2021-1170 IJOI
https://www.ijoi-online.org/

CONSTRUCTING INNOVATION DIFFUSION MODEL OF FACEBOOK FAN PAGE-FROM SYSTEM DYNAMICS PERSPECTIVE

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Abstract

Facebook is the most successfully developed social network in the world. Many businesses create Facebook fan page to strengthen their connection and contact with customers. Governmental agencies also establish Facebook fan page as policy propaganda platforms. For operators of fan pages, how to increase fans and interact with fans to achieve marketing objective is an important issue. In addition, the development of fan page is a dynamic changing process. The study based on diffusion of innovation theory and applied systematic dynamics to construct theoretical model of fan page development,

and simulate the trend of fan page development to provide reference for operators of fan pages.

Key words: Facebook, fan page, diffusion of innovation theory, systematic dynamics

Introduction

Internet is an important tool that people use to obtain information nowadays. People are accustomed to obtain real time life dynamic information through internet and proceed with interpersonal relationships communications. The development of world wide web has gone through stages of Web1.0 and Web2.0. In Web1.0 there were few content creators, in which most users are merely content consumers. (Cormode and Krishnamurthy, 2008) With the appearance of Web2.0, general internet users can own social network and personal blogs through low cost internet agency service or exclusive server. The content of Web2.0 is dynamically grown, allowing readers to publish reviews by methods different from the past and pushing ahead information exchange and cooperation among people in the internet. (Flew, 2008)

Following the development of internet technology, business e-commerce has become a trend and further obtain consumers' real time information through social network and direct interaction with customers to form so-called social commerce. Among social media Facebook is the most popular platform. Facebook was established in Feb. 4, 2004 and until today has over 3 billion users all over the globe and is the most successfully developed social network. Facebook provides individual users to use words, photos, films to share daily life, run personal image and social interaction. Many businesses have also established Facebook fan page to strengthen connection and contact with customers and communicate and interact with customers directly. In addition to serve customers real time, fan page can also increase customers' participation and understand products and service that customers pay close attention to, thus enhancing good reputation of products or services, producing loyal customers and bringing sustainable economic benefit.

For operators of fan page, how to increase fan base, strengthen interactions of fans in fan page and raise fans' attachment to achieve marketing objective is an important issue. Thus this study based on diffusion of innovation theory and Bass diffusion model (Bass, 1969) and applied systematic dynamics to construct theory model of fan page's diffusion of innovation and simulate the trend of fan page development to provide reference to fan page operators.

In addition to Introduction, the 2nd section would explore relative literatures of social network and diffusion of innovation theory; the 3rd section would introduce system dynamics theory; the forth section would base on diffusion of innovation theory to construct systematic

dynamics model of fan page development and simulate developing trend of fan page; the fifth section would propose conclusion and suggestions.

Literature Review

1. Social network.

Comparing to Web1.0 in which users simply browse webpages, Web2.0 emphasizes on people-oriented, in which users connect to the entire world via technology, providing and sharing personal views. (Bowman and Willis, 2003) The specialty of Web2.0 is that content is created by users and production and transmitting methods of information is different from conventional media. (Anderson, 2006) Extensive users make sources of information diversified and broad and messages can be rapidly spread in short period of time. Even some individual users can lead public opinion. (Berthon et al., 2012; Zhao et al., 2013) Web2.0 is an important concept and technological basis in forming social media platform. (Kaplen and Haenlein, 2010) Thus social network and social media developed on basis of Web2.0 has become major media that people communicate in internet. (Han, 2012)

In 1967 American social psychologist Stanley Milgram conducted an experiment and found that through 6 people at most would allow any two strangers to connect, (Milgram, 1967) which become so-called "Six degrees of separation" theory, which was validated by social network. In the internet, people's interconnection continuously expanded social circle and finally form vast social network. (Backstrom et al., 2012)

