A Strategic Analysis of B2B e-Commerce : The Economic Impact of e-Marketplace Adoption

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Abstract - Recently, many organizations in various industries have introduced e-businesses for the purpose of adding value to their businesses. However, due to no comparable business models to e-business in the past, there are no reliable yardsticks to predict the performance of an e-business. This paper considers an environmental change analysis as a means to resolve this difficulty. System Dynamics (SD) could be a useful tool to generate effective results by examining the e-business model. SD model is developed to analyze the effects of an e-sales channel which was appended to the existing sales channels in the steel manufacturing industry. The results show an increase in average price and sales volume through the use of an auction process on the e-marketplace. Stocking expenses are reduced as well by the increase of the sales turnover. A possible scenario was adopted to the developed simulation model and investigated strategic issues to draw desirable strategies with market changes.
Keywords: Electronic Commerce, e-Marketplace, Performance evaluation, System Dynamics, Scenario analysis

1 Introduction

In the past, organizations presumed that they could achieve virtual effects or rewards if they simply stepped into the e-market business regardless of the ROI measurement. Since the dot-com crash, businesses have realized that maintaining e-commerce was not an easy task. It takes time to attract buyers and sellers to achieve enough trading volume to cover operating expenses. Nonetheless, e-markets have been quietly evolving and slowly finding their financial niche, and they are looking for ways to estimate the ROI. This research proposes that system dynamics could be a useful tool for the business analysis of an e-market.

This paper analyzes a steel materials manufacturer which is running a test operation of an on-line sales channel for some limited products in addition to the conventional off-line sales channels. A simulation model by system dynamics was developed to demonstrate the financial effects of the e-market and discuss the influences on each scenario. This research may reconfirm the usefulness of system dynamics modeling and provide an insight for predicting the performance of an e-business.

2 Theoretical Background

Research on the effect of electronic commerce focuses on the element of product and price by defining manufacturing costs, earning rates, and cost justification based on the theory of transaction costs. Most enterprises use a normal return estimation model such as the market adjusted return method or the market model method to estimate the excess profit that will be produced when they open the electronic commerce on the basis of financial estimations. These methods have limitations in electronic commerce because of complex assumptions and radical changes, which become an output assessment as a result of existing IT adoption.

However, most companies tend to drive their businesses without clearly analyzing the effects of electronic commerce because they lack the appropriate model. Thus, the results will fall short of their expectations. This is not because the companies use the incorrect process in adopting electronic commerce but rather due to the fact that there is no analysis about the internal and external changes that will result from adopting a new type of model. The simulation model of system dynamics, which uses system thinking as an analytic tool for complex systems, provides an insight and useful results for companies in their decision making. The system dynamics (SD) methodology attempts to enhance the realism in modeling. It reconstructs the complex and intricate reality to causal-loop diagrams. It allows for the development of a dynamic hypothesis explaining the cause of a problem and can be applied to various situations.

A computer simulation of the SD model shows the effects of relationships between mutual factors within the defined systems. It promotes the understanding of the

factors' actions under alternative policies and scenarios. As a result of this process, the SD model is used to improve decision-making. This technique has been applied to pilots' flight training, e-games, and resource management. Furthermore, it has been recently utilized for the SEM module in the ERP package and strategic planning.

System dynamics dates back to the late 1950s, and interest in the methodology grew rapidly during the 1960s and early 1970s. The field originated from the work of Jay W. Forrester's industrial dynamics. The initial focus was on the application of SD to management issues. However, the field soon extended to include the analysis of environmental, social, and macro-economic problems. In the microscopic dimension, it has been widely applied to improving the capacity of decision-making. System dynamics is different from existing analysis tools based on past information. It allows for the analysis of new enterprises such as e-commerce.

3 Research Model

3.1 Research objectives and scope

This paper analyzes a manufacturer of steel materials that started with e-commerce by opening an online market site. The system dynamic methodology was applied to demonstrate the financial effects of the e-market and discuss the influences on each scenario.

