

## New product development model dynamic systems approach

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### Abstract

*This study aims to identify the key factors in developing successful new products in order to increase customers' attraction rate through identification and prioritization of the key factors in new product development. To this purpose, authors applied the Bass diffusion model and then studied the dynamics of the system and the fundamental theory methods and model development.*

**Keywords:** Bass diffusion theory, system dynamics, new product development, the fundamental theory.

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## **1. Introduction**

Decisions on new product development are crucial but complex. New product development is regarded as a competitive weapon that helps firms to survive and succeed in dynamic markets. Lucrative new products play an important role not only in penetrating markets, but also building and retaining customer relationships and yielding profits. However, new product development, from idea creation to product introduction, requires inter-departmental communication among designers, engineers, and marketing personnel. Furthermore, to achieve a competitive edge in a market, sensible decisions must be made about various aspects of new product development, such as product attributes, customer segment, and promotion and marketing strategies. These decisions are inter-linked and will ultimately affect profitability. It is challenging to reach a consensus among the various parties involved in product development, who have different responsibilities and concerns. Decision aids such as a decision support system are thus of benefit in solving such decision problems.

Although all the articles that have examined the factors influencing new product development, by identifying and modeling the impact of marketing variables, valuable contribution to the development of theoretical principles, they all make the assumption that the parameters do not change over time.

For many reasons we must consider that model parameters as factors that will changed over time. Our daily experiences teach us those markets never stays steady long period of time. Different levels of competitive activities, changes in the level of change advertising and price elasticity, among other factors, have significant influence on diffusion theory and its parameters. Ability to change parameters over time, allow diffusion models to match better with the actual data(Putsis,1998).The aim of this study is to identify main dynamics that have increasing and decreasing effects on success of a new product to be developed and management to identify and to provide a simple illustrations and managerial views to the decision makers. In this study, we examine the factors affecting the success of new products, by creating a dynamic model and to study the interaction of these factors and their impact on the success of new product.

## **2. Research Background**

### **2.1. Bass diffusion**

We will be using Frank Bass's (1969 ) version for the diffusion of innovation, growth and development of new products which is one of the most famous models that is widely used on topics such as marketing, strategy, technology management and other costs. This model has been introduced as a tool for forecasting sales of new products.

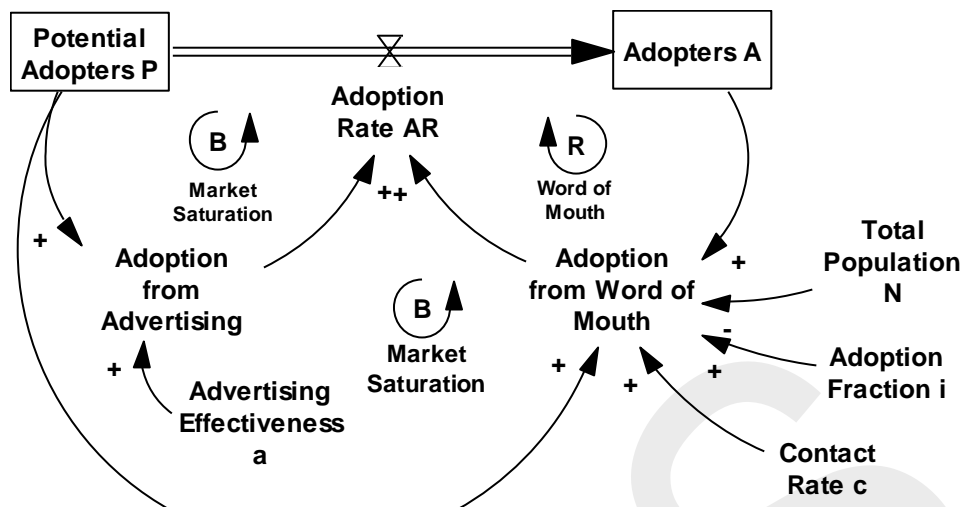


Fig1. Bass Diffusion Model (Sterman 2000)

Bass model can solve the problem of setting up a logistics model for diffusion of innovation because the adoption rate of advertising depends on the population of adopters. When an innovation or a new product is introduced, the rate of acceptance is made up entirely of people who are obtaining information of new innovation from external feeds such as advertising information. By reducing the number of potential adopters, while adopter population increases, the share of total advertising acceptance rate drops as mouth advertising increases. Later, the words of mouth advertising will be dominant and diffusion process continues until the end of the logistic model (Sterman, 2000).

## 2.2. New Product Development

Handbook of Management Association and product development, defined new product development as : A set of tasks, steps and measures that are defined and regulated natural goal to transform ideas premature (beginning) to describe consumer products and services (Griffin,1997). In other words, new product development process is known as a series of activities that by contemplating customers instructions and orders, market demand and technological advances into the process of designing and producing and transmitting (Dougherty, 1992).

## 2.3. Main Factors In Success of New Product Development

Many studies discuss key success factors of new product development. Benedetto (1990) indicates that key success factors of new product development comprise: (1) cross-functional teams to make key marketing and manufacturing decisions; (2) high-quality selling efforts, advertising, and technical support;(3) involving logistics early in planning; (4) good launch management and good support program management;(5) forecasting right timing for the launch; (6) information gathering regarding market testing, customer feedback, advertising testing, etc.

## 2.4. System Dynamics

Various approaches are used to identify concepts and issues affecting the phenomena studied such as social sciences, psychology and other related fields.

One of the best approaches to the study and analysis of the variables relations and issues affecting the behavior of the phenomenon, especially in management is system dynamics which could be used in the simulation of complex phenomena, especially when they are complicated. This approach in industry dynamics was first introduced by Forrester (2000) and then it was used in other fields, especially social sciences and economics. Rodriguez and Paucar, in 2004, believe that basically system dynamics models predict system behavior.

