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A systematic approach for new service concept generation: Application of agent-based simulation

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ABSTRACT

In new service development (NSD), a concept design that influences the direction of other activities is considered as a crucial stage. Although several methods exist, most of them cannot reflect responses of future potential customers because they assume that customers have the same responses in the future. Therefore, by using agent-based simulation (ABS) that can understand the future status of a service system, this paper suggests a new approach to creating the most promising service concept. The proposed approach considers the future trends of various customer responses and service concept strategies of firms by using ABS, generating a more accurate concept. By applying the suggested approach to a healthcare industry, its practicability and utility are verified. The novel approach based on the agent-based simulation method, which has customer, service provider, and competitor agents, is expected to be useful for service providers in a competitive market.

1. Introduction

With economic growth, firms have increasingly found it difficult to survive just on their past successes. They should be continually innovative, and strive for the creation of new ideas and new products and services (Kelly & Storey, 2000). Therefore, new service development (NSD) has been considered as an important competitive concern for many service firms (Johne & Storey, 1998). Recently, NSD has become more popular since not only service firms but also manufacturers who produce mature products intend to introduce new services for survival in increasingly dynamic competitive environments (Chai, Zhang, & Tan, 2005). This movement is known as servitization, i.e., moving from products to services in order to improve the original value of products by providing an additional service (Morelli, 2003).

In NSD, as in the case of new product development (NPD), the most important step in service development is to decide a new service concept because it influences the whole direction of the remaining NSD activities (Lee, Kim, & Park, 2010). A new service concept should reflect the stance of a company in respect of three key service characteristics: (i) the nature of activities; (ii) the nature of potential relationships between customers and service providers as well as service outcomes; and (iii) the degree of solving customer problems (Edvardsson, Gustafsson, & Roos, 2005; Edvardsson, Haglund, & Mattsson, 1995). Hence, a new service concept should include not only information on the service system but also a solution to problems of customers to meet the requirements.

For this reason, many tools have been introduced to design a new service concept based on analyzed customer needs such as brainstorming, conjoint analysis, and the analytic hierarchy process (AHP). These methods of the concept generation use qualitative criteria or consider interrelationships among decision elements in order to meet the customers' requirements (Griffin, 1997). However, the limitation of the aforementioned tools is that they cannot reflect the future trends of customers and competitors accurately because such tools deal with past experiences and qualitative data. For example, AHP assumes that the correlations among attributes and customers' behaviors are not changed over time. However, the customer behaviors can be evolved by interacting with other customers (e.g. word-of-mouth) or by service providers' policy (e.g. price discounting). That is why these existing approaches are difficult to generate a promising service concept even though they can use data on potential customers or plausible trends expected from early adopters. This limitation is critical to design a new service concept because the changing behavior of a target customer should be intensively scrutinized in the procedure of service delivery.

Therefore, in order to reflect evolving future trends including correlations between the concept criteria, this research applies an agent-based simulation (ABS) method to devise a new concept generation process. ABS is differentiated from traditional approaches in that it focuses on finding a set of basic decision rules and behavioral interactions that can produce the complex results

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experienced in the real world (Sallach & Macal, 2001). It allows for the definition of a system model based on autonomous, goal-driven, and interacting entities (agents) organized into societies which is then simulated to obtain significant information on not only the properties of the system under consideration but also its evolution (Garro & Russo, 2010). Thus, it is quite an appropriate method to analyze complex systems that consist of interactions among large numbers of individuals from various disciplines such as finance, economics, social sciences, and logistics (Hoffer, George, & Valacich, 2008; North & Macal, 2007; Tesfatsion, 2002).

However, in order to design a new service concept, the systematic approach which can give an actual solution to generate the concept is needed. In this paper, we ascertain the application opportunities of ABS that consist of customers, service providers, and competitor agents for new service concept generation, and propose a new service concept generation framework that is based on ABS. First, the features of existing service concept generation tools and the ABS method are explained briefly. Then, an approach to generating a new service concept is described, followed by an illustration on healthcare services in the next part. Finally, the limitations and future directions of this research are discussed.