The scope of this research is limited to the investigation of secondary sales products on the e-sales channel following the introduction of e-commerce. The current sales process of the steel industry is divided into primary sales and secondary sales. The scope of this research is limited to the investigation of secondary sales products on the e-sales channel following the introduction of e-commerce. Secondary sales are the sales of remaining products or order-cancelled products, etc. Generally, secondary sales products have been sold through auctions or package sales such as cooperative buying. In this case, the company plans to sell secondary sales products through an online market and expand primary products sales by next stage

The first step of this research is the causal-loop diagram (CLD) modeling of the causal relationships of existing sales channel through expert-workshops in the field, while attempting to verify the realism of the simulation model, stock-flow diagram (SFD) regulated by in-and out-flows through past data. The next step is the modeling of a causal-loop diagram and the simulation model regarding changes in the sales channel after opening e-market sites for secondary sales, to find the financial effects and influences by the analyzing the quantitative differences among outputs.

3.2 The off-line sales channel model

The purpose of an off-line sales channel model is to provide basic sales and production data for an e-sales channel model and to forecast sales for 5 years after 2000 with off-line sales channels. The off-line sales channel model takes into account the forecasting revenue (price/amount sold) and the stock volume of the current production and sales channel for 10 years, from 1995 to 2005. The scope after 1995 is set up for further verification of credibility in the analysis of the off-line sales channel model. Domestic demands and number of customers affect order amounts, while production capacity exerts a positive or negative influence on the amount of production. The amount of production is decided by production capacity and operating ratio. The amount of primary products and secondary products is affected by the required period of time in production or the producing rate. The inventory size and sales volumes are decided according to the production rate and the sales rate.

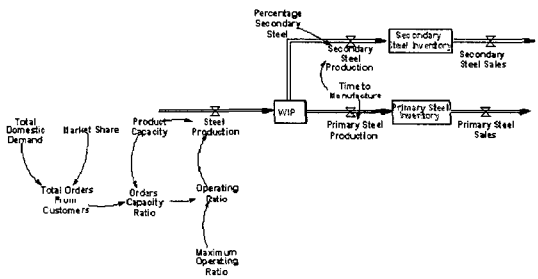

Figure 1. The offline sales channel Model

This model (Figure 1) is implemented to simulate a possible scenario. It is assumed that production and stock rates are stock variables, while the production capacity, production rates, and sales rates etc., are flow variables. Time series data of the production capacity was used. Related variables are defined as a flow variable, stock variable, or auxiliary and formed the system dynamic equations. The fundamental equation is arranged as:

$$Steel\_Production = Product\_Capacity \times Operating\_Ratio$$

$$Operating\_Ratio = Min(Orders\_Capacity\_Ratio, Maxium\_Operating\_Ratio)$$

$$WIP = INTEG(Steel\_Production - Primary\_Steel\_Production - Secondary\_Steel\_Production)$$

$$Secondary\_Steel\_Production = \frac{WIP \times Percentage\_Secondary\_Steel}{Time\_to\_Manufacture}$$

$$Primary\_Steel\_Production = \frac{WIP}{Time\_to\_Manufacture}$$

A part of the variables is applied on constant input variables. For example, the production rate (4%) of the secondary products is a standard production period and the first grade rate of secondary products (50%) is the

average for every 5 years. Direct sale customer (300 companies) is the sum of large-scale demand. These constant input data are calculated by an unchanging fixed value.

3.4 e-sales channel model

In this situation, the company has decided to introduce e-commerce by selling secondary products via online auctions. The purpose of an e-sales channel model is to observe the impact of introducing e-commerce by comparing simulations of a newly developed model with the existing sales channel model. In constructing a system dynamics model, it is important that all factors are integrated in the 'feedback-loop' structure of the system. The feedback loop is a closed channel and links the surroundings to any activity. The result will then return to 'data', which will influence the next activity. It is possible to express the complex causal relationship among factors, but not the existing single analysis. If the feedback loop on the e-sales channel is understood, a behavior pattern of the model can be predicted.

