

A System Dynamics Analysis of Electronic Commerce

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Abstract

In this paper an attempt is made to understand contribution factors in the field of electronic commerce(EC). To do that, we adopt and modify an existing model. Then money sector is added to the model for capturing whole EC process. Also, perception and capacity expansion delay are reduced step by step to find out important factors of EC.

The following two major conclusions are drawn from our simulation. Most of all, the diminution of information delay introduce monotonous growth rather than fluctuation of EC market. The stable increase of revenue or market scale makes us decide the employment or capacity scale quickly. This is critically helpful for success of EC. Second, for favorable and continuous evolution of EC, utilization system of electronic money should be established steadily. The following findings strongly support our claim: We found full oscillation of EC market when electronic money system didn't established well. On the contrary, if electronic money system could provide fast cash flow and fully trustful function, decisions of company or consumer would be executed promptly.

1. Introduction

During the past few years, electronic commerce(EC) has been emerging and overwhelming the world rapidly. But, traditional system dynamics approaches to the commerce are mainly confined to transactions of physical goods only. In order to capture the characteristics of EC correctly, information flow related with production, distribution, consumption of commodity and money should be considered comprehensively.

In this paper, a famous system dynamics model(market growth model; Forrester 1968) related with traditional commerce is adopted and modified suitable for EC structure. Money sector is also added to reflect the effect of 'electronic money'. Then, the amount of perception delay and production capacity expansion delay is reduced step by step, because the utilization of information technology (IT) would make it possible to diminish the time delay by degrees. Finally, we consider the behavior of EC system when the electronic money malfunctions.

2. Effect of Information Delay Diminution in the Market Growth Model

Generally speaking, information delay will be almost vanished when the electronic communication network is completely settled down. EC is a principal application that has this characteristic. In order to insert and examine the new property, one of the

famous traditional models for commerce – Market Growth Model was adopted.

‘Market Growth Model’ was developed by Forrester to investigate the potential market growth behavior. Even though it didn’t consider like limit of demand or competition in the market, it gave some valuable insight about growing market.

There are five delay points in the market growth model; Delivery delay, salesmen adjustment time delay, production facility receiving delay, delivery delay recognition by company and delivery delay recognition by market. In this study, we assume that there are almost not the time delays related with information flow like table 1.

<Table 1> Diminished information delay parameters

Parameters of Delay	Reference Mode	Diminished Delay
Salesmen_adjustment_time	20	20
Time_for_delivery_delay_recognition_by_company	4	1
Time_for_delivery_delay_recognition_by_market	6	1
Production_capacity_receiving_delay	12	12

In this experimentation, all parameters and structure are same except above two parameters. Simulation period was set to 200 time units to get a long run behavior. We can see the simulation result from two kinds of aspects; stability and size of growth.

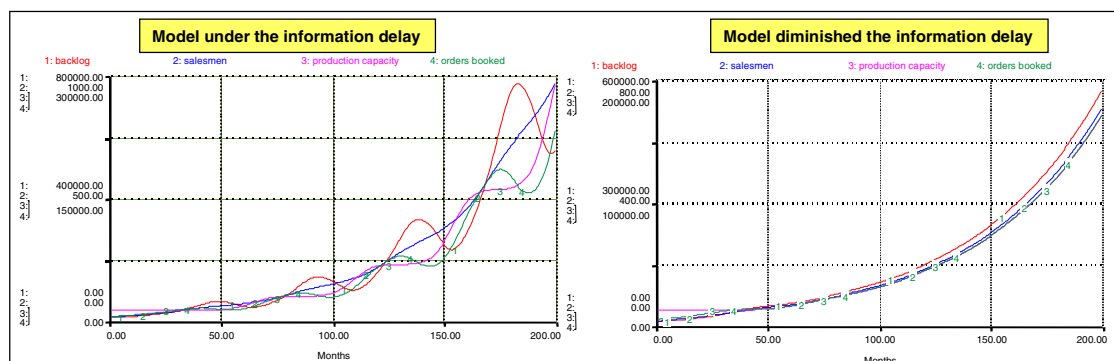


Figure 1. Effect of Diminution of Information Delay

Original model grows greater than delay diminished model in the same period. Yet, fluctuation of growth is almost disappeared in the diminished delay model. The first one is a counter-intuitive result; Most of people think that market will enlarge by utilizing information and communication facilities in the future. Fast information flow can give customers and CEOs chance to make decision promptly. On the contrary, extending production capacity and adjusting new salesmen require some time. So, Fast information flow wouldn’t leave enough time to enlarge the production capacity. Also, the stability of growth will be made by same reasons.

3. Integrated Model including Money Sector

‘Market Growth Model’ just considered the dynamic relationship among ‘customers’ order’, ‘salesmen’, ‘delivery’ and ‘production capacity’. By the way, in the EC system, electronic money is one of the most important actors. In fact, any commerce system should have three major elements to do its proper role; goods

(including services), information and money.

In this study, the money sector is added to the original 'Market Growth Model' to inspect a whole commerce system. In addition to it, a few different parameter sets are made and simulated to get some clue about EC system. The causal map of modified model is shown figure 2 and the parameter sets are like Table 2.

