A Dynamic Resource Allocation on Service Supply Chain

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1. Introduction

Recently, as internet business is growing rapidly, it has been bringing a lot of changes in many aspects of commercial business activities, and especially internet shopping malls, dealing with individual consumers, have continued radical changes and development. Thus, internet-based companies are required to implement variously different and new approaches in the ways of conducting their businesses. Therefore, it is becoming one of the most significant strategic elements for internet-based companies to correctly understand the purchase patterns of individual consumers and properly provide business environments that can give the maximum satisfactions to those individual consumers in service supply chain.

However, despite this radical change in the environment of internet shopping, it is true that most studies on internet-based businesses so far tend to just focus on such studies as the overall size of internet business, investigation on current market status, and practical study on consumer buying patterns from the perspective of consumers, lacking studies in such fields as the strategic management method from the perspective of companies and business investment decisions. Not to mention the lack of such studies as how the shopping mall management strategies, currently being used by the majority of internet-based companies, influence attracting customers to make purchase and customer satisfaction, and how customers' reactions from these strategies are affecting the management outcomes of business entities. Having these as the background in this study, the structure and the strategy of internet-based companies are analyzed based on dynamic speculations which emphasize an internally circulating feedback structure, as getting away from the currently existing linear speculations. Also, a speculative framework for decision makers to learn and understand the behavioral mechanism of the buying decision process is provided by building a system dynamics simulation model which can support long term decision making in the overall speculation instead of the direction of partial and short term oriented approaches. In doing so, the study intends to derive the most efficient investment decision support model for internet-based companies to operate their internet shopping malls in an overall way by understanding the correlation and interdependency among political variables, being needed for the operation of internet-based companies.

For this purpose, after going through the systematic classification and the analysis of existing literature and documentary records related to the internet shopping mall, in this research, four elements - internet advertisement, price reduction, web contents and web server - are derived as the primary factors influencing the buying decision before purchase. And the quality of delivery service and the service of customer support are selected as the variables influencing customer satisfaction and repeat purchases after initial purchase. By doing so, a general business model of internet shopping malls is developed. Additionally, the system dynamics model, which can support decision making for dynamic resource distribution of the overall internet shopping mall, is developed by combining the circulating interactions of cause and effect of individual feedback loop on each influencing variables and the feedback loop of the profit structure of internet shopping mall. In order to evaluate the validity of this dynamic resource distribution model, an internet bookstore, which is one of the most common types of internet shopping malls, is selected as a sample case.

	Statistical Approach	System Dynamics Approach
1. way of Inference	Previous empirical data	Logical causal relationships among variables
2. Analysis Subject	Static behavior	Dynamic behavior
3. Analysis Focus	Correlational Relationships	Feedback Relationships
4. Analysis Purpose	Numerical Accuracy	Structural Accuracy
5. Prediction	Short-term Prediction	Long-term Prediction
6. The Experiment of Various Policies	Difficult	Easy

Table 1. A comparison of existing research method and system dynamics method on the internet shopping

This study analyzes the Internet utilization pattern of customers by comprehensively investigating the previous studies on the behavior pattern of customer in terms of Internet business among the service supply chain using system dynamics. In other words, this study analyzes the behavioral changes of resource allocation of internet shopping malls in service supply chain. Also, under the assumption of an ever-growing and ever-developing industry of internet shopping, this study examines the aspect of dynamic changes of the closed feedback circulation structure in which created profits are invested in other resources of companies, making an increase in resources, subsequently resulting in the increase of productivity, customer satisfaction, and profit re-generation. Based on the analysis, this study develops a research framework that supports strategic decision-making for Internet business resource allocation. Based on the above analysis, this study provides meaningful suggestions on a set of advisable investment portfolios that can bring the most optimized profits to companies. Such research framework would be helpful for providing a typology of Internet business model that can be specialized by each industry.

2. Literature review on key elements for purchasing in the internet shopping mall.

2.1 Decision making steps for the purchasing in the internet shopping mall.

Individual consumers, under the environment of Internet, go through various steps of decision making to finally reach the step of making an actual purchase. This process itself varies depending on the kind of product, the consumer's individual character, and the purchasing status of the product. Generally speaking, consumers go through the steps of problem cognition, information search, alternative evaluation, buying decision, and evaluation after purchase. An Internet-oriented purchase also goes through same steps as the decision making model for a general purchase. However in the internet-oriented purchase, compared to the offline market, due to the uniqueness of the internet, the processes for information search and alternative evaluation can be carried out rapidly, and the potential problems caused by the lack of information and the lack of judgment objectivity can be minimized through providing various supports needed for purchase decision making.

In Finskud(2003)'s study, consumer's buying steps were divided into 6 different steps such as non-cognitive step, cognitive step, knowledge acquiring step, consideration step, purchasing step, and loyalty step. By using these 6 steps, 6 processes related to purchase such as recognition process, knowledge acquiring process, process for feeling attractive to, evaluation process, and purchasing process were established.

Also in the study by Cleland(2000), channels related to customer purchase are categorized by non-cognitive customers, cognitive customers, browsers, users, and loyal customers. And for each category, the degrees of influences from 8 different elements (Connectivity, Communication, Content, Convenience, Community, Customer care, Customization, Consent) are analyzed.

Another research, which analyzes the behavioral pattern of Internet shopping, is the web conversion efficiency model by Berthon et al. (1996). In this study, the web was regarded as advertising media, thus the flow of an Internet surfer's action was modeled as a 6 stepped process (surfer → aware surfer → hits → active visitors → purchases → repurchases). Furthermore, the concept of 5 step measurement ('aware efficiency', 'locatability / attractability efficiency', 'contact efficiency', 'conversion efficiency', and 'retention efficiency') was suggested.

Also, Kalakota & Whinston(1996) explained decision making steps for product purchase through the internet by classifying three different steps of 'pre-purchase interaction, purchase consummation, and post-purchase interaction.