The positive (+) feedback loop on the model conveys that the auction price of the secondary products, the minimum auction price, is presented lower than the customers' expecting price. Thus, customers on the e-market are satisfied with buying the products. If the customer's satisfaction is transmitted to other customers, the number of customers will increase. However, the supply of secondary products is limited. Therefore, the supply/demand rates will be greater, creating more competitive bidding, which would gradually increase the price. If the price increases, then customer attraction to the e-marketplace will decrease. Then, the competitive rates will decrease, lowering prices and creating a repeating cycle. Additionally, new functions and possible problems during the operation of an e-market can affect the attractiveness of an e-marketplace.

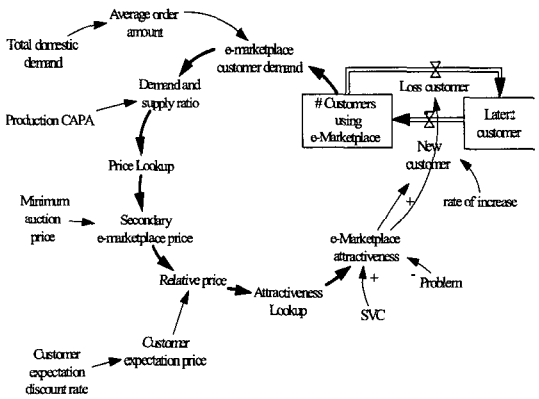

Figure 2. e-sales channel Model

Figure 2 is the conversion-simulated model based on the e-sales channel model. Inventory volume and customer numbers of secondary products are stock variables and production, sales volume, numbers leaving e-market, increasing number on e-market etc., are flow variables. The following are the main equations in this model.

$$e\text{-}Marketplace\_Customer\_Demand = Average\_Order\_Amount \times \#\_Customer\_e\text{-}Marketplace$$

$$\#\_Customer\_e\text{-}Marketplace = INTEG(New\_Customer - Loss\_Customer)$$

$$e\text{-}Marketplace\_Attractiveness = Attractiveness\_Lookup + additional\_Service - Problem$$

$$Secondary\_e\text{-}Marketplace\_Price = Minimum\_Auction\_Price \times Price\_Lookup$$

$$Demand\ \&\ Supply\_ratio = \frac{e\text{-}Marketplace\_Customer\_Demand}{Secondary\_Production\_CAPA}$$

$$Relative\_Price = \frac{Secondary\_e\text{-}Marketplace\_Price}{Customer\_Expectation\_Price}$$

The Lookup function is non-linear among variables and is called a graph or table function. The Lookup function was created and applied to the price and attractiveness of this model. This function was applied to the Lookup function framework after going through expert opinion, which uses each of the relevant references and nonlinear relations to obtain the numerical value.

Constant input variables were applied and calculated by the discount rate (35%) of secondary products against primary products, based on the average of the past 5 years. The first customer numbers of the secondary products (300 companies) are the same as the current customer numbers. In addition, the production rate (4%) of the secondary products was based on the average of the production rates for the past 5 years.

4 Analysis and results

The results of the existing sales channel model and the e-sales channel model are below (Table 1) with main variables ranging from sales prices to inventory costs. According to the results, there are big differences regarding the change rates of each main variable between the existing channel and the e-sales channel.

Compared with the simulation results, there are big changes on sales, average selling prices, inventory costs. In conclusion, the models represent an increase in total sales, selling prices, etc., along with cost reduction among the effects of changes in transactions mode following the introduction of e-commerce.

4.1 R 1: Sales increase

After opening an e-marketplace, sales of the secondary products has increased by 68.1 billion KRW per year (cumulatively 408 billion KRW). This is the result of a price increases through an auction based e-market.