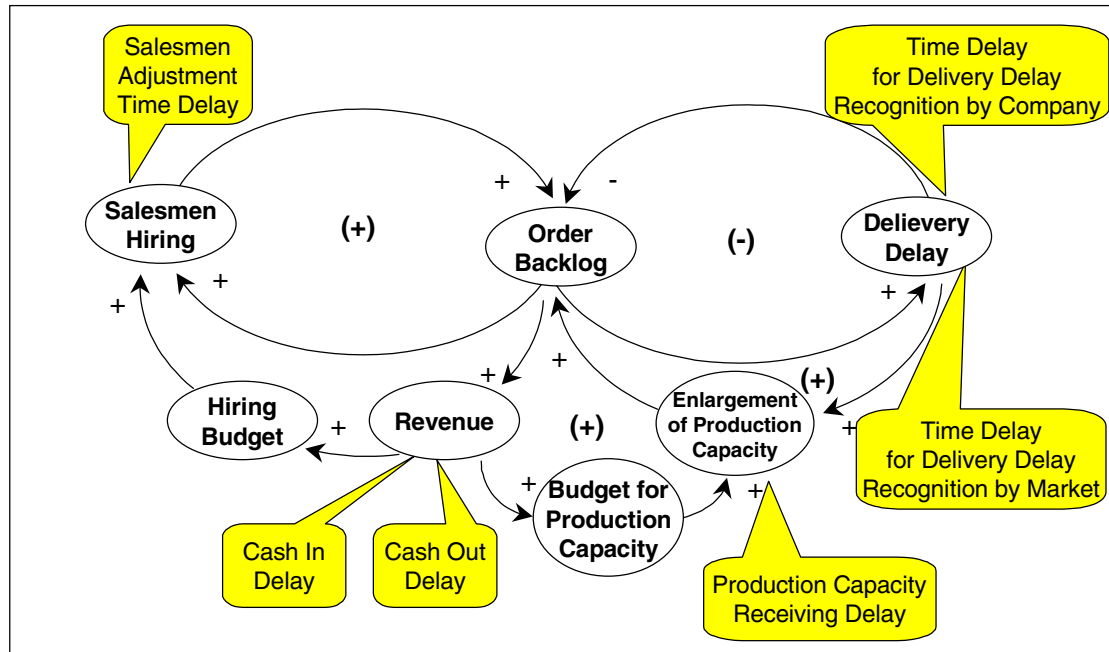


Figure 2. Causal Map of Modified Model

Among parameter sets in the table 2, parameters of 'Reference Mode' are assumed to represent time delays for each delay point in the traditional commerce system. Then, parameters of another columns are set for EC system. The values of parameters for EC are decreased because using electronic facilities will reduce some delays. Especially, Delays related with information flow could be diminished quickly. In the Table 2, information (recognition) and electronic money transfer delays are minimized to just 1 unit time in the EC models.

Additional assumptions are also made for delays connected with material flows like 'Salesmen adjustment' and 'Production capacity expansion'. That is, the adjustment or material flow delays could be reduced by using well-developed information system. We reduced the values of delay related to material flow by stages and simulated the model.

Finally, supposition of malfunctioned electronic money was added in the last column in order to get the result of this situation. Parameters are all the same as EC3 except money flow delays.

The results of experimentation are shown in figure 3 and 4. In the traditional commerce model, heavy fluctuation of revenue is appeared. The favorable procession of commerce is difficult under this situation. On the contrary, all of the EC results showed smooth growth. Diminution of information makes it possible to decide promptly. At the same time, quick action could be made by decrease of money flow delay.

Table 2. Parameter Sets for Simulation

Delay Point in the Model	Traditional Commerce (Reference Mode)	EC 1	EC 2	EC 3	EC 3 + Malfunctioned Electronic Money
Salesmen Adjustment Time Delay	20	20	9	6	6
Time for Delivery Delay Recognition by Company	4	1	1	1	1
Time for Delivery Delay Recognition by Market	6	1	1	1	1
Production Capacity Expansion Delay	12	12	12	6	6
Cash Inflow Delay	6	1	1	1	6
Cash Outflow Delay	2	1	1	1	2

Growth speeds of above three EC models gradually increased according to reducing level of material flow delays. So, we can say that EC has potential to grow stable, yet the growth speed depends on amount of material flow delay.

