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Full Length Research Paper

Analysis of social network sites diffusion in Mongolia

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This paper is proposed to examine the diffusion of social network sites in Mongolia, as well as to understand diffusion pattern at aggregate level. The historical data on the number of monthly subscribers were obtained from two newly launched Mongolian social network sites, Voodoo.mn and Biznetwork.mn. Additionally, the Bass diffusion model was employed as a forecasting technique following nonlinear least square (NLS) approach, and model parameters were estimated using LINGO 9.0 optimization software. It is found that the social network sites diffusion followed traditional S-shaped curve. The results supported for application of Bass model in forecasting diffusion of social network sites in Mongolia. It showed that, the social networking market consisted mainly of imitators. Particularly, social network sites in Mongolia were noted to approximately reach maturity.

Keywords: Social network sites, diffusion of innovation, bass model.

INTRODUCTION

The emergence of social network sites (SNS) in the past few years has had a massive impact on both businesses and consumers. For businesses, it has significantly changed the tools and strategies for communicating with their customers. For the customers, it provided a way to directly connect with others. Today, social network sites such as Facebook, Twitter, Hi5 have become names familiar to millions of people worldwide. Social network sites are applications that enable users to connect by creating personal information profiles, inviting friends and colleagues to have access to those profiles, and sending e-mails and instant messages between each other (Kaplan and Haenlein, 2010). These applications are rapidly diffusing around the world, collecting new users and providing new ways for information exchange. As stated by the 2009 Nielsen "The Global Online Media Landscape" report, the reach of social network sites is growing at a brisk pace, faster than any other online sector. Whilst some cultures are becoming only acquainted with this "new service", others are using it on a daily basis. Nielsen has also reported that the adoption of social networking capabilities, by both consumers and corporation has already crossed the chasm (The Nielsen Company, 2009). This is especially true in technologically advanced countries such as U.S, where more than half of the internet population has an account at least in one SNS (Universal McCann, 2009). However, further examination is needed for many less developed countries. In overall, little is known about how Mongolian consumers are embracing SNS? When will the most of the population appreciate benefits brought by SNS? Will social networking ever be accepted in Mongolia? In this paper, we will direct to this questions using a case of two Mongolian SNS, Voodoo.mn (hereinafter Voodoo) and Biznetwork.mn (hereinafter Biznetwork).

Social network sites can be considered as a new tool of marketing that has gained its popularity in last couple of years. According to Mangold and Faulds (2009), social media must be integrated into the company promotional mix as a new hybrid element. Today, many companies are using SNS as a tool to create their own customized profiles, and then add potential customers and business contacts as friends. Making friends and connecting with a targeted demographic play an important role in new conversation (Kaplan and Haenlein, 2010). Recent

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Abbreviations: NLS, nonlinear least square; **SNS,** social network sites; **ICT,** information and communication technology; **OLS,** ordinary least squares; **MLE,** maximum likelihood estimation; **MAPE,** mean absolute percentage error.

Forrester researches have shown that many companies are shifting from traditional marketing strategies into the social media and the social media spending is increasing even during recession (Owyang et al., 2009). This shift is inevitable for Mongolian organizations as well. At that time, SNS with substantial amount of subscribers will hold advantage. Hence, it is important for these websites to accurately forecast the future subscriptions, growth and timing needed to reach to the peak. In addition, forecasting can help SNS to effectively plan resources and prevent losses. Specifically, SNS are based on revenue models that are largely dependent on amount of subscribers. For example, these sites can generate revenues through advertising, subscription, and or transaction models (Enders et al., 2008).

The objective of this study is twofold. First, is to extend the existing literature on social networking by examining its diffusion across Mongolian population. Second, is to replicate the traditional diffusion of innovation theory into the social networking environment.