Table 1. The Simulation results

		2000	2001	2002	2003	2004	2005	Average
Secodary Revenue (billion won)	e-marketplace	303	367	362	360	361	361	352
	Existing Channel	284	284	284	284	284	284	284
	Change Rate	7%	29%	28%	27%	27%	27%	24%
Secodary Price (thousand won/K ton)	e-marketplace	334	358	350	351	351	351	349
	Existing Channel	276	276	276	276	276	276	276
	Change Rate	21%	29%	27%	27%	27%	27%	26%
Secodary Sales (thousand ton)	e-marketplace	1,045	1,028	1,028	1,028	1,028	1,028	1,031
	Existing Channel	1,028	1,028	1,028	1,028	1,028	1,028	1,028
	Change Rate	2%	0%	0%	0%	0%	0%	0%
Secodary Inventory Cost (million won)	e-marketplace	952	553	548	546	546	546	615
	Existing Channel	1,161	1,161	1,161	1,161	1,161	1,161	1,161
	Change Rate	-18%	-52%	-53%	-53%	-53%	-53%	-47%
Secodary Customer (#Company)	e-marketplace	1,320	1,564	1,488	1,494	1,493	1,493	1,475
	Existing Channel	300	300	300	300	300	300	300
	Change Rate	340%	421%	396%	398%	398%	398%	392%
Secodary Demand (thousand ton)	e-marketplace	5,776	16,619	16,169	15,953	#####	15,969	14,410
	Existing Channel	3,207	3,207	3,207	3,207	3,207	3,207	3,207
	Change Rate	80%	418%	404%	397%	398%	398%	349%
Secodary Production (thousand ton)	e-marketplace	1,028	1,028	1,028	1,028	1,028	1,025	1,028
	Existing Channel	1,028	1,028	1,028	1,028	1,028	1,025	1,028
	Change Rate	0%	0%	0%	0%	0%	0%	0%

4.2 R 2: Increase of average sales price

The new auction sales mode of an e-market allows the average selling price to be higher than the price on the existing sale channel due to an increase in consumer competition. Thus, after opening an e-marketplace, the price is expected to increase for a limited period of time in relation to an increase in customer numbers, followed by a mediation period, with average-sales price stabilizing at 350 thousand KRW.

4.3 R 3: Decrease of inventory costs

If sales had a faster turnover rate, inventory levels would decrease. With that, inventory costs will decrease to 500 million KRW per year. . Inventory costs are estimated by the sum of capital opportunity expenses due to inventory holdings and the costs of inventory maintenance. If the results of the above effective analysis are re-estimated by the synthetic effectiveness of financial effects, which is a sales-balance deducted by stock expenses, the e-market of secondary products would lead to higher profits; 68.2 billion KRW for the first 5 years or 409 billion KRW after 5 years.

Therefore, the generated financial effects are that the average sales per year will increase by 68.1 billion KRW (an average of 24%), while the average price rises by 73,000 KRW (an average 26%). This will decrease stock expenses by 47% (5.46 million KRW) per year. However, the results of the analysis are interpreted and focused on the influence of each variable by the introduction of e-commerce, not the numerical analysis.

5 Scenario Analysis

The creation of an action plan, by looking systematically at the relationships between the main environmental factors, is used as a method for quick responses if a similar scenario should arise. It is utilized as the methodology of strategic management planning and its utilization rates are more frequent due to an increase of market uncertainty.

Scenario analysis causes not only the financial effects of secondary products on the e-market, but also allows for the investigation of various scenarios through simulations. The process of scenario analysis in this research is used to understand variables of a scenario from a system dynamics model and to construct other possible scenarios. Each scenario has been examined by analyzing the graphical and numerical values of the simulation and other probable situations.

First, we chose scenario variables among the variables in the secondary e-sales channel model. Scenario variables are directly uncontrollable variables on the company side. Scenario variables show the threats and opportunities of the company. At that time, this possible scenario can be compounded into one or more ways. This research sets up scenario variables with domestic product demands, customer expecting discount rates, and problem occurrences. Also, the result variables in the scenario's progress are the secondary demands, secondary prices, secondary sales, e-market attractiveness, and the number of secondary customers. The purpose of this scenario analysis is to find possible problems. So, through the use of scenario variables, excluding the basic scenario, a possible problem scenario is established like in table 4. The scenario period was from September 2000 to July 2002 and each scenario was executed on July 2002.