Social network service helps to strengthen internet and actual existing personal network relationship. All kind of practical advanced service that exceeds previously conventional message communication let users to communicate and share common interest with friends in community. This type of connecting relationship may derive other needs after gathering over long period of time and generate other potential internet business opportunity. (Kwon, Park and Kim, 2014) Social network marketing needs to be operated through social network sites that can produce clustering effect. Members of social network sites can be influenced by information in the community, especially recommendations and reviews about products or services. (Raache and Bonds-Raacke, 2008) In present famous social network sites include Facebook, Plurk, and Twitter, etc. These well-known social network sties generally own millions of registered users. Using social network sites have become users' daily life style. (Ellison, 2007) People in different corners on earth are connected through social network site. Especially the progress of internet communication technology allows social network sites to contain many possibilities and business opportunities. (Kwak, Lee, Park, and Moon, 2010) From data collected from social network sites one can also observe specific "pattern" of users' behavior and interaction between media content and social network members. (Beer, 2012)

In 2007 Facebook launched mechanism of fan pages, that provide a

window for businesses, celebrities or organizations to allow members, potential customers and general consumers and listeners, etc. can autonomously discuss issues they like and share information. Any other platforms or unregistered users can also search fan pages through internet, which is beneficial to marketing objective. Users can also grasp newest development of celebrities, organizations or brands they like by clicking "likes" or "follow" the fan pages they are interested in and at the same time share with friends the content they care about. (Dholakia and Durham, 2010) Because the usage of Facebook has been very popular, it can save the process for consumers to register other network. In addition, consumers are already familiar with Facebook interface, the entry threshold of fan pages is nearly non-existent for consumers, so that Facebook fan page has become a field most suitable for developing brand social network. (Lin, 2006)

2. Diffusion of Innovation Theory

Web2.0 website attracts other new users to join mainly by increasing users and creating solid website content. Users' accumulation and contribution is an important indicator of website growth. Thus "diffusion of innovation theory" can be used to explain the growth and changing process of Web2.0 (Otto and Simon, 2008) and diffusion model can be used to analyze developing structure of Web2.0. (Watanabe et al., 2011)

Diffusion of innovation is the process of an innovation communicating through special channel in social system over a period of time. The process of communicating innovative information is diffusion of innovation. Following the changes of time, the process that members apply and spread innovative information in social system forms a S shape growth curve. (Rogers, 1983) In the past study on diffusion model mostly used Bass diffusion model as basis or extend new influencing variable to modify diffusion of innovation model. (Bass, 1969; Sterman, 2000)

Bass Model pays attention to users' flow. Suppose that potential users of new products are influenced externally and internally, of which external influence means influenced by mass media. Users influenced by mass media are not affected by existing buyers and apply innovation by themselves, thus are called innovators. Internal influence is influence by reputation, meaning that users are affected by previous buyers, thus called imitator. In addition to internal and external influences, the changing condition that individual or organizations apply innovation described by diffusion innovation is also a dynamic process. (Rogers, 1983) Innovative information would change rapidly with time, complex endogenous and exogenous variables greatly increase uncertainty of information spread. Thus applying systematic dynamic research can clarify relationship among factors in complex system and can get an entire hold of innovative information spreading mechanism easier.(Sterman, 2000) Because innovative products have not developed successfully, system dynamics can be used first to construct theory model and proceed with simulation, then subsequently based on

actual conditions to feedback and modify pattern to make research result more in compliance with actual condition and satisfy forecasted needs. (Otto and Simon, 2008)

System Dynamics

System dynamics (SD) is a research methodology developed in 1956. The pattern structure of system dynamics uses arrow to present information feedback relationship constructed by causal link, level, rate, and auxiliary, to form a closed causal loop diagram, (Forrester, 1961) and uses one layer or multiple layers of derived function to show feedback structure, causal relationship and lagging effect of system's complex problems, thus interpreting system's characteristic and dynamic developing trend. (Milling, 1996)

1. Causal link

Causal link is shown in Figure 1. Arrow between variables represents causal relationship. If variable is changing in positive direction, it is shown as "+", while "-" would show for opposite changes.

