

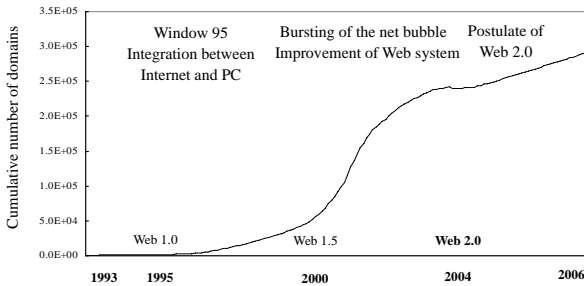
Title	Transition Dynamism in Web 2.0 : Emerging Dynamism of New Functionality(English Session)
Author(s)	SHIN, Jae-Ho; WATANABE, Chihiro
Citation	年次学術大会講演要旨集, 22: 181-184
Issue Date	2007-10-27
Type	Conference Paper
Text version	publisher
URL	<a href="http://hdl.handle.net/10119/7239">http://hdl.handle.net/10119/7239</a>
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Description	一般講演要旨

## Transition Dynamism in Web 2.0: Emerging Dynamism of New Functionality

○Jae-Ho SHIN, Chihiro WATANABE (東京工業大学)

### 1. Introduction

The transition of the Internet-based communication structure has provided significant impacts on the business behavior in the world. While the bursting of the net bubble early in the 2000s revealed the fragileness of an information society, successive emergency of Web 2.0 that emerged from a conference brainstorming between O'Reilly and MediaLive International (O'Reilly, 2005) has explored the new wave toward a ubiquitous society. Figure 1 demonstrates the trend in the Japanese corporates' Internet-based communication over the period May 1993-June 2006 by means of cumulative number of co.jp domains.



**Figure 1. Trend in Cumulative Number of co.jp Domains**  
(May 1993 – June 2006).

Source: Japan Registry Services Co., Ltd (2006).

Looking at this Figure we note that while this trajectory first traced a sigmoid curve with its inflection point around 2000, it moved slightly to upward from 2003-2004. This suggests a transition from Web 1.0 to Web 1.5 corresponding to the bursting of the net bubble and emergence of the Web 2.0 in 2003-2004 (Wikipedia). The characteristics of Web 2.0 (“user participation” and

“open orientation”) inevitably lead to shift in the leading role between innovators and imitators in the process of the development and dissemination and subsequent change in functionality. In light of the significant impacts such a shift may provide on the business behavior, this paper attempts to demonstrate the foregoing hypothetical views. An empirical analysis focusing on the diffusion trajectory of Japan’s Internet dependency taking number of co.jp domains over the last 14 years is conducted. By means of the empirical analysis utilizing the Bi-Bass model, this paper attempts to demonstrate that the emergence of Web 2.0 has induced a shift from innovator initiative to imitator initiative and enhanced functionality development and also identify substantial transition timing from Web 1.0 to Web 2.0.

### 2. Analytical Framework

#### 2.1 Diffusion Model

Since the prime objective of this paper is to analyze the transition from Web 1.0 to Web 2.0, and also the shifting trend from innovator initiative to that of imitator as illustrated in Figure 2, proposed diffusion model should satisfy both functions of equations (1) [Bass model] and (2) [Bi-logistic growth model] leading to the Bi-Bass model as depicted by equation (3).

$$Y(t) = \frac{N(1 - e^{-(p+q)t})}{1 + \frac{q}{p} e^{-(p+q)t}} \tag{1}$$

$$Y(t) = \frac{N_1}{1+a_1e^{-bt}} + \frac{N_2}{1+a_2e^{-bt}} \quad (2)$$

	Single model	Bi-model
Logistic	Simple logistic growth model	Bi-logistic growth model
Bass	Bass model	<i>Bi-Bass model</i> Shift from $p$ (innovator) to $q$ (imitator) Co-existence of Web 1.0 + Web 2.0 and their transition

Figure 2. Concept of the Bi-Bass Model.

$$Y(t) = \frac{N_1(1 - e^{-(p_1+q_1)t})}{1 + \frac{q_1}{p_1}e^{-(p_1+q_1)t}} + \frac{N_2(1 - e^{-(p_2+q_2)t})}{1 + \frac{q_2}{p_2}e^{-(p_2+q_2)t}} \quad (3)$$

