

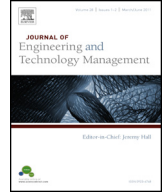


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A novel model of technology diffusion: System dynamics perspective for cloud computing



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ABSTRACT

The diffusion of cloud computing is going to create a pervasive impact on the global economy and on society. This study proposes a two-stage diffusion model of cloud computing to strengthen the objectivity of system dynamics in numeric prediction. The results indicate that the main factors affecting the diffusion of cloud computing are service quality, the degree of maturity of infrastructure, price, the degree of technological maturity, etc. This paper also proposes a prediction about the diffusion of cloud computing in the coming decade to provide guidance for future technology planning and strategic deployment.

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Introduction

The term technology diffusion covers a series of procedures from R&D (Research and Development) to the commercialization of products, which includes promotion and marketing. The diffusion of technology has the capacity to shape and change society. If enterprises can gain insight into the diffusion process and understand the dynamics of technology development, they can construct more predictive models to support effective and timely decision makings. There have been a variety of technology diffusion models proposed by various researchers (Hung and Wang, 2010; Robertson et al., 2007; Meade and Islam, 2006; Hameed et al., 2012). However, these studies normally relied upon sales data to evaluate the possible rates of diffusion, but failed to make a comprehensive exploration of the

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factors affecting it. Confronted with rapid changes in emerging technology, previous models of technology diffusion have become largely outmoded. There have been studies that used a comparatively analyzed predictive method of diffusion (Meade and Islam, 2006). However, the researchers in such studies have consistently been unable to identify an “optimal method”, but only the most “suitable combined methods” (Meade and Islam, 1998; Porter, 2004). The field of technology diffusion itself is not only concerned with the evolution of technology, but other factors as well, such as society and the environment. A number of studies proposed therefore examine changes in technology and society from a more macro perspective (Linstone, 1999; Akgün et al., 2014).

Along with the rapid development of IT technology, cloud computing has recently attracted significant attention (Marston et al., 2011). Cloud computing refers to applications and services offered over the Internet. It is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management efforts. Cloud computing represents a large ecosystem of vendors and services, each with their own approaches to exploit the gains that cloud computing provides (Chang et al., 2013). The diffusion of cloud computing will have a pervasive impact on the global economy and on society. The cloud industry is not only an innovation in technology, but also an innovation in service. With regard to cloud computing, the innovative technology that combines technology, innovation and services, the previous technology diffusion model is far from able to provide a detailed outline of the causal relationships within.

This study integrates multiple perspectives into the system dynamics to explore technology diffusion (Linstone, 2003). System dynamics is used to explore and model the diffusion of cloud computing. Regarding the aspect of numerical analysis, ANN (Artificial Neural Network) is well suited to solve dynamic complexity and non-linear issues and then construct more precise predictive models. Therefore, it is anticipated that the diffusion model of cloud computing proposed in this study, entitled two-stage ANN, will strengthen the objectivity of system dynamics in numerical prediction.

The organization of this paper is as follows. Section 2 is a literature review; Section 3 is an introduction to cloud computing and applications; Section 4 demonstrates the research method and models – the dynamic model of cloud computing will be introduced, and the construction of a predictive model, with the help of ANN, will be explained; Section 5 provides the results of our empirical studies and analysis; Section 6 draws conclusions and provides suggestions for future studies.

Literature review

The diffusion of technological innovation is a process among firms who transform abstract ideas, concepts, substantial technological information and the needs of society into practical use (Rogers, 1995; Dao and Zmud, 2013). A number of researchers have investigated the diffusion of new products and services (Bass, 1969; Meade, 1984; Gatignon and Robertson, 1985; Jippes et al., 2013). Among the numerous diffusion models, the Bass model has been extensively utilized (Bass, 1969) because it can easily depict the effects of external and internal influences. In addition, the Gompertz model and the Logistic model have also been popular. Many variations of these models have been introduced in keeping with the rapid changes of the market and the increasing complexity of the issues faced (Mahajan and Muller, 1996; Islam and Meade, 1997, 2000; Dekimpe et al., 1998; Gruber and Verboven, 2001; Kiiski and Pohjola, 2002; Crenshaw and Robison, 2006).

Of all the research on technology diffusion, ICT (information and communication technologies) is considered one of the most important topics for discussion. With the Bass model, Dekimpe et al. (1998) conducted research into the application of mobile phones and discovered that the social system size and the maximum number of adopters were key factors affecting transnational technology diffusion. Kiiski and Pohjola (2002), adopting the Gompertz evaluation models for technology diffusion, analyzed the GDP of each country in the Organization for Economic Cooperation and Development (OECD) and the costs of Internet usage, and discovered that average “years of education” had a significant effect and that the lower the price of Internet usage, the faster the diffusion was. Gruber and Verboven (2001) utilized regression analysis to examine the diffusion rate of the number of mobile phone users between 1984 and 1997 in 15 countries of the European Union

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