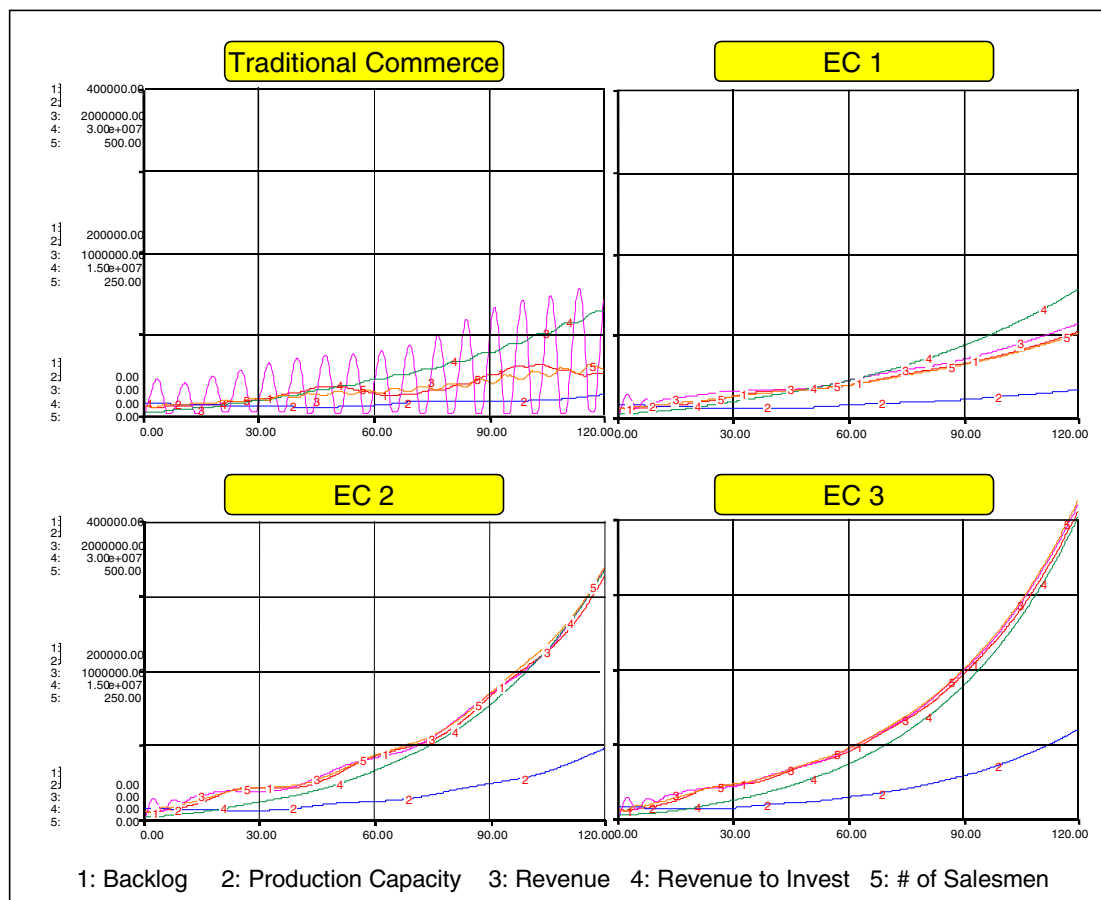


Figure 3. Simulation Results using different Parameter Sets.

Above all, one of the most important factors of success for the EC is electronic money. Even though all delays reduced enough, unless electronic money system is

established well, the revenue of EC shows severe oscillation and all of the indices reveal great reduction like figure 4.

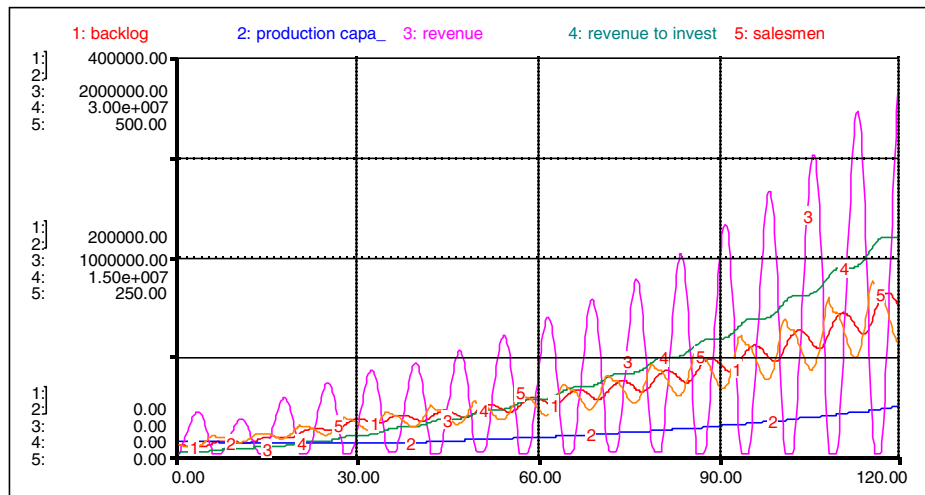


Figure 4. Fluctuation for Malfunction of Electronic Money

4. Future research

EC is emerging and promising as well as comprehensive. So it is very complex and dynamic. In this study, a well-developed traditional commerce model (market growth model) are adopted and modified for capturing characteristics of EC system. Therefore, the original market growth model may have some unsuitable structure for EC. In addition to it, the market growth model mainly focused potential of growth. It didn't consider other important factors including competition, resource and demand constraint etc. So the model structure should be refined by reflecting other important factors. The more precise measurement of delay values is also necessary.

[Reference]

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