## 2.2 Functionality Development

Provided that the state of innovations and their diffusion are traced by the trajectory of functionality development, this functionality leads to create successive innovations through the efforts for maintaining its level. While emergence of innovation creates new functionality, it obsolesces immediately. Given the lengthy years of efforts for emerging an innovation, lifetime of newly created functionality is an ephemeral existence. While newly emerged Web 2.0 could promote firm's technology development and its performance, it broadly popularized long-tail phenomena that accelerate obsolescence of technology. Therefore, information technology's (IT) new functionality development corresponds to the effort to prolong this ephemeral existence as demonstrated in Figure 3.

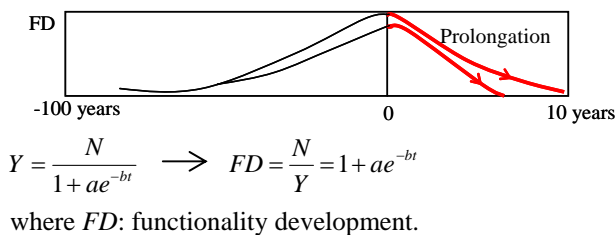


Figure 3. Emergence of Innovation and New Functionality.

In case when the diffusion trajectory is traced by the Bass model in equation (1), its  $FD$  can be depicted by equations (4).

$$FD = \frac{N}{Y} = \frac{N}{\frac{N(1 - e^{-(p+q)t})}{1 + \frac{q}{p}e^{-(p+q)t}}} = \frac{1 + \frac{q}{p}e^{-(p+q)t}}{1 - e^{-(p+q)t}} \quad (4)$$

## 2.3 Diffusion Dynamism of the Bi-Bass Model

### (1) Inflection of Diffusion Trajectory

While the transition timing from Web 1.0 to Web 2.0 can be identified by the inflection point of the Bi-Bass model, this can be identified by means of the 1<sup>st</sup> and the 2<sup>nd</sup> differentiation of the Bi-Bass model as follows [equation (5) and (6), respectively]:

$$\frac{dY(t)}{dt} = \frac{N_1(p_1 + q_1)e^{-(p_1+q_1)t}(1 + \frac{q_1}{p_1})}{(1 + \frac{q_1}{p_1}e^{-(p_1+q_1)t})^2} + \frac{N_2(p_2 + q_2)e^{-(p_2+q_2)t}(1 + \frac{q_2}{p_2})}{(1 + \frac{q_2}{p_2}e^{-(p_2+q_2)t})^2}$$

$$\frac{d^2Y(t)}{dt^2} = \frac{N_1(1 + \frac{q_1}{p_1})(p_1 + q_1)^2 e^{-(p_1+q_1)t} [1 - \frac{q_1}{p_1}e^{-(p_1+q_1)t}]}{(1 + \frac{q_1}{p_1}e^{-(p_1+q_1)t})^3} - \frac{N_2(1 + \frac{q_2}{p_2})(p_2 + q_2)^2 e^{-(p_2+q_2)t} [1 - \frac{q_2}{p_2}e^{-(p_2+q_2)t}]}{(1 + \frac{q_2}{p_2}e^{-(p_2+q_2)t})^3}$$

Figure 4 illustrates trajectories of equations (1), and the equations (5) and (6) which demonstrate the properties of the diffusion trajectory examined.

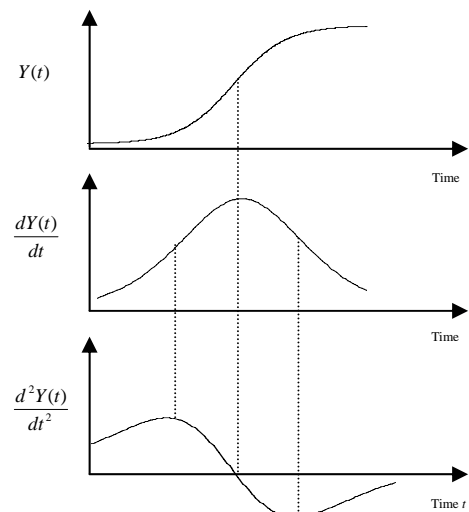


Figure 4. Properties of the Diffusion Trajectory.