Figure 1 Causal Link

2. Level

Level is the quantity accumulated during system operating process. It indicates things that accumulate or reduce with times, representing the condition of environmental variable at a certain point of time and is the source of information in the model, shown by squire frame, as shown in Figure 2.

Figure 2. Level

3. Rate

Rate is the changing volume of level within unit time. It can increase or decrease due to different directions. Rate indicates changing speed of certain level in a unit time. It is the place that information process and transform to action. The symbol of rate is shown in Figure 3.

Figure 3. Rate

4. Auxiliary

Auxiliary is the parameter value that assists in describing pattern, or represents the process of information handling. It can be any real variable and also auxiliary variable of input and output information variable. There are three types of meaning in the model, including middle process of information handling, parameter value and input testing meaning of model. As shown in Figure 4, variables A, B, C, and D all are auxiliary.

Figure 4. Auxiliary

5. Stock flow diagram

After variables are quantified to level and rate, they are connected as stock flow relationship, such as the stock flow diagram shown in Figure 5. It can further operate simulation analysis.

Figure 5. Stock flow diagram

System dynamics is composed by element symbols. It can explain causal chain relationship and directions of variables in the system and show interrelationship between causal circle variables. Through model structure of visualized image, it can rapidly assist in controlling system's entire structure characteristic and convenient to be used in communicating with others. (Sterman, 2000) The modeling of system dynamics emphasizes on system structure, which will decide system's behavior (trend) In order to change system's behavior structures must be changed. If structures are unchanged, system will remain in consistent fixed pattern. In present system dynamics is used mostly in system dynamic behavior characteristics or industry structure analysis of industry development, business operation, national defense technology, and policy development, etc. (Hsiao, 2014) Because development of fan page is influenced by internal and external factors like mass media and reputation, etc., which is a dynamic changing process, thus this study applied system dynamics as theory tool for model structures.

Model Structures And Simulation Analysis

Previous literatures stated that theory based on innovation diffusion model can better explain phenomena of Web2.0. Diffusion models in literatures are mostly based on Bass model and further expanded and modified. Studies on applying system dynamics theory to construct Bass model can also be induced to find that its core mainly include the two level system formed by two level variables of "potential customers" and "customers basis" of website. Potential customers from knowing the website click and read to become customers and further share to the public. The process of growth and decaying is affected by internet spread and oral spreading. The study refers to Bass model of innovation diffusion theory of Paich and Sterman (1993), and then follows modeling process of system dynamics (Forrester, 1961) to structure diffusion model system dynamic flowchart of fan page with Vensim DSS7.1 software. (as shown in Figure 6)

Figure 6 is the theory model structured by this study. The relative equation and parameter setting is obtained by referring to relative

literature or statistical data of Facebook fan page. The main purpose is to simulate system behavior (developing trend) through system structure of fan pages. As shown in Figure 6, potential numbers of people that click "likes" will become cumulative numbers of people who click "likes" by clicking "likes". Relative information of fan page will spread in social network after fans click "likes" to form words of mouth effect. Words of mouth will attract more people to click "likes" (positive feedback), but may reduce potential number of people that click "likes".(negative feedback) Some people that have clicked "likes" may cancel "likes" and following and come potential people that click "likes" again. Due to fast speed of internet spreading, number of people that click "likes" will tend to stall after growing to a certain level and appear to stop growing state. Thus, cumulative number of people that click "likes" in fan page would form S curve developing trend. (as shown in blue line of Figure 7).