SOCIAL NETWORK SITES IN MONGOLIA

Mongolia is the 19th largest and the most sparsely populated independent country in the world, with a population of around 3 million people (The World Factbook, 2010). Because Mongolia is characterized by vast distances and sparse population the social network sites can bring connectivity both locally and internationally. Currently in Mongolia, only a small portion of the population is engaged in social networking activities, mostly due to poor information and communication technology infrastructure. As of 2008, there were 330,000 internet users, comprising only 10.8% of total population (The World Factbook, 2010). Indeed, internet infrastructure is far from perfect, but nevertheless Mongolia is improving its internet capability dramatically. During the last years, information and communication technology (ICT) was seen as a dynamic and active sector in Mongolia. Foreign investments, technical assistance, and cooperation with technically advanced nations have enabled Mongolia to achieve significant progress in ICT development (ICT). The Government initiated “E-Mongolia”, the national program for development of ICT sector for 2010. Accordingly, the future looks promising for both ICT and social media sector in Mongolia.

The current condition can be illustrated by performance of few newly launched social network sites such as Voodoo, Biznetwork. Both sites are web based and allow users share ideas, activities, events, and interests within their individual networks. Open since August 2009, Voodoo.mn provide multimedia social networking service to people above 13 years old. Biznetwork, which was established nearly one year ago, more precisely on January 2009, defines its’ target audience as business and working people interested in idea sharing and searching for business opportunities. Beside these locally operated sites, more and more people a subscribing into international SNS. Most popularity has earned U.S owned social network website Hi5.com, followed by Facebook.com Alexa Internet Inc., (2010). Recently, Twitter.com seem to have gained power, since significant number of accounts pertaining to Mongolian users, can be found. Although all these sites are commonly considered as social network sites, the services and applications which they provide vary considerably. For example, Twitter’s current service model is “asymmetric” model, which implies that someone can “follow” someone without following him or her back-thus the relationship may or may not be mutual. On the contrary, Facebook has “symmetric” model, where both parts have to agree to be friends - in other words, relationship is two way. One of the main differences between these SNS is the ability of users to personalize their profile pages. With Facebook users are not able to change the overall look of their profile pages. While in the case of Hi5, users can easily change it, choosing from the ready-made profile page skins that are available on the site. Local websites are only available in Mongolian language, while any of the above mentioned international SNS not include Mongolian. Because, each of the above SNS provide bunch of new features and services, study presume that each SNS represent new service and innovation for a particular user.

DIFFUSION OF INNOVATION

Before elaborating on diffusion of SNS, it is important to understand the tenets of general diffusion theory. There is a long history of trying to understand the spread of new products, services, ideas and actions within social systems. The diffusion of an innovation is defined as the process by which innovation is communicated through certain channels over time among the members of a social system (Rogers, 2003). There are four factors that influence adoption of an innovation, the innovation, the communication channels, time, and the nature of the society (Rogers, 2003). Within vast domain of diffusion research two subfields had received much theoretical support: consumer innovativeness and new-product growth models (Hauser et al., 2006). Research on consumer innovativeness, investigates adoption at individual level and describes various mental, behavioral, and demographic characteristics of adopters. New-product growth models focuses on understanding diffusion at the aggregate level. Most authors, studying innovation diffusion from consumer innovativeness perspective seem to consider innovativeness a trait, the nature of which is still under question (Roehrich, 2004). Moreover, much of these researches are timeless in the sense that the time dimension is simply ignored. The inclusion of time as a variable in research is one of its strengths, but the

measurement of the time dimension (often by means of the respondents' recall) can be criticized (Rogers, 2003). New product growth models are developed for capturing the typical market sales pattern of a new product when it goes through the subsequent stages of the product life cycle. These models use a mathematical model to forecast the diffusion of innovation that results in a graph of penetration vs. time known as "S-curve". Several mathematical variations are available, including linear, exponential, logistic, Gompertz and Bass model. In this paper, the diffusion of SNS is analyzed using Bass model developed by Bass in 1969. This model was chosen because many studies have not only empirically tested it, but have also showed to be superior over other methods (Meade and Islam, 2006; Hauser et al., 2006). Moreover, this model has shown to be successful in forecasting wide range of innovations (Meade and Islam, 2006; Mahajan et al., 1990; Hauser et al., 2006) in different countries. The Bass model has also been successful in forecasting the number of adoptions at the peak of the sales curve using early sales data and in estimating long term pattern of diffusion (Wright and Charlett, 1995).