Source: Mahajan et al. (1990).

The trend in  $\frac{d^2Y(t)}{dt^2}$  demonstrates a tendency to

inflect with time, the maximum/minimum diffusion level, and also increasing/decreasing trend in diffusion trajectory.

## (2) Substitution of the Bi-Bass Model

In addition to the above analysis, dynamism inducing a transition from Web 1.0 to Web 2.0 can be analyzed based on a concept of substitution. On the basis of existing works, the mechanism of substitution can be analyzed by utilizing equation (6). This analysis leads not only to transition dynamism from Web 1.0 to Web 2.0 but also to emerging dynamism of post-Web 2.0.

## 3. Empirical Analysis

### 3.1 Diffusion Trajectory

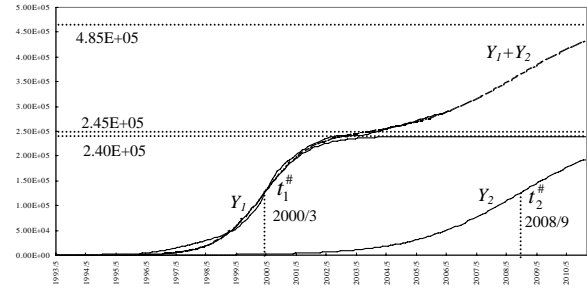
Aiming at identifying the diffusion trajectory of the Japanese corporates' Internet dependency incorporating a transition from Web 1.0 to Web 2.0, a comparative empirical analysis of the monthly diffusion trend in number of co.jp domains over the period May 1993–June 2006 is conducted.

#### (1) Bi-Logistic Growth Model

**Table 1** Estimation of the co.jp Domains by the Bi-Logistic Growth Model (May 1993 – June 2006)

Parameter	Estimate	t-value	adj.R <sup>2</sup>	AIC
$N_1$	$2.40 \times 10^5$	129.49	0.999	17.08
$N_2$	$2.45 \times 10^5$	32.83		
$a_1$	$8.36 \times 10^3$	6.10		
$b_1$	$0.11 \times 10^{-2}$	54.49		
$a_2$	$7.14 \times 10^3$	2.87		
$b_2$	$4.79 \times 10^{-2}$	23.05		

Sub trajectory	Inflection point
$Y_1$	$t_1^{\#} = \frac{\ln a_1}{b_1}$ 82.8 (Mar. 2000)
$Y_2$	$t_2^{\#} = \frac{\ln a_2}{b_2}$ 185.0 (Sep. 2008)



**Figure 5.** Estimation of the co.jp Domains by the Bi-Logistic Growth Model (May 1993- Dec. 2010)<sup>a</sup>

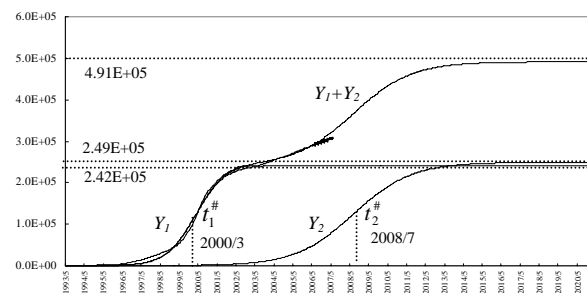
<sup>a</sup> May 1993 - Jun. 2006: actual, and Jul. 2006 - Dec. 2010: extended estimates.