In innovation diffusion theory, development of innovative information users all have its growth limit, the diminishing marginal utility of economics. Senge (1990) pointed out that growth of objects is pushed by certain factors to get big gradually, but when it develops to a certain level, there will be other factors that suppress objects' growth to gradually slowing down. This is so-called "limits to growth" in system dynamics. (Meadows et al, 1972; Senge, 1990)

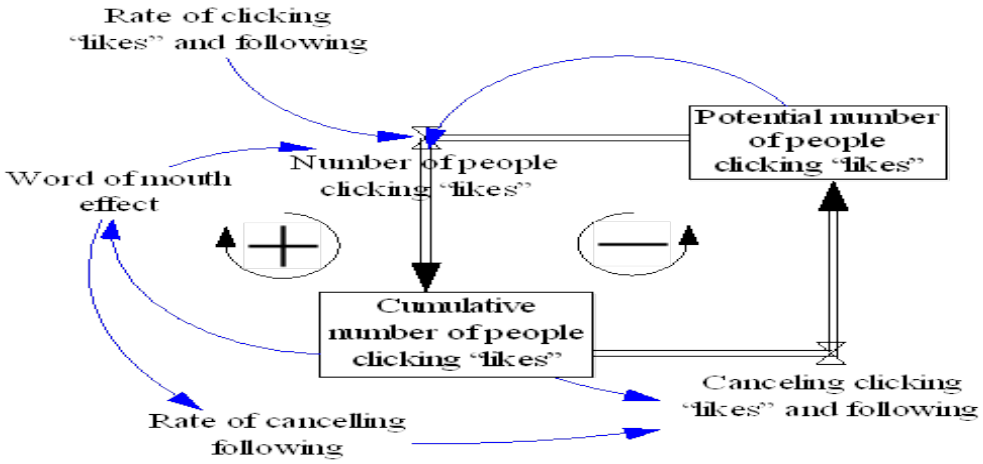

Figure 6. Fan page developing model system dynamics flowchart

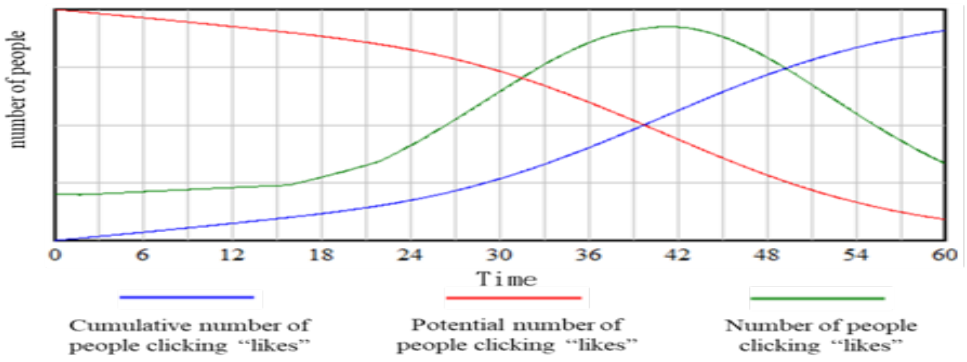

Figure 7. Fan page "like" people developing trend simulation

In Web2.0 the increase of users can increase more content, thus bringing in more members. Website operating models all emphasize on membership growth as the major strategy and objective of operation, (Otto and Simon, 2008) but there will be limit on growth from system's view point. In the model of Figure 6, "'likes' following rate" is an operative exogenous variable, meaning that dedicating in running fan page to attract potential "likes" clicking people to click "likes" and follow would become ratio of people who actually click "likes". The study simulates different level of "likes" clicking following rate to see the effect on developing trend of cumulative numbers of people who click "likes" on fan page. As shown in Figure 8, blue line is the contrast standard line while the remaining dotted line represents effect of increasing different level of clicking "likes" following rate. The simulation result showed that dedicating in running fan page to attract fans to join in clicking "likes" or share, under the characteristic of internet communication and rapid spreading, apparent effect of marketing activity can be seen. But for long term development trend, there is still upper limit on growth due to guide of system structure.

