J. Eng. Technol. Manage. 32 (2014) 40–59

Contents lists available at ScienceDirect

Journal of Engineering and Technology Management

journal homepage: www.elsevier.com/locate/jengtecman

Market penetration among competitive innovation products: The case of the Smartphone Operating System

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ARTICLE INFO

Article history:
Received 21 February 2013
Received in revised form 13 September 2013
Accepted 1 October 2013

Keywords:
Scenario analysis
Lotka–Volterra model
Co-diffusion model
Diffusion model

ABSTRACT

Competition models have seldom considered the future development of products. However, to make decisions about products, it is key to understand their future demand and competition with other products. In the present study, we considered four Smartphone Operating Systems (OSs) (Android, iOS, Symbian, and Blackberry), and proposed an integrated model that combines scenario analysis and the Delphi to predict possible scenarios for the future development of the four OSs. Then we used the Lotka–Volterra competitive model and an innovation diffusion model to forecast the adoption volume of each OS over the next 5 years. We suggest strategies for decision makers.

Introduction

Regarding sales volume forecasting, the logistic and Gompertz models are popular technology forecasting models, whereas the also-popular Bass model (Bass, 1969) is used to forecast sales for the timing of initial new product purchases. These three popular new product diffusion models all assume that the product in question is independent of any other product. However, high-tech products/technologies tend to have short life cycles and high competition and substitution effects. Therefore, estimating the sales volume among competitive innovation products/technologies has become increasingly critical in this era.

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http://dx.doi.org/10.1016/j.jengtecman.2013.10.002

Three models focus on sales forecasting among technologies, Peterson and Mahajan (1978) extended the Bass diffusion model (1969) to include more than one innovation simultaneously. They specifically conceptualized four extensions of the fundamental diffusion model, depending on whether innovations are independent, contingent, complementary, or substitutes. In 1993, Bucklin and Sengupta (1993) described the concept of co-diffusion, which is the positive interaction between the demands of complementary innovations that have separate adoption tracks. The interaction arises because the adoption of one innovation enhances the value of the other to the end-user. The Lotka–Volterra equation, which had been developed to model the interaction between two competing species, has been adapted to model competitive market situations (Kreng and Wang, 2009). For example, Lopez and Sanjuan (2001) analyzed the effects of competition among websites. Kim et al. (2006) explored the Korean mobile phone market and found a set of commensal relationships.

These proposed models have focused on the competition relationship, however, the future development of competing products is contingent on various external developments not included in these models, such as sales volume forecasting, technological breakthroughs, societal backlash, and so forth. Moreover, the development of new high-tech technologies involves many considerations (including societal, technological, economic, environmental, and political issues), may be hindered by future uncertainty, and is often limited by a relative lack of data in early stage. At this time, how do experts forecast the sales volume of competitive products/services?

Traditional scenario analysis is a qualitative method, which considers macro- and micro-economic factors as well as future uncertainty to present rich and complex portraits of possible future scenarios (Porter et al., 1991). Until, Wang and Lan (2007) and Tseng et al. (2009) combined scenario analysis (to address future uncertainty) and quantitative multi-generation sales forecasting methods to analyze the future development of new-generation technology. Generally speaking, researchers collect the opinions of experts when conducting scenario analysis; however, experts' opinions often vary greatly. Therefore, some researchers combine scenario analysis and the Delphi method to generate future scenarios (Rikkonen and Tapio, 2009; Czaplicka-Kolarz et al., 2009). Tseng et al. (2009) and Tseng and Wang (2011) combined scenario analysis with the innovation diffusion model and the Delphi method to analyze the development of a new technology. Dong et al. (2013) reviewed a generic step process for scenario development and suggested that there are three limitations to the current practice: the number of quantitative scenarios developed, the lack of probabilities attached to the scenarios, and the lack of transparency in how descriptive scenario storylines are converted into quantitative scenarios. Dong et al. (2013) tested scenarios with qualitative and quantitative techniques and identified two limitations of applied quantitative techniques: (i) the need to extend discrete scenarios to continuous scenarios to more completely cover future conditions and (ii) the need to introduce probabilistic scenarios to explicitly quantify uncertainties. They suggested that these limitations can be overcome by using computational algorithms to develop a large number of scenarios and then using Bayesian probabilities to narrow them down. Önkal et al. (2013) proposed using scenario analysis to aid in quantitative judgmental forecasting. Varho and Tapio (2013) used the Q_2 technique to produce forward-looking and heuristic scenarios that combined qualitative and quantitative Delphi methods.

Based on these studies of combination methods, the present study proposes an integrated model to analyze the relative development and sales forecasts among competitive innovation products/technologies with future uncertainty and limited data. We combine scenario analysis and the Delphi to develop scenarios and the experts' forecasts, the diffusion model and the competitive model to forecast the sales volume of each product/service in the scenarios.

Mobile phone types can be divided into basic phones, feature phones, and Smartphones. However, Smartphones have invaded the feature-phone market, due to their multiple features and applications, and their share of the overall mobile phone market has continued to grow (Chen, 2009). Previous studies have found that mobile services drove the growth in the adoption of the mobile phone. Sharma and Xiaoming (2012) developed and tested a value model for the adoption of mobile data services in international markets. Tojib and Tsarenko (2012) proposed a post-adoption model of advanced mobile services that emphasizes relationships between actual use and its antecedents: service ubiquity and experiential value. Moreover, as Smartphone sales have continued to grow, mobile phone providers' innovation is concerned not only with telecommunications functionality but also operating systems