2.2 The purchasing elements for internet shopping

In this study, as variables which make potential consumers aware of a product or brand and attract people to visit an internet shopping mall, elements related to marketing promotion such as internet advertisement, internet promotion, sales promotion activity, and the word of mouth activity are defined. Also, strategic variables related to actual purchase from an Internet shopping mall are categorized into three variables of price discount promotion, the quality improvement of web system, and the intensification of web contents. And strategic elements related to customer satisfaction after purchase are categorized into the quality of delivery service and the quality of customer support. Strategic variables such as price promotion, web system quality, and quality of web contents have meaningful effects on the level of customer satisfaction. The level of customer satisfaction is the collective concept of

the website features of Internet shopping malls such as the web system and web contents. The quality of delivery service and customer support service, which are the evaluation elements for measuring customer satisfaction after purchase, are the variables related to service quality inducing re-purchase or market exit through satisfaction or dissatisfaction by customers. The previous studies on service quality elements related to Internet purchase are as follows.

Variables	Researcher
Internet Advertisement & Promotion	Berthon, P., Pitt, L.F., and Watson, R.T. (1996), Cleland. Robin S. (2000), Ducoffe, Robert H. (1996), Grover, R. (1992), Peterson, Robert A., Sridhar Balasubramanian and Bart J. Bronnenberg (1997),Smith, R. E. & Vogt, C. A. (1995).
Word of Mouse	Bone, P. F. (1995), Bristor, J. M. (1990), Chrysanthos Dellarocas (2003), Ellison, G. and Fudenberg, D. (1995), Gelb, B. and Johnson, M. (1995), Harrison-Walker, L. J. (2001), Richins, M. L. (1983), Richins, M. L. & Root-Shaffer, T. (1988), Singh. Jagdip (1990), Smith, R. E. & Vogt, C. A. (1995), Sundaram. D. S., Motra. K., & Webster. C. (1998).
Price Promotion	Bailey, J. P. (1998), Grewal, Dhruv and Howard Mannorstein (1994), Kalra, Ajay and Ronald C. Goodstein (1998), Krishnamurthi, Lakshman and S. P. Raj (1985), Roughgarden, J. (1998), Smith, Michael F. and Indrajit Sinha. (2000).
Quality of Web System	Bucklin, Randy and Catarina Sismeiro (2000), Donthu, Naveen (2001), Dorian S. and Schubert, P. (1998), Lin, J. C., and H. Lu (2001), Liu, C. and K. P. Arnett (2000), Sedehi, H, Boscolo, F and Vaccaro, N. (2000), Wan, H. A. (2000), Yoo, Boonghee & Naveen Donthu (200l).
Quality of Web Contents	Barnes, S. J., and Vidgen, R. (2001), Dholakia, Utpal M., and Lopo L. Rego (1998), Davis, F. (1989), Dorian S. and Schubert, P. (1998), Egger, Florian N. (2000), Ghose, Sanjoy and Wenyu Dou (1998), Huizingh, E. K. R. E. (2000), Moe, Wendy and Peter Fader (2001a), Urban, G., Fareena, S. and William Qualls (1999).
Quality of Delivery	Bienstock, Carol C., John T. Mentzer, and Monroe Murphy Bird (1997), Brynjolfsson, Erik and Michael D. Smith (2000), Erik R. Larsen, Ann van Ackere and Kim Warren (1997), J. T. Mentzer, J. F. Daniel, and J. L. Kent (1999), J. T. Mentzer, J. F. Daniel, and G. M. T. Hult (2001), Membrillo, Annabel, James Ritchie-Dunham, and Conrado García Madrid (1999), Oliva, R. and Sterman, J. D. (2001), Randall, L. and M. Senior (1992), Zeithaml, V.A., A. Parasumaran and L.L. Berry (1990).
Quality of Customer Support Service	Anton, J., Vivek, B. and Bill, H. (1999), Feinberg, R. A., I. Kim, B. Hokama, K. Ruyter, and C. Keen. (2001), Fung K. K. (2001), Garnett, O., A. Mandelbaum, and M. L. Reimann (2002), Grossman, T. A., D. A. Samuelson, S. L. Oh, and T. R. Rohleder (2001), Mandelbaum, A. and N. Shimkin (2000), Saltzman, R. and V. Mehrotra (2001).

Table 2. Literature review of major variables for online purchasing

3. Research model and methodology

3.1 Conceptual framework

As can be seen in figure 1, the conceptual framework is constructed based on previous literature. Potential customers go through each step of the Internet shopping market by recognizing the existence of online shopping malls with the use of the internet. As Internet users go through each step, they create profits for internet based companies by sometimes being just one-time buyers or by sometimes being loyal customers depending on the operation strategies of internet shopping malls. Depending on the investment ratio by strategic decision making, these profits are re-invested back into the operations of internet shopping mall, which is the process of company growth. In other words, the whole flow goes through the following process in circulation; Investment with efficient resource allocation → Promotion for the purchase/re-purchase of internet oriented customer → Profit generation → Re-investment in the operating resources of internet based companies. Thus, it is impossible to understand the process for explaining the growth of Internet based company in the perspective of a simply continuous linear process, and the process for growth can only be understood when intricate circulating interactions of cause and effect, which exist among explaining variables, are grasped.
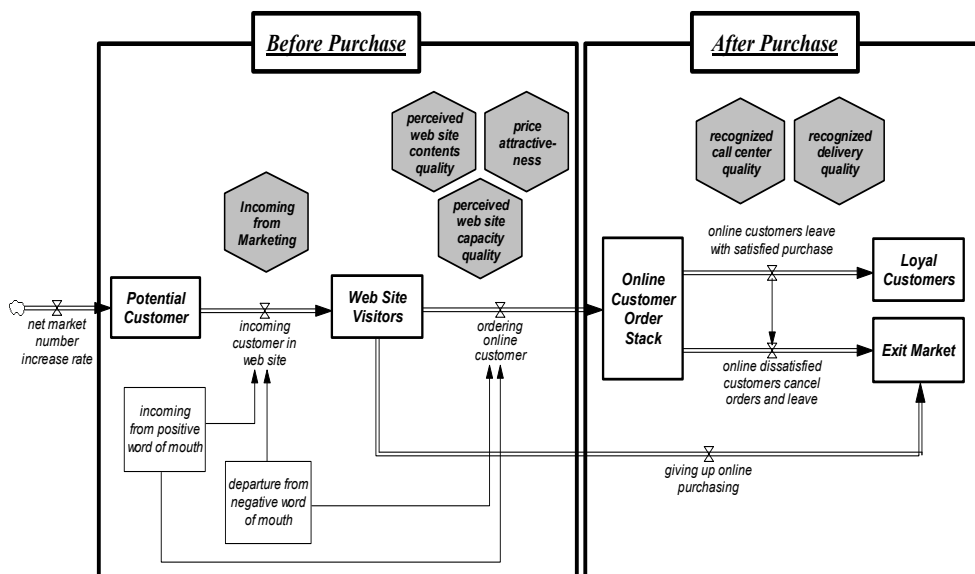