BASS MODEL

A key feature of the model is that it embeds a "contagion process" to characterize the spread of word-of-mouth between those who have adopted the innovation and those who have not yet adopted the innovation. The model attempts to predict how many customers will eventually adopt the new product and when they will adopt. Bass (1969) proposed that the probability that someone in the target segment will adopt the innovation by time t is given by a non-decreasing continues function F(t). The derivative of F(t) is the probability density function f(t), which indicates the rate at which the probability of adoption is changing at time t and is defined to be equal to

$$f(t) = (p + qF(t))(1 - F(t)) \quad (1)$$

The distribution function is given as

$$F(t) = \frac{(1 - \ell^{-(p+q)t})}{(1 + \frac{q}{p} e^{-(p+q)t})} \quad (2)$$

Here, p is interpreted as coefficient of innovation and q is coefficient of imitation. The Bass model divides the population of potential adopters into two groups: innovators, who are intrinsic adopters and depend upon advertising, product reviews and imitators, who are influenced by those who have previously adopted the product. Letting m be the number of eventual adopters, the cumulative sales N(t) is given by Equation (3).

$$N(t) = mF(t)$$

$$n(t) = (p + qF(t))(m - F(t)) \quad (3)$$

Estimating the diffusion curve requires the parameters p, q, m to be identified. This can be achieved using several methods. Bass (1969) developed a method of estimating these parameters using ordinary least squares. Schmittlein and Mahajan (1982) demonstrated that the classical approach of using ordinary least squares (OLS) procedure for parameter estimation may yield parameter estimates that are unstable or have wrong signs and there is a time-interval bias because discrete time-series data are used for estimating a continuous model. To overcome these shortcomings, Schmittlein and Mahajan (1982) have suggested a maximum likelihood estimation (MLE) procedure. However, this procedure also has limitations, because it considers only sampling errors and ignores all other errors such as the effects of excluded marketing variables that influence the diffusion process, it underestimates the standard errors of the estimated parameters, resulting in possible wrong inferences about the statistical significance of the parameters (Srinivasan and Mason, 1986). To overcome this shortcoming, Srinivasan and Mason (1986) suggested a nonlinear estimation procedure. This paper fit the Bass model to social networking subscription data using the NLS method to estimate parameter values to minimize the sum of squared errors. Both price elasticity and advertising elasticity was set to 1, assuming no effect.

Website subscription data are used as a proxy for sales. The study posits that Voodoo and Biznetwork can illustrate overall picture of Mongolian SNS market. Subscription data on Voodoo and Biznetwork were obtained from company internal records. Both companies allowed their monthly data from launch until March 2010. The dataset include both active and inactive subscribers, it is worth mentioning that subscriptions are defined as the accounts created by users and do not necessarily correspond to active subscriptions. To shed more light on the diffusion of SNS at other parts of the world, similar analysis were conducted with Facebook.com. Data were retrieved from compete.com and indicate monthly unique visitors from launch. According to compete.com, these numbers count a person only once, no matter how many times they have visited a site.

The parameters of Bass model were estimated to minimize the sum of squared error and corresponding estimates were obtained using optimization software package LINGO 9.0.

RESULTS AND DISCUSSION

Table 1 presents results from parameter estimation as well as estimated time of peak and magnitude of peak for three SNS examined in this study. As shown in Table 1,

Table 1. The parameter estimates, timing of peak, magnitude of peak for SNS

Parameter	p	q	m	T*	N(T*)
Biznetwork	0.018	0.082	138.4	15.16347	4.219512
Voodoo	0.0599	0.3014	50.1	4.472078	5.424634
Facebook	0.00047	0.669	827.7	12.36188	144.6866

