begun to spread.

Looking at the history of cellphone carriers, on the other hand, due to the 1985 institutional reforms that banned new market entries, NTT DoCoMo came to monopolize the cellphone carrier market. Regulations were eased later, and NTT was divided along regional lines throughout Japan. New market entries were also approved. Companies other than NTT continued to carry out M&A. In 1988, KDDI au was set up, and SoftBank entered the field in 1994. (Telecommunications Carriers Association, 2015).

According to statistics provided by the Ministry of Internal

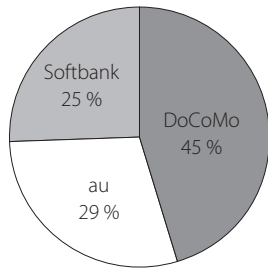


Figure 1: The shares of the three cellphone carriers

Affairs and Communications, cellphones' market penetration had reached 104.5 % at the end of FY2014. Japan's cellphone market is currently saturated. Figure 1 shows market share as percentages. NTT DoCoMo (hereinafter "DoCoMo") accounted for 45 % of market share; KDDI (hereinafter "au") had 29 %; and SoftBank Mobile (hereinafter "SoftBank") had 25 %. (Search for cell phone numbers, 2015). Competition has intensified among the three companies, and the battle to capture other companies' customers continues.

3. Various concepts seen in consume behavior

Despite the lack of literature on this topic, this section examines the criteria used by consumers when selecting a cellphone carrier—in other words, the various factors relating to cellphone carriers that influence a consumer's buying behavior.

Kuroda (2010) points out that the cellphone market can be seen as a multifaceted market and that the number of cellphone carriers' official websites has a significant influence on cellphone subscription demand. Akematsu (2011) points out that, although consumers do not always make use of all the services available, business operators need to consider what kind of services take root in consumers' lifestyles when expanding their business. The above literature verifies that a consumer's selection of cellphone carrier is influenced by the number of cellphone carriers' official websites and by the consumer's lifestyle.

Here, are examined several concepts relating to consumers' buying behavior. Cellphone carriers typically offer products and services to their customers comprehensively, centering on products, prices, distribution, and promotions. The focus of their product strategy is the development of new products and improvements and updates to existing ones. A product's components are usually divided into three parts: the "core," the "form," and "associated functions." The "core" comprises of the product functions and values that form the basis of meeting a consumer's basic needs. "Form" refers to the characteristics, style, quality, brand, and packaging that are attached to the product's core, while "associated functions" comprise of other elements that the consumer recognizes as added value, such as after-sales services and warranties. Integrat-

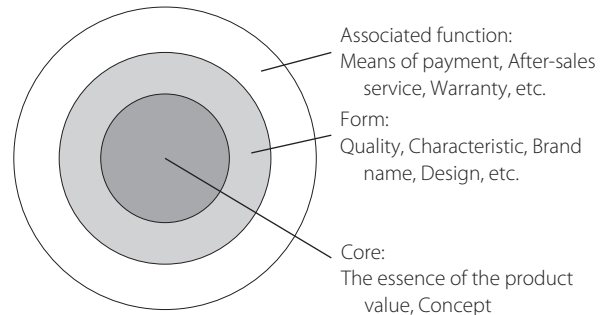


Figure 2: Conceptual diagram of product concepts

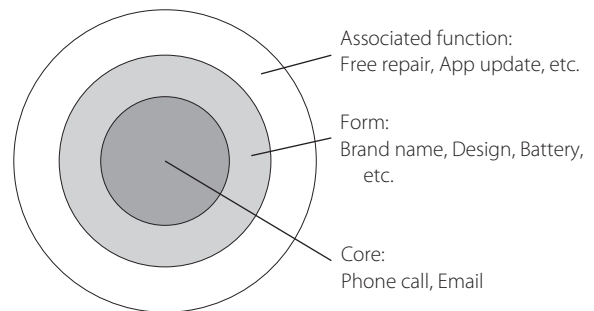


Figure 3: Conceptual diagram of product concepts

ing cellphone products into the conceptual diagram of this product concept (see Figure 2) produces Figure 3 below. The core of a cellphone product centers on the ability to assist communication, such as via phone calls and emails, whenever necessary and at any time. Color variations and designs that support a cellphone's functions make up the form of a product. Free warranties and app updates may be regarded as associated functions.