Figure 1. The system dynamics model of resource allocation decision making

Therefore, in this study, for the purpose of examining the series of such circulating causal relationships among strategic elements related to Internet purchasing, the system dynamics framework of the efficient decision making for resource allocation in Internet shopping mall is developed. VENSIM DSS Ver. 5.5, which is the tool for system dynamics simulation, is utilized to construct and analyze the model.

3.2 The expansion process of demand in pre-purchase step.

3.2.1 The system dynamics model of investment for internet advertisement and promotion

Bass, in his expansion model (1994), presents advertisements and promotional activities that stimulate radical demand, along with the word of mouth activities that can induce mimicking demand, as the political variables that attract customers in the process that potential customers visit the web site with the recognition of a product and brand.

When it comes to attracting customers to the web site and getting them involved in actual purchase, Internet advertisements and promotions, which stimulate radical demand in the Internet shopping mall, are more cost-effective and efficient than traditional media. They provide information on the internet shopping mall or their products, eventually deriving sales through bi-directional online communication. Furthermore, they are utilized to introduce new products of an internet shopping mall or promote purchase by providing customized information to existing customers via emails, and by contacting the customer continuously (Cleland & Robin S. 2000; Ducoffe & Robert H. 1996).
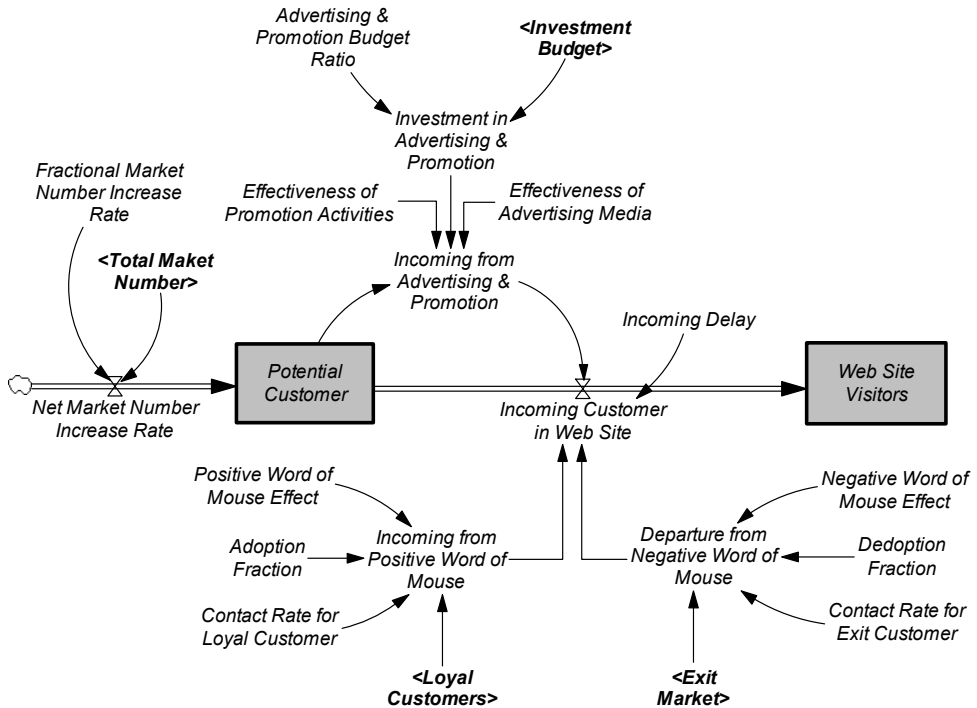

Figure 2. The system dynamics model of investment for Internet advertisement and promotion

Regarding word of mouth, as described in the literature review, the customers with previous purchase experience tend to introduce the shopping mall or products to other

potential customers. In other words, satisfied customers will spread positive words, and those unsatisfied will spread negative words. And through these processes, customer inflow by positive word of mouth and customer loss by negative word of mouth is created (Godes, D. & Mayzlin, D. 2003).

Each auxiliary variable, which are used in the system dynamics model of this study, was measured by utilizing the example of an Internet book store, which is one of the most common forms of internet shopping mall, and these variables were applied to the actual model. And in the case where it is hard to draw concrete value, the variable values presented in existing theoretical study were used. Regarding the growth of the potential market, the types of growth are hypothetically divided in two different types for analysis. First, with the assumption that the overall market size of an internet bookstore makes a letter S shaped logistic curve, in the early stage, the market grows slowly, however, later as time flows, the market makes rapid growth, and in its maturity stage the growth gets slowed down making the typical S shaped market size. The second model assumes that the Internet bookstore market shows an exponential increasing pattern, meaning that the market grows rapidly every year with a regular ratio. The rapid growth ratio from this model may be able to explain the rapidly growing pattern of the Internet bookstore market but since it is more general that the market growth speed gets dull and slows down as time flows in reality, each of the above 2 assumptions on market growth was applied to subsequent analysis.