#### (2) Bi-Bass Model

**Table 2** Estimation of the co.jp Domains by the Bi-Bass Model (May 1993- June 2006)

Parameter	Estimate	t-value	adj.R <sup>2</sup>	AIC
$N_1$	$2.42 \times 10^5$	145.87	0.999	17.08
$N_2$	$2.49 \times 10^5$	75.66		
$p_1$	$1.38 \times 10^{-5}$	8.35	$p_1/q_1 = 0.78 \times 10^4$	
$q_1$	$1.08 \times 10^{-1}$	58.33		
$p_2$	$0.25 \times 10^{-5}$	2.60	$p_2/q_2 = 2.20 \times 10^4$	
$q_2$	$0.55 \times 10^{-1}$	22.74		

Sub trajectory	Inflection point
$Y_1$	$t_1^{\#} = \frac{\ln q_1/p_1}{p_1 + q_1}$ 82.9 (Mar. 2000)
$Y_2$	$t_2^{\#} = \frac{\ln q_2/p_2}{p_2 + q_2}$ 182.9 (Jul. 2008)



**Figure 6.** Trend in the co.jp Domains by the Bi-Bass Model (May 1993- Dec. 2020)<sup>a</sup>.

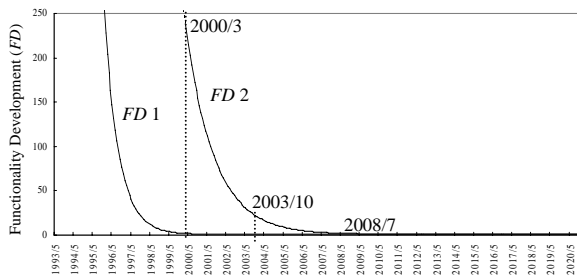
<sup>a</sup> May 1993 - Jun. 2006: actual, and Jul. 2006 - Dec. 2020: extended estimates by the model using May 1993 - Jun. 2006 data.

### 3.2 Result of the Empirical Analysis

Results of the comparative empirical analysis indicate that both bi-diffusion models (Bi-logistic growth model and Bi-Bass model) demonstrate statistically significant. These bi-diffusion models demonstrate that the trajectory of this Web can be decomposed into two trajectories,  $Y_1$  and  $Y_2$ .

### 3.3 Functionality Development

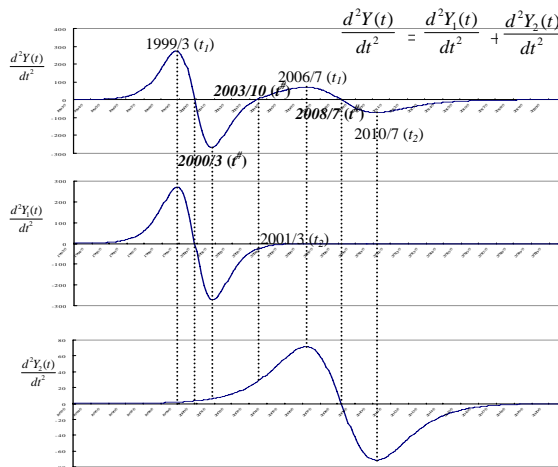
Web 2.0 demonstrates higher functionality development than that of Web 1.0 as demonstrated in Figure 7. It is identified that the emergence of Web 2.0 has induced shift from innovator to imitator and enhanced functionality development and this result support our hypothesis.



**Figure 7. Trend in Functionality Development in Two Trajectories (May 1993- Dec. 2020)<sup>a</sup>**

<sup>a</sup> May 1993 - Jun. 2006: actual, and Jul. 2006 - Dec. 2020: extended estimates.

### 3.4 Transition Timing from Web 1.0 to Web 2.0



**Figure 11. Trend in  $\frac{d^2Y(t)}{dt^2}$  (May 1993 – Dec. 2020).**

### 4. Conclusion

In light of the noteworthy observation that the emergence of Web 2.0 has been substantially changing the traditional Internet-based communication structure, this paper attempted to elucidate inside the black box of its transition dynamism.

First, substitution effect induced by the dynamism of “Switch (disadopt)” and “Acceptance of the innovation” is linked by transition dynamism leading to higher functionality development and shift from innovator to imitator in Web 2.0.

Second, functionality development can be considered the motivation of substitution and then induces the transition dynamism through elasticity of substitution. These phenomena also can be observed in the transition of the co-existence and co-diffusion of Web 1.0 and Web 2.0 shifting from innovator to imitator initiative.

Third, the analysis utilizing the Bi-Bass model demonstrated that the transition from the preceding trajectory (Web 1.0) to the succeeding trajectory (Web 2.0) identified by the inflection point of diffusion trajectory was Oct. 2003.

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