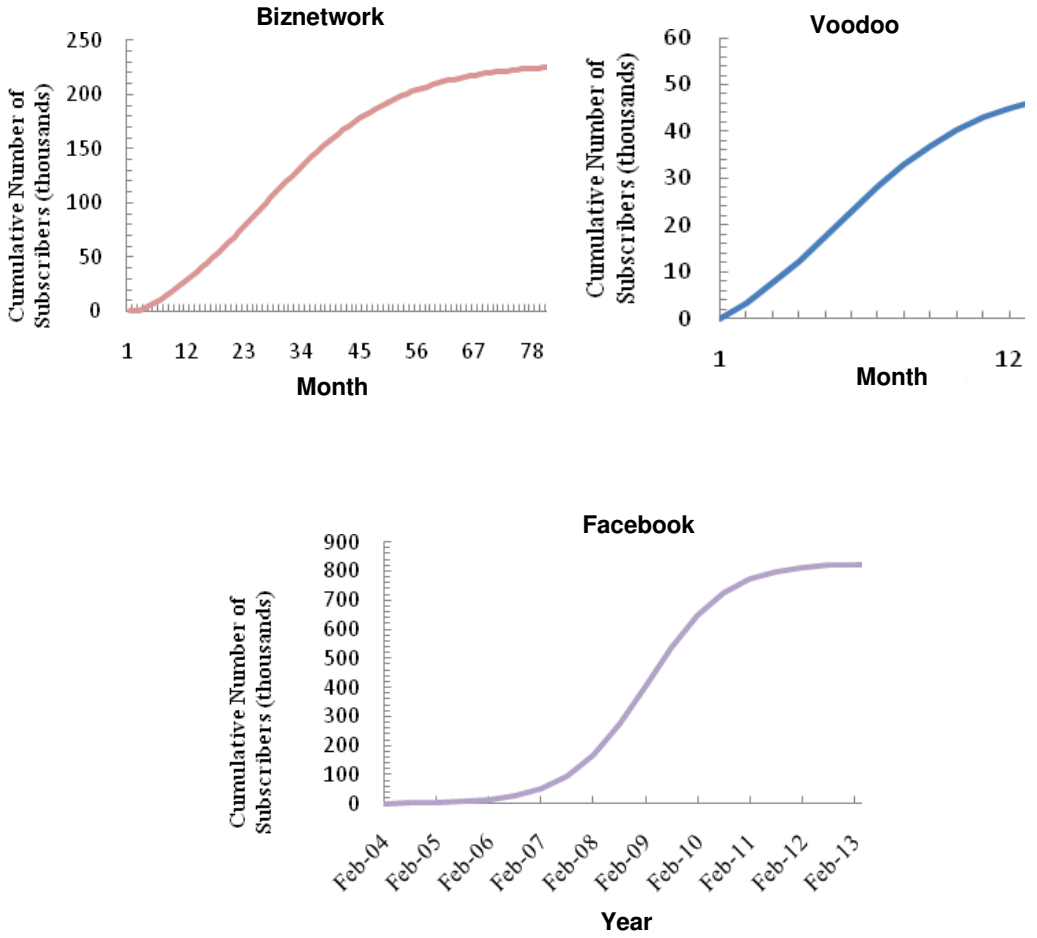

Figure 1. Estimated cumulative number of subscribers for SNS.

results suggest 229 thousand subscription for Biznetwork and 50.1 thousand for Voodoo at saturation. The Mongolia SNS market is small in size. Here, successive generations such as internet play crucial role. The estimated market potential for Facebook is around 827 million subscribers, with peak time achieved between August 2009 and February 2010.

The parameters p and q, as were defined earlier in the description Bass model, represent the forces of innovative and imitative behavior. For all cases, imitation parameter q appears to be larger than innovation parameter p. It indicates that the SNS market consists mainly of imitators. Favorable word-of-mouth can help to gain momentum for SNS. Interestingly, however innovation coefficient is higher for Mongolian SNS than for Facebook. This finding is inconsistent with previous research, which report higher innovation coefficient for developed countries (Talukdar et al., 2002).

Subscriptions of all SNS increase up to a certain point and then decrease. This happens because the Bass model assumes that innovations compete at each time point. The analysis suggests that the high-growth phase of the diffusion of Voodoo ended in 4th month, when the rate of growth of the number of subscribers began to decline. As for Biznetwork, inflection point will occur at 15th month. Figure 1 illustrates cumulative number of users over time. As can be depicted from Figure 1, the social networking subscription diffusion process follows S-curve pattern.