Regarding the efficiency evaluation on investment for advertisement and promotion, in order to measure the efficiency of on-line advertisement, such issues as how much traffic the internet advertisement has created, in what channels customers come across the information on the site, and what types of banner advertisement are being introduced to customers have to be grasped. Therefore, in this study, for evaluating the availability of advertisements, values provided from the selected internet bookstore, and the values from analyzing a log file such as 'hits', 'page views', duration of stay, sessions, and the number of visitors being the barometer for evaluating the efficiency of advertisement, are used. Also, the data of CPM (click per mill) and CTR (click through rate), both having relations to Internet advertisement, are used. For the availability of promotional activities, this study used measurement values acquired from customer reaction toward the promotional activities of the sampling company. And among the variables related to word of mouth, the probability of contact with loyal customers, which is the measurement variable for the positive word of mouth effect, and the probability of contact with non-purchasing customers, which is the measurement variable for the negative words of mouth effect, were applied with historical data from other previous theoretical literature. The previous literature suggests that the negative words of mouth have about 7.5 times more effect than positive word of mouth. And for the information of selection ratio and rejection ratio, values from previous literature were applied. The efficiency of positive word of mouth and negative word of mouth were constructed with nonlinear function and analyzed the degree of changes in values through sensitivity analysis.

3.2.2 The system dynamics model of investment on the quality of web system

It is the most important thing for an Internet shopping mall to provide faster and more stable system maintenance as a virtual retail shop under Internet based circumstance.

However, if the number of visitors or transactions for the web site increases, it creates more web traffic, causing the appropriateness of web server infrastructure to go down. And this, again, reduces Internet transactions due to the decrease in business attractiveness, resulting in a negative feedback structure. The negative feedback effects means that the overall structure of a sub-system circulating around a feedback loop is in the form of scattered mixture between some increase from positive effect and some decrease from negative effect, and eventually maintaining a stable system structure as time goes by. However, if profits from Internet business transactions are invested on web server, an improved web server infrastructure can play as the factor for revitalizing Internet business transactions by elevating the appropriateness of the server. Therefore, the operator of an internet shopping mall must commit to constant investment on the infrastructure of a web server in advance for making smooth transactions in the internet shopping mall possible(Donthu & Naveen 2001).

The following is the explanations of the system dynamics model on the quality of web system.

If the number of users searching or purchasing products in web site increase, the traffic of web site gets heavier, resulting in the increase of crowdedness in web site. This will cause the overload of web server capacity, considerably slowing down the loading speed and
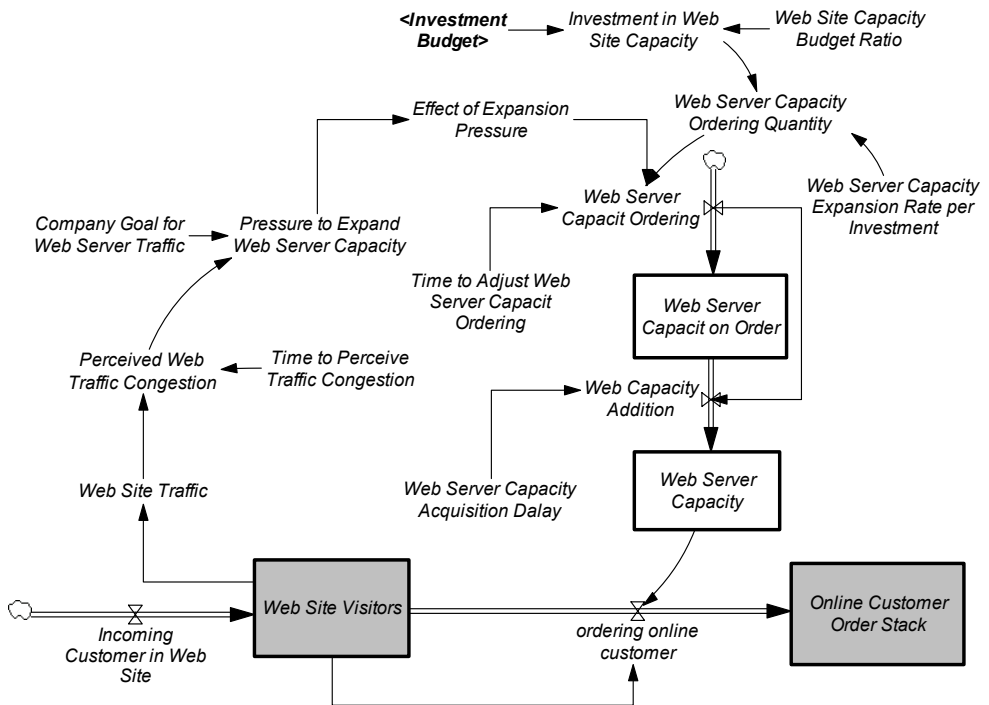

Figure 3. The system dynamics model of investment on the quality of web system

download speed of web site. Overloaded server capacity puts continuous pressure of investment on increasing more web server capacity as the traffic of customers in web siteincreases. And the administrator of web server in the Internet shopping mall has to make an investment decision on a web server by judging from the difference between the status oftraffic in current web system and the expectation of customers on crowdedness in the process of searching through or purchasing products from the mall. And depending on the difference or the directions between the degrees of web traffic crowdedness that customers feel actually and customers expect, customers have satisfaction or dissatisfaction toward their purchase from the Internet shopping mall. Customers who are satisfied with the speed or reliability of the web server system end up buying products or services from the Internet shopping mall, and customers who are not satisfied give up their purchase from the mall and end up using offline malls, or completely give up their purchase from anywhere.

Therefore, investment on web server lessens the gap between customer's recognition and their expectations on the web system, making the purchase environment amicable. However, the administrator of a web site needs to have a solid pre-management plan on traffic, since the investment related to the expansion of web server takes some interval time (Liu, C. & K. P. Arnett, 2000). Thus, it is essential for the administrators of Internet shopping malls to provide conditions in advance and timely fashion to customers that they can enjoy shopping through Internet under the circumstance of faster speed and more stability in the step of searching or purchasing.

3.2.3 The system dynamics model of investment on the quality of web contents

To convert simple site visitors of internet shopping mall into actual consumers, more useful and more reliable information has to be provided to them. In other words, it is essential not only to construct useful contents that can stimulate the interest of customers, but also to provide a systematically structured web site with systematic navigational structure in which customers can easily browse through. Therefore, the contents provided by the web site of the internet shopping mall have to be equipped with, first, the merchandising function introducing the variety of products to customers, secondly, the navigational function making easier product search possible, thirdly, the web design emphasizing external aspects such as visual appeal, overall website design, graphics, and effective color usage, and fourth, information security providing information reliance on purchase. The issue has been raised that these four aspects have to be individually analyzed with a more subtle and scientific approach. By doing so, customers will be experiencing feelings of satisfaction or dissatisfaction, and making a purchase decision or giving up purchasing, based on information provided by the Internet shopping mall (Dholakia, Utpal M. & Lopo L. Rego 1998; Huizingh, E. K. R. E. 2000).