Next, the process by which a consumer moves toward buying behavior is examined. One of the leading theories of consumer buying behavior is the AIDMA theory, which suggests that consumers transit the following stages from the time they learn about a particular product to ultimately buying it: Attention → Interest → Desire → Memory → Action (Takahashi, 1989). The AMTUL theory, meanwhile, posits the following five stages: Awareness → Memory → Trial → Full-scale usage → Fixation on a brand (i.e., loyalty) (Sternthal and Craig, 1982).

These two theories on consumers' buying behavior can be summarized as follows. The first step is absorbing previously unknown information through a variety of advertisements and word of mouth. Consumers memorize the details as needed, try out samples, and, if satisfied, purchase the product and use it. If they are satisfied with the product, they may become repeat buyers. Whereas AIDMA can be seen as a model that describes short-term consumer buying processes, AMTUL is a model that describes a consumer's long-term buying processes.

From a corporate standpoint, moreover, the following may be said about these two theories: attractive promotional strategies such as advertisements are essential for consumer purchases. Offering outstanding products, services, and prices can also create repeat buyers, thus establishing a population of fixed customers.

4. Development of a system for making recommendations

The three cellphone carriers are focusing their efforts on price competition, advertising wars, and increasing store numbers while offering high-performance products and detailed services to consumers. In the following, as a basis the product concepts and purchasing processes consumers display in their buying behavior are used to carry out a market survey to identify the main factors in play when a customer is selecting a cellphone carrier. Based on the findings, a system of cellphone carrier recommendation is then developed.

4.1 Market surveys

Customers selecting among the three cellphone carriers appear to base their choice on two factors: the cellphone carrier and the cellphone itself. This survey therefore asks 13 questions on "Items relating to a cellphone's contracting company," focusing on aspects such as the company's name, price, coverage/service area, and services, and eight questions on "Items relating to the cellphone itself," focusing on aspects such as model type, performance, trend/fashion, and price. The subjects answered each question on a scale from 1 to 5 (1 = "Would not consider at all;" 2 = "Would consider slightly;" 3 = "Cannot say either way;" 4 = "Would consider somewhat;" 5 = "Would consider extremely strongly"). The survey was conducted via questionnaire from November 14 to 28, 2014, targeting 180 adults. A total of 143 responses were collected, and 140 were valid. Figure 4 shows the breakdown of the respondents. Comparing Figures 1 and 4 shows that the results of this survey closely parallel the shares held by nationwide cellphone carriers as measured by number of subscribers. Of the 140 respondents, 115 were satisfied with their current carrier. The breakdown of cellphone companies with which the subjects have a contract is DoCoMo (50 subjects), au (38), and SoftBank (27).

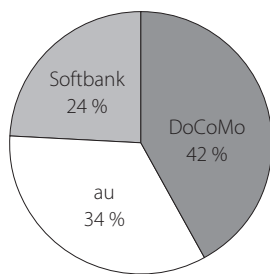


Figure 4: Breakdown of survey subjects' existing cellphone carriers

Figures 5, 6, and 7 show the total scores of the factors the consumers regard as important regarding the three cellphone carriers. Items such as price, rates, coverage, and model type are ranked high, matching the results of past surveys conducted by research companies (Oishi, 2013; Tanaka, 2014). Ranked lowest were items concerning advertisements.