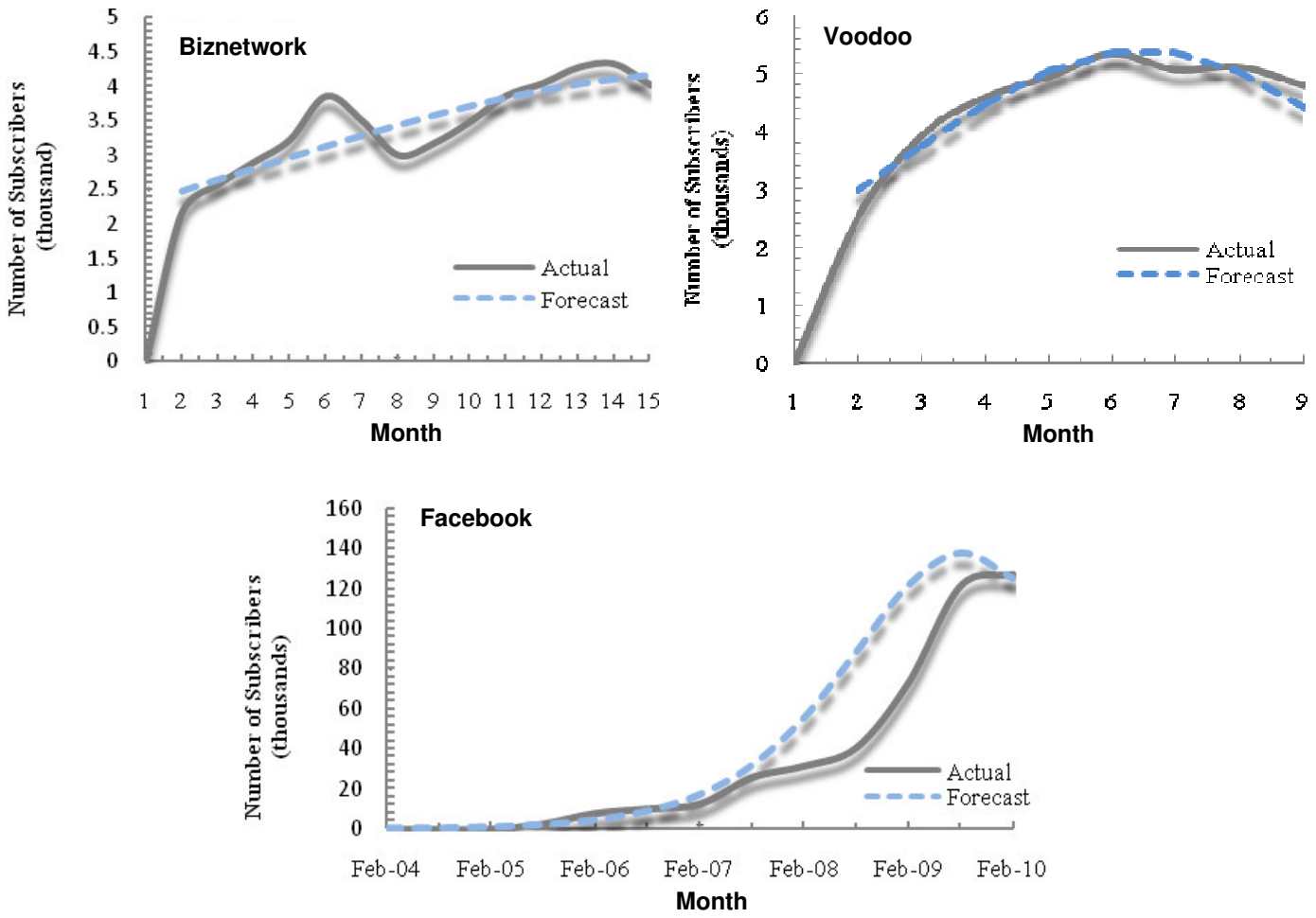

Figure 2. Comparison of forecast value and actual.