In the system dynamics model of investment on the web contents of internet shopping mall, it is suggested that the environment of internet shopping has to be constructed so that it can provide more abundant and organized information to customers through the four variables which came from previous research (Moe, Wendy & Peter Fader 2001). Each influential variable decides the quality of web contents by the relative differences between the customers' actual recognition of the contents of an internet shopping mall by visiting it, and the level of quality that customers can accept through the four variables. The quality of contents in a web site like this becomes a very important standard for customers to judge the site by looking at the quality gap between actual recognition and expectation, thus, this

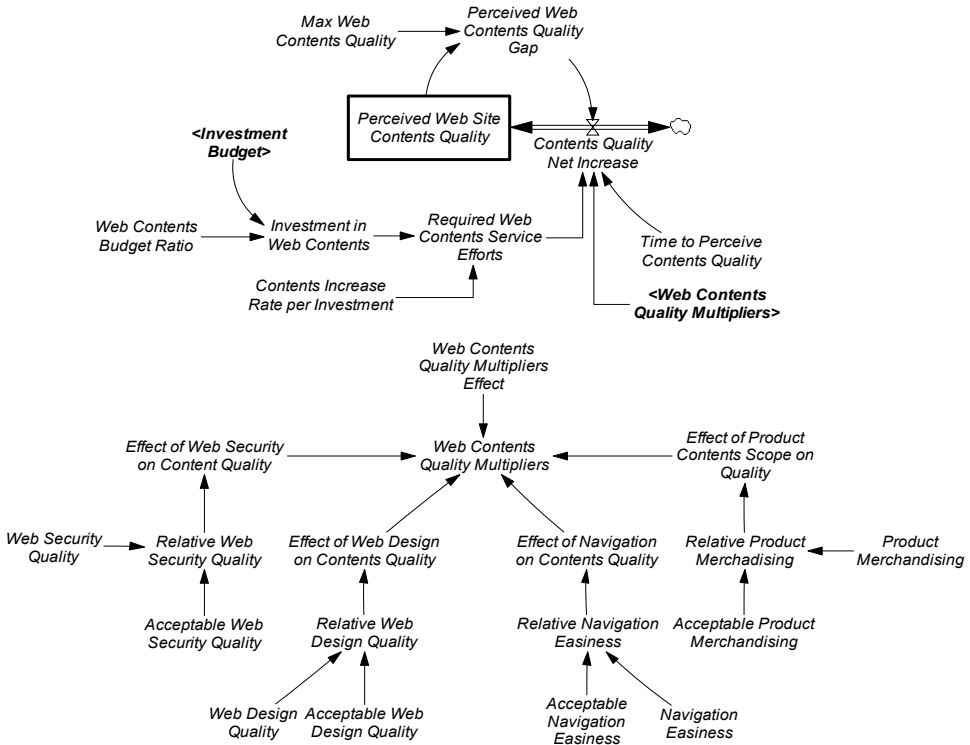quality recognized by customers becomes very influential element for decision making on purchase.

Figure 4. The system dynamics model of investment on the quality of web contents

In this study, as the materials for system dynamics simulation, values for four variables composing web contents are decided based on relative ratio between acceptable values and actual values. These values are analyzed by utilizing concrete values acquired from the sampled Internet bookstore's own consumer surveys. And for the anticipation level of what customers expect on the contents of the web, the average values of Internet bookstore industry in Korea from the survey conducted by KWPI (Korea Web Power Index) are used.

3.2.4 The system dynamics model of investment on price promotion

Price promotion is one of the important elements influencing customers' purchase decision in the internet shopping mall. According to Bailey's research(1998), the profit increase of a company has a positive effect on the investment related to the quality of service, and improved quality of service accelerate customer demand by providing an extra price premium on product or service. Furthermore, it is analyzed that improved quality of service boosts up the level of attractiveness customers feel about a product or service, bringing positive effect on the market share of a company. Moreover, the revenue increase of a

company is followed by the cut down of cost due to its negotiation superiority and economies of scale. And the cost reduction effect brings down the price of products, making a low price policy possible (Smith, Michael F. & Indrajit Sinha. 2000). Such price differentiation strategy has a positive effect on increasing sales in the internet shopping mall by attracting more purchasing needs from customers. But, as examined in other previous studies, the level of satisfaction on price through price reduction policy is not an element influencing directly on the overall satisfaction level toward internet shopping mall, but it can influence a customer's purchase decision in the case that there is no product differentiation in each internet shopping mall. Therefore, rather than applying the same range of price discounts on the overall products in the internet shopping mall, the administrator needs to maintain the price strategy that can speed up product sales through such promotional activities as differentiated pricing policy depending on the types of customers, limiting the quantity of a products to be sold, and special pricing promotion for limited time.
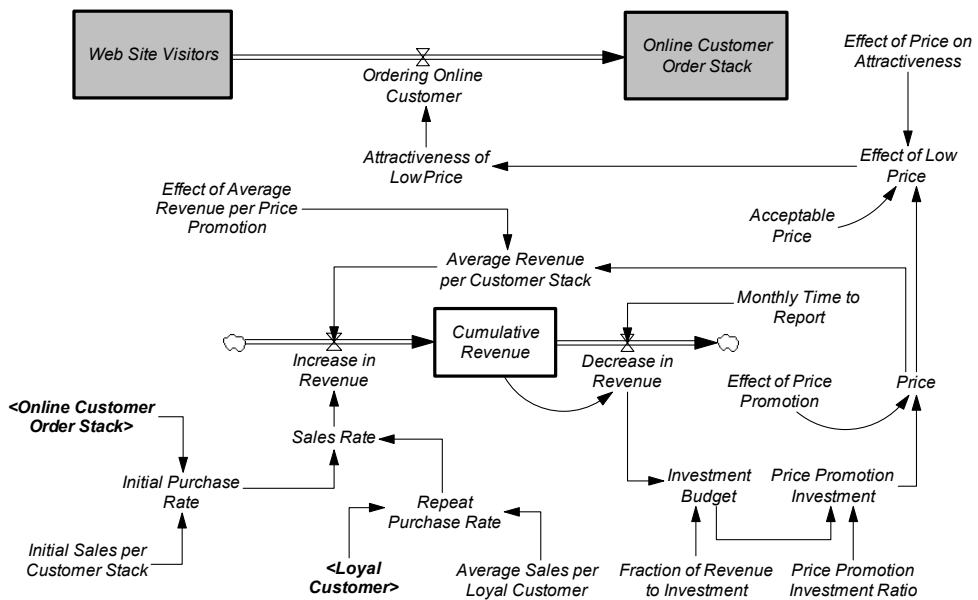

