Patent network based conjoint analysis for wearable device

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ABSTRACT

Current state of wearable device market is in a chasm, which indicates a disconnect of high technology adoption between early adopters and early majorities. The purpose of this paper is to suggest features of wearable device which will provide a successful beachhead for its adoption from early majorities. Our suggestion is based on the two step analyses consisting of the patent network analysis (PNA) for reflecting technological trend of the area and the patent based conjoint analysis (CA) for considering target customers' preferences. First of all, we identify *measuring or processing data from the human body for medical purposes* as prospective technology in wearable device area by using PNA. Based on the identified technology from the PNA, individuals who are very interested in using a medical-purposed wearable device are distinguished as target customers. We conduct patent based CA reflecting their preferences. This paper suggests research direction, which is to cross the chasm and attain first mover advantage, to the first mover companies in wearable device market.

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1. Introduction

No obvious first mover company leads the wearable device market because this market in its current state is in a chasm, which indicates a disconnect in high technology adoption between early adopters and early majorities (Moore, 2002). Many released wearable devices, such as Google Glass, Apple Watch, Nike Fuel Band, Fitbit Force, and Samsung Galaxy Gear, are only used by some early market customers (innovators and early adopters) who have a strong interest in state-of-the-art technology. However, these devices have yet to be adopted by mainstream market customers (early majorities and late majorities) who comprise more than half the total customers. Extreme diversity of wearable devices, which is generated from rapid growth of wearable technology and market, has confused customers about the usage of wearable device and made them hesitate about their buying decision.

In the environment of wearable device, both technology and market grows quickly, first mover companies have faced difficulties in attaining advantage from their early entrance to the market. The advantages include technological leadership, preemption of scarce assets, and buyer switching costs (Lieberman and Montgomery, 1988). This circumstance of wearable device market is in line with Suarez and Lanzolla (2007). They contend that first movers in an environment where both market and technology grow rapidly usually do not obtain the advantages as a first mover. One of the main reasons supporting their opinion is that negative word-of-mouth effect rumoring that later entrant's products are superior interrupts the build of switching costs (Kalish and Lilien, 1986). Wearable devices' excessive diversity which resulted from the

rapid evolution of its technology and market, has created uncertainty over the devices' purpose and interrupted the accumulation of switching costs by letting people expect the next better device.

However, a unique technological feature of wearable device, constantly collecting data from human body, will change this circumstance in the long term. It is expected that the personal data collected in wearable device will generate enormous switching costs because the device can provide users with customized functions by analyzing collected data. Also, people's tendency that avoids opening their personal data (Nakagawa et al., 2013) will be another cause of switching cost. They may want to record their personal information on one reliable platform rather than various different platforms. Therefore, we assume that a successful first mover adopted from majority of customers will attain considerable first mover advantage in the long run, despite the abrupt growth of wearable market and technology.

Therefore, firms related to wearable devices need a reasonable strategy to cross the chasm and become a major first mover in the wearable device market. According to the theory of Moore (2002), to cross the high technology market chasm and to reach the bowling alley—where early majorities start to purchase the product—firms must first target an extremely segmented market and gradually broaden their market share through the word-of-mouth effect. The theory of Moore (2002) also emphasized that firms are not required to first select an optimally segmented market, but they must satisfy selected target customers by providing a desirable product. Well-targeted early majorities can promote the product diffusion because they are in a unique position providing important link in the interpersonal networks of diffusion process (Rogers, 2003).

This study aims to suggest features of wearable device that can provide a successful beachhead for related first mover firms to cross the

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chasm by successfully targeting a segmented market. Our suggestion consists of a two-step analysis. First, to lower a firm's uncertainty caused by the broad scope of a wearable device technology, we identify the prospective detailed technology through patent network analysis (PNA) using United States Patent and Trademark Office (USPTO)'s enrolled patent data related to wearable technology. Through the patent analysis, we not only identify prospective technology but also can suggest more competitive (Change, 2004; Sohn et al., 2013), productive, and innovative (Narin, 1994) features of wearable device. Second, using the technology identified from the PNA, we define target customers who desire the identified technology and conduct patent-based conjoint analysis (CA) by surveying the defined target customers. To more deeply reflect the result of the PNA into our suggestion, attributes and levels of CA are determined on the basis of the identified technology.

Our suggestion for features of acceptable wearable device can support related firms to cross the chasm and effectively target the first bowling pin of the mainstream market. The organization of the remainder of this paper is as follows. Section 2 reviews the concept of chasm theory and first mover advantage theory in wearable device market and explains the use of PNA and CA in our research. Section 3 shows the two steps analysis using PNA and CA. Lastly, Section 4 provides the conclusions and limitations of this study.

2. Review and theoretical framework

In this section, we review the chasm theory and FMA theory, which form the basis of our analysis. In addition, we describe how PNA and CA are used together in our research.