To change system's behavior one must change the structure. (Meadows et al., 1972; Senge, 1990; Sterman, 2000) Because the cumulative numbers of people who click "likes" in fans page come from potential people that click "likes". With the development of fan page, the number of potential people that click "likes" would gradually decrease, thus growth is naturally limited. In order to improve the growth limit caused by system structure, the study added level of potential friends circle in the model of Figure 6. Through contact of friends circle, more people would have contacted fan page and further becomes potential people that click "likes", (as shown in Figure 9) among which contact ratio of friends circle is operable exogenous variable, presenting ratio of potential fans' other Facebook friends that would have contacted fan pages. The study simulates the effect of different level of friends circle's contact ratio on development trend of cumulative people that click "likes". As

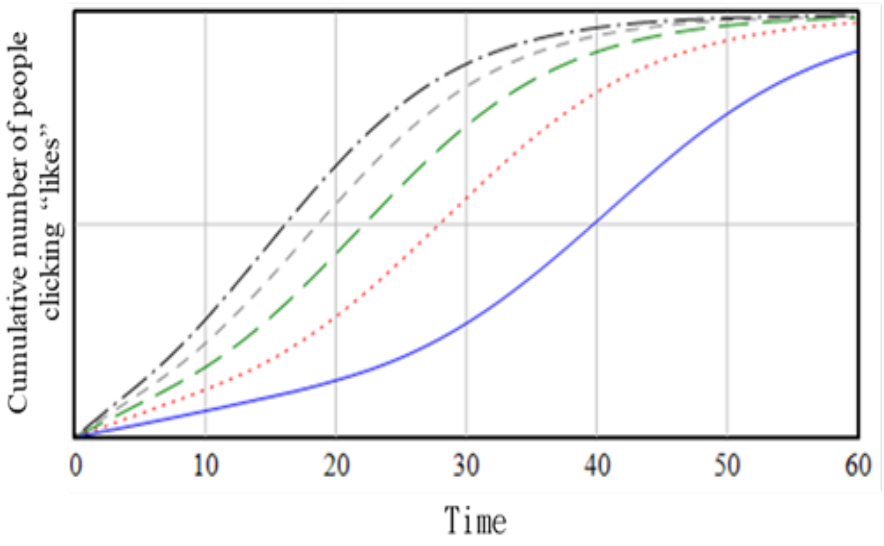

Figure 8. Simulation on trend of effect of "'like' clicking following rate" on cumulative number of people that click "like" on fan page