Figure 5. The system dynamics model of investment on price related promotion

Although the investment on price promotion plays a positive role in the profit structure of an internet based company, it also has negative aspects. As examined in literature review, the investment on price promotion functions as a factor to bring more purchases from the users of an Internet shopping mall, stimulating more sales. However, on the contrary, discounted pricing can be an element to worsen directly the profit of a company, because it causes customers to have a tolerance on continuous price reduction, so the internet based company has to maintain persistent price promotion to derive continuous purchasing from customers. Therefore, the policy maker of an internet shopping mall has to use the

promotional policy with full consideration in positive and negative aspect of discounted price.

The investment on price discount means that some portion of the net revenue of a company is being utilized for price promotion, and through the width of the discounted price compared to the reference price on same products in other internet shopping mall, customers feel the attractiveness of the discounted price, stimulating customers' purchase. The effect of purchase influencing price discount is calculated by multiplying the price effect on the level of purchasing attractiveness with the value of actual price/acceptable price level. And, the price effect on the level of purchasing attractiveness is modeled in nonlinear function by applying Gutenberg- type price sensitivity function.

Furthermore, price discounts have a reverse function on the profit structure of an internet based bookstore. When the company revenues are calculated by multiplying total quantity of products sold and the sales price, the decrease in sales price at the same time leads to lower the accumulated revenues of a company. Thus, the administrators of internet shopping malls must satisfy their customers with appropriate pricing ranges and methods by grasping both the negative and positive aspects of discounted price.

3.3 The process of demand expansion after initial purchase

Customers evaluate the internet shopping mall they use depending on their purchasing experiences from the mall such as how fast and safely the delivery of product they ordered is made and how conveniently problems regarding their ordered products can be resolved. Based on evaluation via their shopping experiences, customers decide whether or not they should revisit to repeat their purchase. Therefore, it is not necessarily possible that customers are satisfied with the internet shopping mall just because it had a promotional event one time and built a good purchasing environment on the website. Only when all the necessary elements customers want are operated together in harmony, will customers' full satisfaction be possible.

3.3.1 The system dynamics model of investment on the service quality of delivery

According to the market growth model by Membrillo et al., (2002), the more the customer orders are received the more there will be delays of product delivery, diminishing the market attractiveness of a product or service. And the increase in the delay ratio in product delivery adds pressure on the company to expand investment in additional delivery capacity. Thus, in the same model, they insist that companies have to satisfy customers by minimizing delay of product delivery, and utilizing their capacity efficiently. Also, in the studies by Oliva & Sterman(2001) and Mentzer et al., (2001), as customers place more and more orders, the backlogs of placed orders increase, needing the expansion of delivery capacity, eventually bringing the feedback effect that performs delivery smoothly through the expanded delivery system capacity which is added after some time interval.

In the case of an Internet shopping mall, the more customers make their purchase on line, the more delays of deliveries there are for the portion that exceeds current delivery capacity. Even though the delays in product deliveries keep adding up, it happens that Internet based companies and their belonging market can recognize this only after some time. Furthermore, even at the point of time Internet based companies realize the delays, there is already a big gap between the delivery service customers experience and the delivery service the company aims for, due to the accumulation of overloaded orders from

customers. Then, it will make the customers' level of dissatisfaction on delivery service increase, causing the cancellation of orders or the decrease of potential orders. That is, the loop related to delays in product deliveries has a negative feedback effect, so orders will decrease more and more after some point. However, delays in deliveries give the administrator of a internet shopping mall more pressure on expanding delivery capability and capacity, thus, some portion of company profits is invested in expanding the delivery system. In fact, the pressure effect of expanding the facilities for delivery service is modeled by indicating in a nonlinear way the difference between the actually recognized delay of product delivery due to the increase in orders being placed and the duration of product delivery that the Internet shopping mall company is aiming for (Sterman, 2000).

Delivery capability expanded from the re-investment on the delivery service processes orders efficiently and provides satisfactory feelings to customers by bridging the gap between what customers expect and what they experience. By doing so, it influences customers' decision on re-purchase by boosting up the loyalty of customers towards online purchasing (Bienstock et al., 1997).
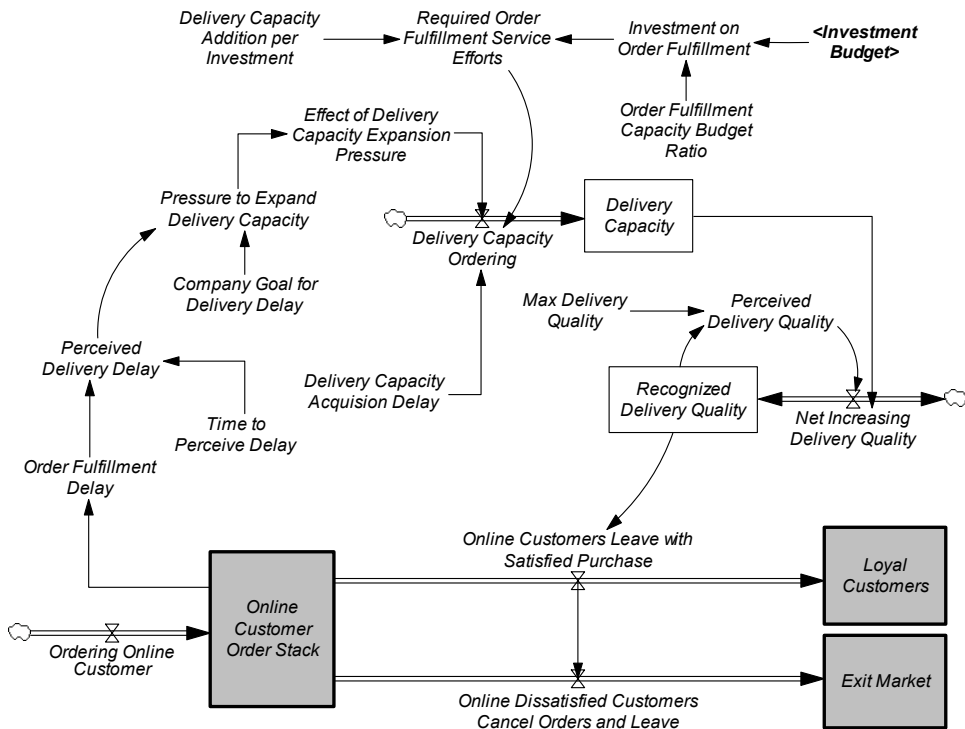