The graphical depiction of model fit is shown in Figure 2. The results show that the NLS model fits the data very well. A model that successfully fits the historical data is generally considered to
be structurally sound.

In order to assess forecasting accuracy, the data was split into two parts “training data” and a “evaluation data”. The evaluation data is a portion of the real data, that is hold back for later evaluation and training data is remaining historical data, which is used to estimate the model parameters. The “trained” models are evaluated regarding their ability to forecast the evaluation data. Data concerning last 1, 2 and 3 months were used as an evaluation data and mean absolute percentage error (MAPE) was calculated for all sets of data. The corresponding results are given in Table 2.

For all set of trained data, MAPE is low enough in case of Biznetwork and Voodoo, which indicate that the Bass model is appropriate for forecasting SNS in Mongolia. However, in the Facebook case, MAPE measure is very high, showing model inaccuracy in international domain.

CONCLUSION

The vast body of literature encompassing the Bass model provides little evidence for determining the extent to which the Bass model is reliable as a forecasting tool in social networking services. The purpose of this study was to apply diffusion theory into SNS. It can be concluded that the Bass model is reliable enough to fit the actual data and therefore to forecast SNS penetration. Cumulative number of SNS subscribers increase in S-shaped pattern. Another objective of this study was to evaluate the diffusion pattern on country specific basis. The analysis of Mongolian SNS demonstrates that the saturation level for Voodoo was already met in December 2009 and that Biznetwork will approach its peak in the near future. Therefore, the market is now probably mature enough to welcome a new technology, such as mobile social networking.

These findings should be of interest both to social networking professionals and researchers interested in assessing the social networking capabilities, in diffusion

Table 2. Estimated parameters and MAPE for evaluation data and entire dataset.

Evaluation data[1]	p	q	m	MAPE
Biznetwork				
ED1	0.011	0.066	228.9	0.068862
ED2	0.015	0.072	176.1	0.086482
ED3	0.026	0.101	95.3	0.088443
Total	0.018	0.082	138.4	0.074836
Voodoo				
ED1	0.065	0.23	56.4	0.055618
ED2	0.066	0.2	59.4	0.067792
ED3	0.066	0.18	61.5	0.068566
Total	0.0599	0.3014	50.1	0.032152
Facebook				
ED1	0.000462	0.669	827.8	1.091928
ED2	0.000517	0.668	829.6	1.262451
ED3	0.000642	0.667	831.8	16.58031
Total	0.00047	0.669	827.7	0.938922

Note: [1]ED1, ED2, ED3 shows that one, two, or three period of data were hold back respectively.

of innovations from product and country perspective. Lately, SNS are mushrooming worldwide and many are just about to launch. Results of this study can serve as reference for SNS planning for new start. Because historical subscription data are not available for new entrants, they can adopt parameters found in our study as analogue and forecast their future demand. Past researches have widely used parameters obtained from other, similar products or from other countries to forecast new adoptions in an early stage of the diffusion process (Bass, 2004). There are various avenues for further research. First, present study chose the original Bass model as reference model, because model has been reported to have excellent predictive capability. Although, the model fits the data fairly well, it is important to rely on appropriate models. Therefore, future research should employ other sophisticated techniques to contrast forecasting accuracy and find optimum model in forecasting SNS. These models should incorporate the effects of cross-national learning, marketing mix variables, economic variables etc. Secondly, the number of adoptions is estimated as a single value, with which a confidence interval is not associated. This limitation is shared by most applications of the Bass model which have been published to date. Future study can incorporate confidence intervals

Thirdly, findings suggest high innovation coefficient for Mongolian SNS than for Facebook. Further research is needed to verify this finding with other SNS pertaining to specific developed country rather than with global SNS. Finally, it should not be assumed that the diffusion and adoption of all innovations are necessarily desirable (Rogers, 2003). This paper assumes that social networking service has beneficial consequences for adopters and for society. Future research must study the potential impact of SNS on particular society.

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