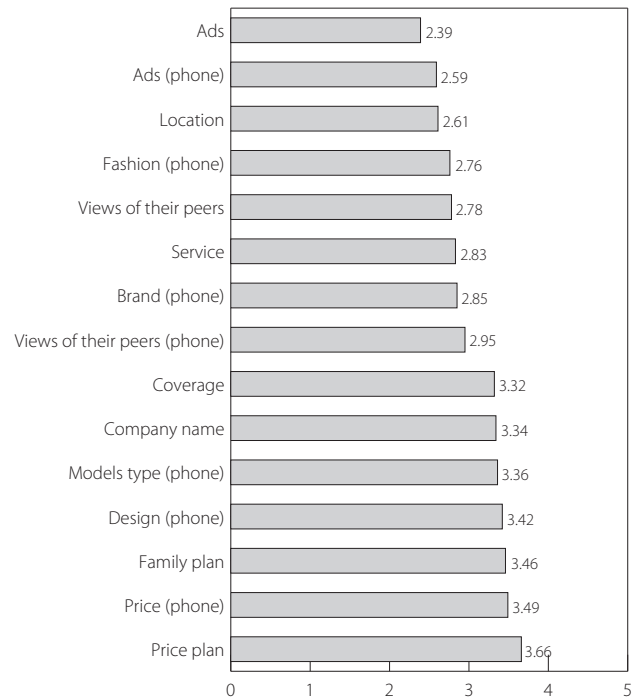


Figure 5: Scores for DoCoMo

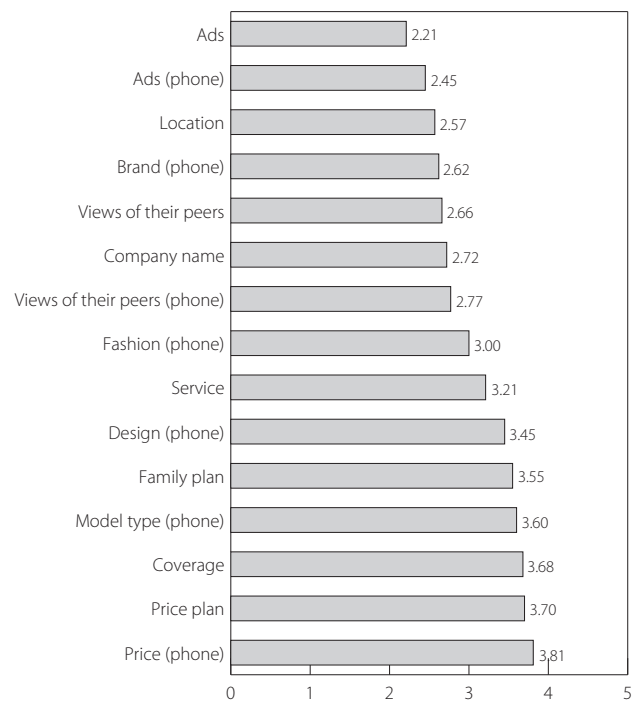


Figure 6: Scores for au

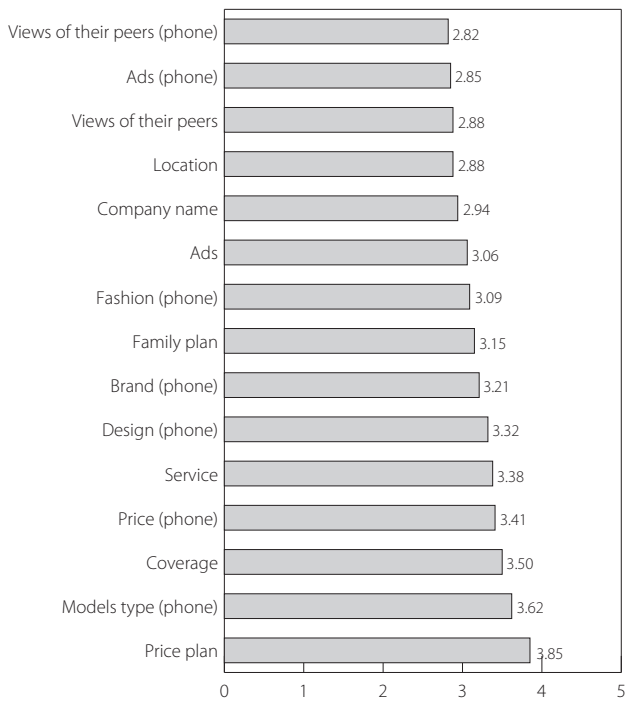


Figure 7: Scores for SoftBank

Table 1: Results of classification using 115 subjects

| Cell phone carrier | Discrimination results | | |
|--------------------|------------------------|--------|----------|
| | au | DoCoMo | Softbank |
| au | 31 | 8 | 11 |
| DoCoMo | 9 | 18 | 10 |
| Softbank | 13 | 6 | 9 |

Table 2: Results of classification using 84 subjects

| Cell phone carrier | Discrimination results | | |
|--------------------|------------------------|--------|----------|
| | au | DoCoMo | Softbank |
| au | 17 | 7 | 4 |
| DoCoMo | 4 | 18 | 6 |
| Softbank | 4 | 7 | 17 |

Table 3: Results of classification using 84 subjects (with parameter adjustments)

| Cell phone carrier | Discrimination results | | |
|--------------------|------------------------|--------|----------|
| | au | DoCoMo | Softbank |