Figure 6. The system dynamics model of investment on the service quality of delivery

3.3.2 The system dynamics model of investment on the quality of customer support service

An Internet shopping mall has to think deeply about strategies and operations that can provide customers with contact opportunity on some meaningful benefits and make them happy. It is the customer support center which is the closest contact point improving relationships with customers by listening to customers. The performance of the customer support center, which is the contact point between customers and company, depends on how it satisfies customers with a reasonable amount of cost, and prevents them from staying away from the company. The customer support service team processes the complaints or the questions from customers by utilizing the resources related to the service with limited amount of budget. Then, the way and delay level of responding to customer complaints and questions influences customers' confidence on the Internet shopping mall, and ultimately affect the level of customer satisfaction after their purchase. Therefore, it is essential for Internet based companies to be equipped with a real time customer support system that can respond to complaints and questions in a timely and kindly manner (Anton, J. et al., 1999).

As the number of customers placing orders online at an Internet shopping mall increases, more various questions or complaints regarding the purchases or the deliveries of products are created. And these questions or complaints are resolved through the customer support center of the Internet shopping mall, the information desk of web based call center, and the
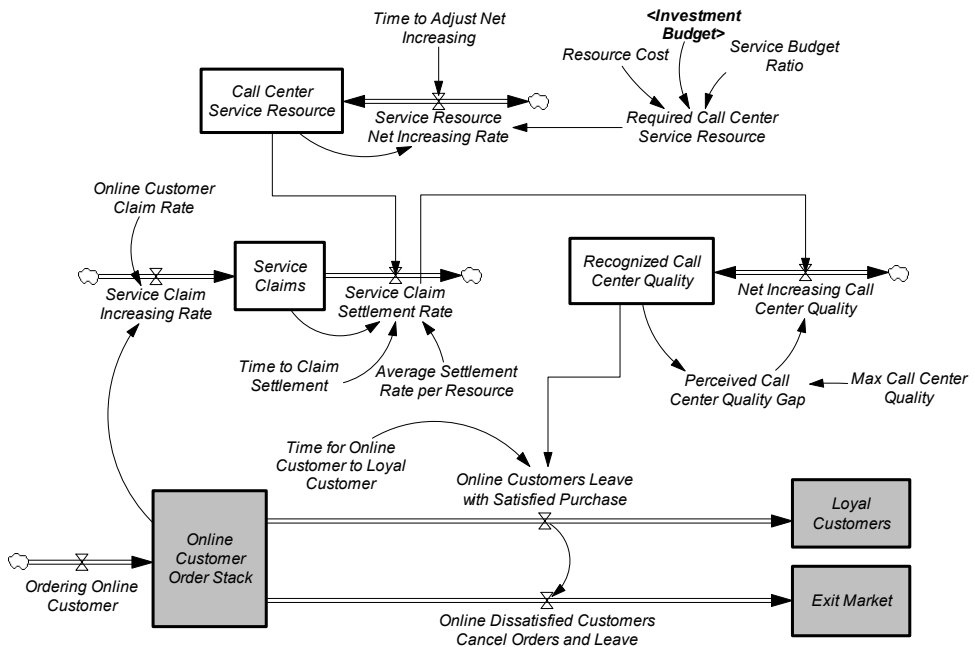

Figure 7. The system dynamics model of investment on the quality of customer support service

FAQ (Frequently Asked Question) section of the site. There are some differences between the service level customers expect regarding the management of complaints and questions and service level provided actually by the internet shopping mall. According to the level of such difference, the service quality of call center that the customers of the mall feel about will be differentiated. The quality of call center influences the level of satisfaction after their purchase, further, affects customer loyalty. Therefore, the administrators of Internet shopping malls need to respond to customers' request in timely fashion by utilizing the human and physical resources that can process efficiently the service claim related to their consumers (Ward Whitt, 1999).

4. Simulation analysis and its result

4.1 The validity of the system dynamics model

Before analyzing the decision making model of Internet shopping mall, first, the validity of the model has to be confirmed. According to the study of Barlas (1989), the method of evaluating the validity of model can be divided into two general approaches. One is the validity of model structure and the other is the validity of model behavior.

First, in the validity of model structure, after the conceptual modeling was constructed based on various theories and research results from previous literature regarding the purchase decision in the internet shopping mall, the structural validity and boundary appropriateness were verified by going through several discussions with many practical managers, followed by amending the structure of the model. Also, in this study, the unification of measurement unit was achieved by conducting simulations for 60 months along with according the unit of measurement from the numerical formulas of each variable at the same time. In the validity of model behavior, the pre-tests on each partial loop were conducted to reflect the elements from the pattern of purchase decision in the Internet shopping mall such as the symptoms of problems that can be witnessed in real world, the behavioral pattern, the behavioral change in each step, and the fluctuation. And, the initial value of the model is adjusted to arrive at the balancing status – a certain point where the condition of simulation reaches the stabilized step through the connection of loop in the overall model. By doing so, the conditions for the reproducibility and normality of model behavior were satisfied. Also, by conducting sensitivity analysis on each LOOKUP function, the validity check on each function is carried on at the same time.