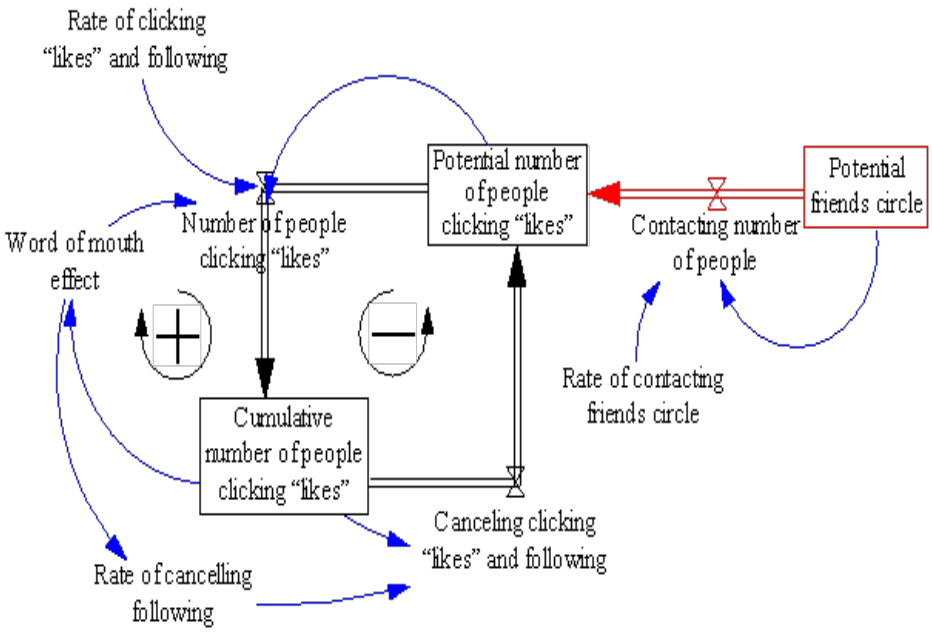

Figure 9. Fan page development model-increase potential friends circle

shown in Figure 10, blue line is the contrast standard line, while the remaining dotted lines represent effect of different level of friends circle's contact ratio.. The result of simulation showed that when friends circle's contact ratio is higher, the cumulative number of people that click "likes" on fan page would have higher growing space.

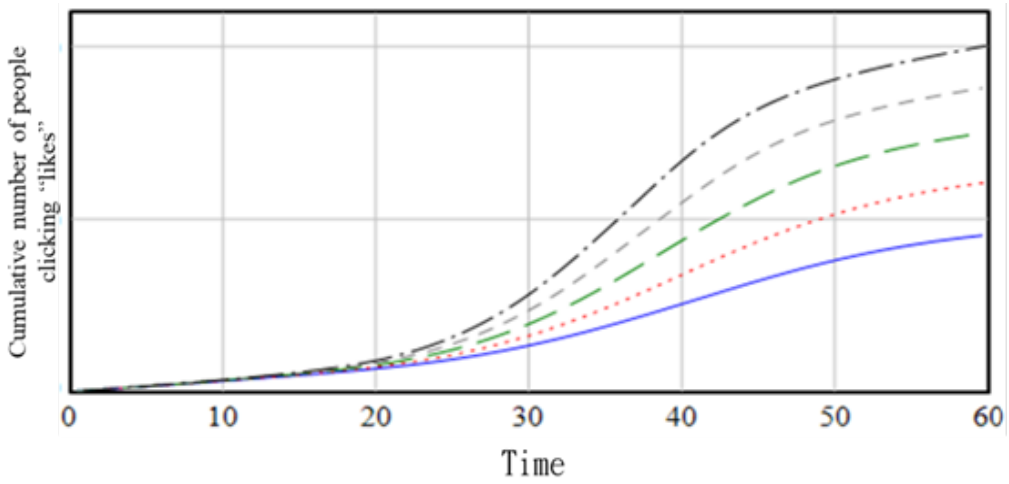

Figure 10. Trend simulation of effect of "friends circle contact ratio" on cumulative numbers of people that click "like" on fan page

Conclusion and Suggestions

Facebook fan page can generate interaction and connection with fans and provide communication between business and consumers, forming an innovative marketing platform and business opportunity. The development of fan page is a dynamically changing process. Business dedicates in running fan page to attract fans joining to click "likes" or share. Under characteristics of internet communication and rapid spreading, obvious effect can be seen on marketing activities. However, based on innovation diffusion theory, long-term development trend has its growth limit and business needs to think how to improve system structure to breakthrough growth limit. The study based on innovation diffusion theory to apply system dynamics in constructing theoretical model of fan page development and simulating developing trend of fan pages.

Because Facebook fans are highly homogeneous and design of Facebook algorithm can easily cause "echo chamber effect", resulting in circulation of posts of fan page, fans' "likes" clicks and share in the echo chamber. It must expand contact of friends circle to improve system structure to allow more people contact fan page and further become potential followers and expand

foundation of subsequent growth so cumulative numbers of fan page followers can have more growing space. The model simulation constructed by this study also show the same result.

The study applies system dynamics methodology to construct theoretical model of fan page development. In the future the study can be conducted on different fan pages as case study and further investigate or feedback operating data of fan page, and expand and adjust model to run strategic simulation analysis, achieving more decision and practical values.

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