| au | 18 | 2 | 8 |
| DoCoMo | 6 | 16 | 6 |
| Softbank | 1 | 3 | 24 |

4.2 Experiments using a classifier

The cellphone carrier with which the customers were most satisfied was used as the objective variable and the experiment described below was conducted, employing automatic Weka classifier J48 software (Witten et al., 2011).

The experiment was conducted employing data on the

cellphone carriers used by 115 subjects. The results showed a 50 % accuracy level (F value = 0.51). The classification results are shown below.

To enhance the level of precision, focus was put on the fact

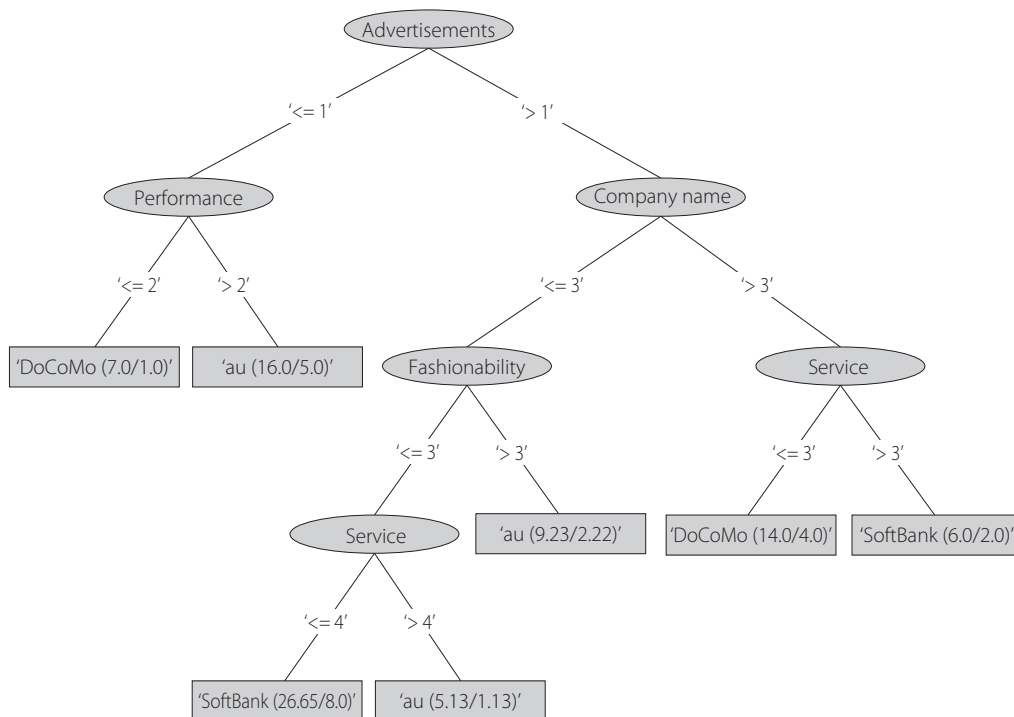


Figure 8: The decision tree

that the number of cellphone carriers, the objective variables, was inconsistent. Therefore the numbers were matched to 28, the smallest number shown for SoftBank, and the extra numbers for DoCoMo and au above 29 were deleted. Then, the data was classified in the same fashion using J48 and a precision level of 62 % (F value = 0.62) was obtained.