The most important and the most influential LOOKUP function among all the LOOKUP functions used in this study is the function of price discount on the level of attracting purchase. The price sensitivity function of Gutenberg type is used for the LOOKUP function. The hypothesis suggested in the Gutenberg model is that if the price gap between the company's own product price (P_i) and average competing price (P_i^*) is small, such difference in pricing have a relatively low influence on the quantity of company products sold or the market share of the product.
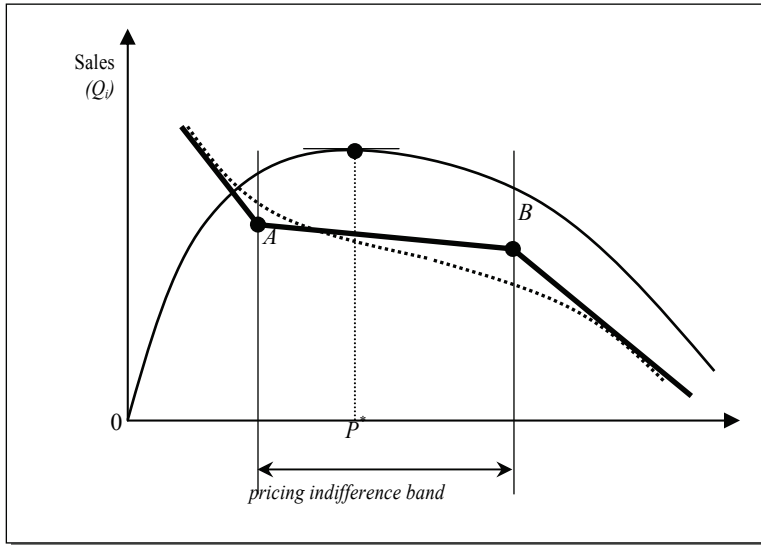
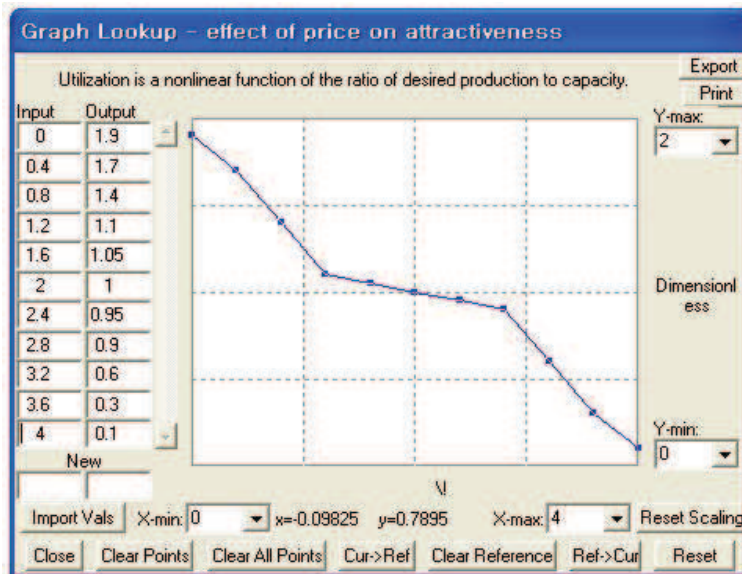Figure 8. Non-linear price response function (Gutenberg Model)

Figure 9. LOOKUP function of the effect of price on attractiveness

In the Gutenberg model, the section between A and B is the area of price by which customers' purchasing decisions are not influenced. The model assumes that customers in this section will keep purchasing the product or the service of the company with the

intention of paying extra money. This assumption is only possible when current customers have favorable feelings about purchasing the product of the company and there exists a switching cost for customers to change their preference. Therefore, when the price gap is not big, customers mostly tend to keep purchasing products they currently use.

Thus, this study analyzed the interactive relationship between price discount and the quantity of products purchased by customers by the Gutenberg model. In other words, customers tend to show the increase of their purchasing intention when they recognize more significantly transactional effectiveness – the difference between internal reference price and actual sales price which is formed through the price comparison with other internet shopping malls. In the sensitivity analysis for the influence of price discount on the level of attracting purchase, the effect of discounted price on customers' buying decision and the decision making related to the overall resource allocation is appeared to be not much significant. However, it is found that depending on the partial changes of the nonlinear relation of LOOKUP function, the values of overall stock variables and flow variables change bit by bit. But it is also found that this changing ratio lies within an acceptable range, not having major influence on decision making.

4.2 Simulation analysis

When analyzing the company in the example, the simulation is conducted for 5 years (60 months) with the unit of analysis in a month, considering the environment of internet market, changing so fast more than ever. In the analysis for the example company, the cases are divided in two assumptions for the analysis and comparison, one being the growth pattern of internet bookstore market in (A) S-shaped logistic curve and the other being (B) in the form of constant increasing growth. In the case with the assumption of the growth pattern of internet bookstore market being an S-shaped logistic curve, the assumption means that there is a negative feedback structure for the overall size of internet bookstore market not to be able to grow continuously. Under the basic assumption of Bass's model of expansion in demand, the market grows due to the definition feedback loop at the early stage. However, as time passes, the market growth gets oppressed by the strengthening of the effect of a negative feedback loop (Bass, 1994). Under the case that the overall size of the market is in the form of S-shaped logistic curve due to the limit of growth, the demand of the market grows rapidly at the early stage due to the effect of the limited number of potential users and then later, the demand decreases due to growth limits. Namely, when the overall market size is called M and the number of actual consumers at the point of time t is called $n(t)$, the number of potential users left is $M - n(t)$. And assuming the conversion ratio of potential consumers to actual consumers as c, at the point of time t, the number of converted consumers from the potential to the actual is $n(t) \times \{[M - n(t)]/M\} \times c\Delta t$ and $dn(t)/dt = c \times [M - n(t)/M] \times n(t)$. When $n(t)$ is calculated through this, it is as following formula (1).

$$n(t) = \frac{M}{1 + [(M - n_0)/n_0]e^{-ct}}, \quad t \geq 0 \tag{1}$$

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