2. Background

2.1. Concept generation methods

Although the NSD process is different from the NPD process (Martin & Horne, 1993), the NSD process includes making a series of decisions as in the NPD process (Krishnan & Ulrich, 2001). It generally consists of four large processes, namely, design, analysis, development, and full launch (Johnson, Menor, Chase, & Roth, 2000). In particular, the concept design process has three sub-processes such as the formulation of service objectives/strategy, idea generation and screening, and concept development and testing. In fact, a lack of research has been found between idea generation and launch (Davison, Watkins, & Wright, 1989). First, in practice, most service firms have been observed to use informal procedures and qualitative methods (Easingwood, 1986; Edgett, 1993). Second, the existing quantitative methods for concept design also have critical limitations to reflect the change of customers' behavior. For example, the quality function deployment (QFD) method, which is a method to transform user demands into design quality and deploy the functions forming quality (Fisher & Schutta, 2003), cannot select an appropriate scope for the new service concept because it starts from current or past requirements. In other words, since existing customer needs (the voice of customers) do not reflect the future trends of customers, the new concept can hardly succeed in developing future markets.

Actually, regarding NPD, Griffin (1997) found that the three most important market research tools for customer-driven new idea generation processes were: voice of customer, customer site visits, and beta site testing, all of which focus on existing customers. These tools help to understand customer needs and affect the determination of the design direction. Other tools used to support an ideation process include brainstorming (Rossiter & Lilien, 1994), focus groups, customer visits (McQuarrie, 1998), conjoint analysis, and some promising new works on channeled ideation (Goldenberg, Mazursky, & Solomon, 1999). These concept generation tools are designed to collect new needs and solutions from past data (Griffin, 1997). A similar problem exists in NSD because most NPD concept generation methods are applied to NSD. While a lead-user (LU) approach has led to an idea generation process designed to collect data on both critical needs and solutions from lead users in order to predict the future trends on customers (Lilien, Morrison, Searls, Sonnack, & von Hippel, 2002; Urban & von Hippel, 1988), it does not consider the interaction with others. However, the personality of customers can be changed by behavior or experiences of others. For example, a word-of-mouth mechanism affects the purchase decision of a new customer because the new customer generally wants to get more correct information to reduce the buying risk (File, Cermak, & Prince, 1994).

In addition, the analytic hierarchy process (AHP) has been widely used for concept selection in NPD due to its ability to handle qualitative criteria (Marsh, Slocum, & Otto, 1993) and the analytic network process (ANP) allows for more complex interrelationships among decision elements (Ayağ & Özdemïr, 2007; Lee et al., 2010). However, they cannot handle difficult problems in which there exist interdependencies among decision attributes in real time. Besides, the interrelations among decision elements are based on the analysis results of current data.

Thus, a new service concept should include dynamic patterns of customer behavior over time. When a new service design is finished, the target customers are not previous or current customers but rather potential customers in general. In other words, since the needs of individuals greatly change over time, a future customer who has different personalities and preferences should be dealt with to develop a successful service. Thus, a useful tool is the simulation method that performs the modeling of a system as it evolves over time, providing a better understanding of complex systems (Law & Kelton, 2000).

2.2. Agent-based modeling and simulation

ABS is a new approach to model systems of autonomous, interacting agents (North & Macal, 2009). It is different from traditional simulation methods such as discrete-event simulation (DES) because most DES models employ a top-down modeling approach and use passive entities, i.e., some events occur to the entities while they move through the system. On the contrary, ABS is a bottom-up modeling approach and has active entities, i.e., the entities themselves can take on the initiative to perform an action (Lin & Long, 2011; Siebers, Macal, Garnett, Buxton, & Pidd, 2010). In other words, an ABS agent is an identifiable, discrete individual with a set of characteristics or attributes, behaviors, and decision-making capabilities (North & Macal, 2009). Therefore, it is very useful when the goal is modeling the behaviors of individuals in a diverse population or when agents have dynamic and complicate relationships with other agents (Siebers et al., 2010).

Basically, ABS is being applied in many areas spanning social, physical, and biological systems (Barbati, Bruno, & Genovese, 2012). Applications range from modeling ancient civilizations that have been gone for hundreds of years to designing new markets for products that do not exist right now (North & Macal, 2009). In the social science area, in order to figure out the correlations among actors in the market, many agents are modeled in ABS, e.g., customer and company agents. Particularly, the customer agent is the most important because s/he represents the market response, enabling the researcher to predict the real market.

One approach in customer models is Consumat, which is based on a comprehensive conceptual model of choice and decision-making behavior (Jager, Janssen, De Vries, De Greef, & Vleck, 2000; Jager, Janssen, & Vleck, 1999). As such, it tries to offer a more psychology-based meta-theory of human decision-making than the frequently used 'rational actor' approach. It considers basic human needs and uncertainty as the driving factors behind the human decision-making process. First, the needs are formed by the human and natural environment, and then are memorized in a mental map of agent. Then, the agent engages in different cognitive processes and chooses one alternative and updates the information in their mental map. After the consumption of opportunities, a new level of need satisfaction will be derived. This approach is valuable