2.1. Wearable devices in a chasm

Customers adopting new technologies can be categorized into five groups—innovators, early adopters, early majorities, late majorities, and laggards (see Rogers (2003)). Moore (2002) called the severance of technology adoption between early adopters and early majorities a chasm. The disconnect between these two groups is inevitable because the characteristics of early adopters and early majorities are the opposite of each other. The former seeks radical innovation, whereas the latter tends to take a conservative position to minimize discontinuity from previous technologies. If the early majorities do not adopt a new technology, the technology gradually disappears from the market.

Moore (2002) emphasized that a strategic way to cross the chasm is to engage in simple and preferential targeting of segmented market customers who absolutely need the new product. Researchers have proposed strategies to target a successful niche position in a mainstream market to commercialize disruptive technologies (Hendry et al., 2007; Ho and Chen, 2009).

Moore (2002) also highlighted that providing appropriate products for the determined segmented market customers is much more crucial than first finding an optimal target. His theory insists that if a firm gains definite trust from its own purposed target customers, the rest of the public eventually changes and regards the firm as a positive and reliable image. Through the word-of-mouth effect, the segmented target market's customers play the role of an effective first bowling pin that is expected to broaden the firm's market share. Well-targeted early majorities can effectively accelerate the product diffusion because their position, which links early adopters and relatively late adopters, plays an important role of interconnector in customer network (Rogers, 2003).

The adoption of wearable devices is in a chasm. If the first movers in the wearable area do not find a moderate strategy to overcome this situation, the product category will not survive in the market (Almeida and Fernando, 2008). Therefore, the related firms need a strategy for crossing the chasm by developing an appropriate wearable device that highly satisfies the needs of specific target customers.

2.2. FMA in the wearable device industry

FMA represents the gain in performance that a firm achieves from being the first to enter a market for a new product category. Researchers have made many arguments regarding whether FMA truly exists. For example, Arthur (1996) claimed the importance of entering the market first, whereas Sandberg (2001) asserted that being the first mover offers no advantage to companies in most cases. Some researchers noted a negative relationship between the order of market entry and market performance (Bond and Lean, 1977; Robinson and Fornell, 1985). Other researchers, such as Golder and Tellis (1993) and Lilien and Yoon (1990), showed that no relationship exists between market share and the order of market entry. Thus, no conclusive evidence exists to support or refute the existence of a FMA because numerous empirical studies on FMA have offered various opinions.

Existing FMA theories have three main streams: isolating mechanisms, micro aspects, and macro aspects. The first stream—isolating mechanisms—has many classification standards, and the most widely accepted one is the standard by Lieberman and Montgomery (1988). Their standard classifies the isolating mechanisms into three categories: technology leadership, preemption of scarce assets, and switching costs/buyer choice under uncertainty. Second, the micro aspects explain the effect on FMA of a firm's asset and the strategic maneuvering attained from the order of market entry. Some studies used historical cases to provide an overview of the relationship between the order of market entry and market performance (Klepper, 2002; Klepper and Simons, 2000). Finally, theories based on the macro aspects explain the existing relationship between the environment and a FMA.

Suarez and Lanzolla (2007) pointed out that existing FMA theories related to macro aspects are not organized to effectively consider the environmental factors; thus, they suggested a new taxonomy standard for classifying the macro environment using the aspects of market and technology dynamics. They defined the environment in four categories—both technology and market grow abruptly, both technology and market grow smoothly, technology grows abruptly and market grows smoothly, and technology grows smoothly and market grows abruptly—and analyzed how FMA is supported or refuted in each environment. Among these environmental circumstances, we focused on the environment in which both market and technology grow abruptly because the wearable device situation belongs to this category. According to Suarez and Lanzolla (2007), gaining an advantage from early entrance into a new product market in an environment that both technology and market grow rapidly is difficult, and many supportive studies exist on this theory (Henderson and Clark, 1990; Tushman and Anderson, 1986; Porter, 1985; Weick, 1993). One of the main supportive opinions is that generating switching costs in a rapidly changing environment is difficult because the negative word-of-mouth effect hinders technology adoption (Kalish and Lilien, 1986).

However, different from existing FMA theories, we expect that another aspect of switching costs will be generated in the long term from wearable devices because such devices can accumulate personal data and provide customized services by utilizing the data. Furthermore, customers would prefer piling up their body data in one reliable platform and mind changing the platform. Although first movers in the wearable device market have yet to gain FMA, the situation is expected to change when a first mover appears that crosses the chasm in the area.

2.3. Use of PNA and CA in our research

Social network analysis (SNA) is a methodology used to investigate the relationship between nodes and their significant role in a network. SNA can be applied to many different fields (Otte and Rousseau, 2002), and PNA is one of the many application fields of SNA. For example, Jun and Park (2013) engaged in PNA to search for central technologies at Apple. Dongsheng and Xin (2010) used PNA to analyze GM's and