Table 2. Scenario cases

Scenarios	Contents	Scenario variable		
		Demand	D/R	Problem
S0: Basic Model	Scenario is not produced	35,433	35%	Nothing
S1: Decrease in product demand	Domestic steel demand decreasing 10%	31,889	35%	Nothing
S2: Increase expected price discount	Expected discount for secondary steel increasing 10%	35,433	45%	Nothing
S3: Problem occurrence (Uncertainty in e-Marketplace)	What if there is a small problem with the e-Marketplace (such as server down, loss of important information, task errors etc.)	35,433	35%	Occurrence

5.1 S 1 : Decrease in product demand

If a 10% reduction in demand scenario is simulated, the demand and prices of secondary products will slightly decrease, which would lead to the lowering of prices of secondary products. However, the lower prices will heighten the attractiveness of e-markets, causing the number of customers to increase. This shows that the prices and demand of secondary products will recover, in relation to an increase in customer numbers. The demand decrease scenario above shows that a 5-year cumulative financial effect of a 10% demand decrease is equal to a reduction by 4.6 billion KRW, compared to a non-applied case. The simulation shows that the change rates (the sales amounts deducted by inventory costs) of financial effects are very low(-0.24%). Also, the demand of secondary products is higher than the supply, and thus, the slight

degree of the decreased demand has not greatly affected the price.

5.2 S 2: Increase expected price discount

If customers expecting discount rates increase by 10%,expecting auction prices will get lower and the prices of secondary products at auction will go down. As the prices drop, the attractiveness of e-markets is heightened by the customer expectations because they can buy the product at a lower cost. Therefore, the number of customers will increase and as a result, the demand of secondary products will rise. This scenario demonstrates that a 10% increase in discount rates allows for an average price decrease by approximately 2%. This is a cumulative 2% decrease in profits. Thus, it is reflected by the peculiarity of auction markets that customers decide the prices.

5.3 S 3: Problem occurrence

This new e-commerce system has possible problems such as server maintenance, loss of important information, task errors, and etc. If these problems occur on the e-sales channel, it gives rise to a decrease in customer number due to a decline in customer satisfaction. If demand decreases, the price will also decrease accordingly. However, after a period of time, the appeal of the products will increase due to the low prices. Customer numbers and demand will thereby increase again. The result of the possible problems scenarios show that if there are problems in the e-market, the average price will fall 1.14% and would decrease the profit margin by 1.28%. Thus, possible problems will cause customers to go to other markets, leading to a decrease in demand and prices.

6 Conclusion and further research

This research demonstrates the financial effects of introducing e-commerce. In terms of the secondary products e-marketplace, the price of secondary orders are higher with a faster turnover while inventory volume decreases. Also, customer satisfaction is expected to increase following a greater number of buying opportunities. The factors for success are:

(1) Customers satisfaction or an increase in customer numbers: These variables greatly affect the auction process.

(2) Decrease of customer expectation for a discount rate: In the case of secondary products, the customer expectation of discount rates against primary products is an important variable for customers in deciding the price they bid when participating in the auction process.

(3) Improvement of secondary products attractiveness: In order to promote repeat customers on a e-market, the customer's accessibility to the product is critical, for factors such as price, delivery time, quality and etc.

Therefore, on the secondary products e-market, it is important to carefully observe the number of buyers, auction markets, and connecting times. If there is big drop or decrease in these figures, the new solutions improved value will be needed to recover customer numbers. The reduction of customer's expectation for a discount rate is used to make customer's trust higher regarding secondary products quality and to expand benefits through the e-marketplace like reducing delivery time.

The methodology of this research is to incorporate a system dynamics model that provides various results due to various variables through simulations. System dynamics seems effective in understanding the trends and tendencies of markets, and not just a forecast methodology. Therefore, this research has more emphasis on the analysis of actual states, and less on the numerical values. By different strategies of introducing e-commerce in various industries, there are some limitations in generalizing this field. However, by developing probable scenarios, system dynamics could contribute to developing useful strategies for the rapidly varying business environments including e-commerce.

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