Next, J48's parameters were adjusted, establishing the value of m in NumObj as 5 and the confidence value as 0.03. The precision level reached 69 % (F value = 0.69) as a result. Six attributes were used: the name of the cellphone carrier; the carrier's phone rates, ads, and services; cellphone performance; and the fashionability of the cellphone's model type. The results and the decision tree are shown below.

The following decisions can be made using the decision tree illustrated above.

- (1) DoCoMo can be recommended to customers who do not consider advertisements at all for cellphone carriers and who hardly consider cellphone performance. au can be recommended to customers who do not consider advertisements at all for cellphone carriers but consider cellphone performance somewhat.
- (2) Customers who consider advertisements for cellphone carriers have two major options depending on whether they regard the name of the cellphone carrier as important. SoftBank can be recommended to customers who do not deeply consider the name of their cellphone carrier, the fashionability of their cellphone model, or the services provided by the cellphone carrier. au can be recommended to customers who do not give too much consideration to the name of their cellphone carrier or the fashionability of their cellphone but who do give some consideration to the services provided by the cellphone carrier. au can also be recommended to customers who do not deeply consider the name of their cellphone carrier but who do consider how fashionable their cellphone model is.
- (3) DoCoMo can be recommended to customers who consider the name of their cellphone carrier but who do not particularly consider the services provided by the company. SoftBank can be recommended to customers who consider both the name of the cellphone carrier and its services to some degree.

5. Discussion

Japan's cellphone market is saturated, and the three major cellphone carriers are engaging in high-level competition in products and services. Thus, practically all the items the three companies provide, such as products, prices, sales, and coverage/service areas, are at similarly high levels, making it difficult to differentiate among them. In all past surveys, price, coverage/service area, and model type were the major fac-

tors in customers' choice of cellphone carrier. Most customers believe, however, that all three companies offer very similar coverage/service areas.

This study's system for recommending a cellphone carrier uses the following six attributes: the cellphone carrier's name, call rates, advertisements, and services as well as the cellphone's performance and model type. The decision tree illustrating the results of the experiments indicates that advertisements are an important starting point for considering all the factors consumers examine when selecting a cellphone carrier. Advertising is initially regarded as a judgment criterion, while prices and model type remain as the factors consumers still consider. The decision tree does not include a "coverage/service area" item, though it appears in conventional surveys, because all three cellphone carriers provide nearly identical coverage/service areas. Finding that the cellphone carrier's name is taken into consideration shows the importance of brand loyalty in marketing. DoCoMo has the longest history and thus a brand loyalty advantage. Partly because of this chronology, the three cellphone carriers are constantly engaging in vigorous advertising campaigns. SoftBank and au, in particular, are working to strongly communicate their company names and increase their name recognition. Advertising also allows companies to release information on the currently popular model types and publicize them more intensively. As explained in Chapter 2, recognition is the first essential stage in consumer buying behaviors. Advertising is thus one of the few techniques that a cellphone carrier can use to create market differentiation. Advertising has not been ranked highly as a carrier selection factor in past surveys, including ours; nor has its importance been fully substantiated.

This study examined the factors consumers consider when selecting a cellphone carrier. Based on the findings, a system for recommending a cellphone carrier using a Weka classifier device was developed. Evaluating six items—company name, rates, advertisements, services, performance, and trend/fashion—will likely enable the recommendation of the cellphone carrier closest to the customer's tastes and preferences. Future studies should increase the accuracy and precision of this recommendation system.

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