### **2.5. Grounded Theory**

The method is based on the identification and classification of variables (in three steps: open coding, axial and selective) and the relationship between them. With usage of these categories, theories are made, in other words, the method is carried out first and then concluded and theory is obtained. In this approach, the analysis is that data collected by such means as interviews and codes then major issues are extracted from codes. Coding is meaning of extraction and categorization of answers to the issues and their relationship. The fundamental theory research is searching for categories and extraction of collected data. The aim of the researcher in this method is by achieving to explain a particular phenomenon by studying the deep beliefs, opinions and attitudes.

### **2.6. Literature Review**

Main success factors can be defined as areas in which, if satisfactorily in those fields will insure successful competitive performance of the organization. According to Rakhart (1979), main success factors are those with satisfactorily results in their fields that ensure success of the organization. Brown and Eisenhart (1995) have expressed research on the success or failure of new product development projects in three streams and in general. Yahoo and Feng (2009) have examined the key factors of success of new product development and have identified five key factors of success. Also Benedetto (1999) has introduced six new product development successes. Poolton and Barclay (1998) have described tactical and strategic success factors into two broad categories. Also Henard and Szymanski (2001), point out the strategic importance of enterprise features and development processes are instances that have much close relations with two general categories. In another study by Kandemir and Rosanna (2006), the main success factors are divided in complex human resources, resource development, assessment resources and commissioning resources.

Mu and colleagues (2007) in the field of small and medium businesses in China, has examined critical success factors in new product development in three stages of Vinson Model. The total numbers of the examined factors in the study were 46 factors in four general categories of technical, marketing, managerial and business. In another study by Sun and Wing (2005) has been in the toy industry in Hong Kong, among 54 primary success factors, eight factors are expressed as main success factors. On the other hand, researchers such as Cooper (1979) and Song and Perry (1997) have classified new product development in four wide range of the new product: (1) external environment of company, (2) internal environment company, (3) process of product development and (4) product competitive advantage. The results of Mu and colleagues (2007), about the critical success factors in the industry in new product development in China, shows that four parameters influencing the product development process include: technological factors, marketing, management and commercialization.

### 3. Research methodology

This research combines fundamental theory and methods of system dynamics. The goal of this research is to be practical, and surveying is the method that will be used. In this section, we will be examining method of fulfillment, implementation of fundamental theoretical approach of and dynamics of systems and applications, research model as a whole, considerations relating to the validity and reliability of the instrument and their usage know-how will be examined.

In general method of data collection was done by field and library studies. The relationship between variables has been determined by using expert opinions and conclusions were based on the frequency of responses. Data were collected for this study by in depth interviews with experts in the field of new product or service development experts and university professors and professors in the industry. The studied population consisted of experts from industry and academia in connection with the subject of research, new product development and academic experts in the dynamics of the system.

### 4. Cause and effect diagram and dynamic hypothesis

After extracting the variables affecting the system, on bases of this interaction modeling begins. Derived variables and their relationships are expressed in the form of dynamic hypotheses. The dynamic hypothesis refers to the graphic depiction of the causal relationships between the different elements and feedback loops to repeat the basic structure of the system that complement each other. Because of the complexity of interactions between variables of model, main loops as a form of hypotheses dynamics about cause and effect diagram will be considered separately.

The following figure shows the loops of cause and effect associated with research and development (R & D) and official marketing company. In the first loop, company with official advertisement, identifies and attracts customers. With increased sales, an increase in revenue will be realized and in turn this will increase the budget for marketing and advertisement of the company. On the other hand what increases the effectiveness of official advertising is product attractiveness which is determined with characteristics such as price, design, performance, packaging, and product quality. This characteristic of research and development through improving the mechanism are shown in the second ring.

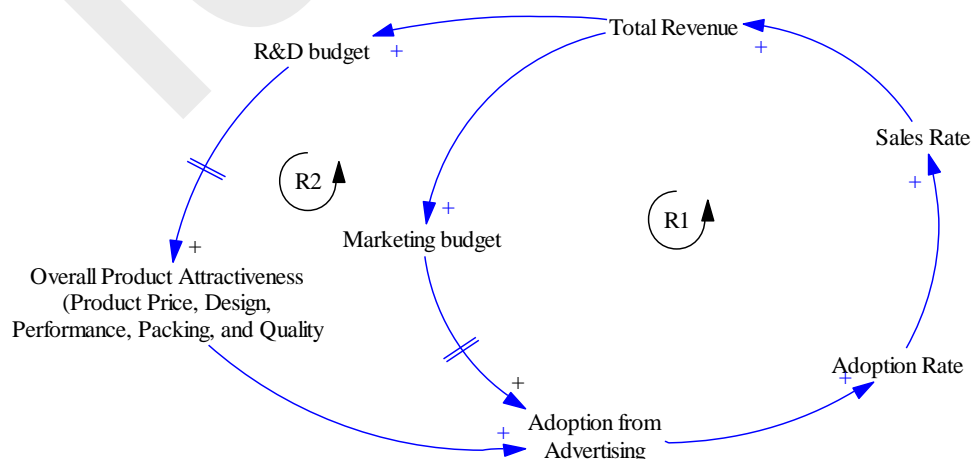


Fig2. Cause and Effect Loops Associated with R & D

The figure below shows the effect of word of mouth advertising. According to the figure, the absorption increase of customers who use the company's products for the first time, will lead to an increase in active customers. Because of the attractiveness of the product, it will increase word of mouth which will increase the rate of customer absorption.

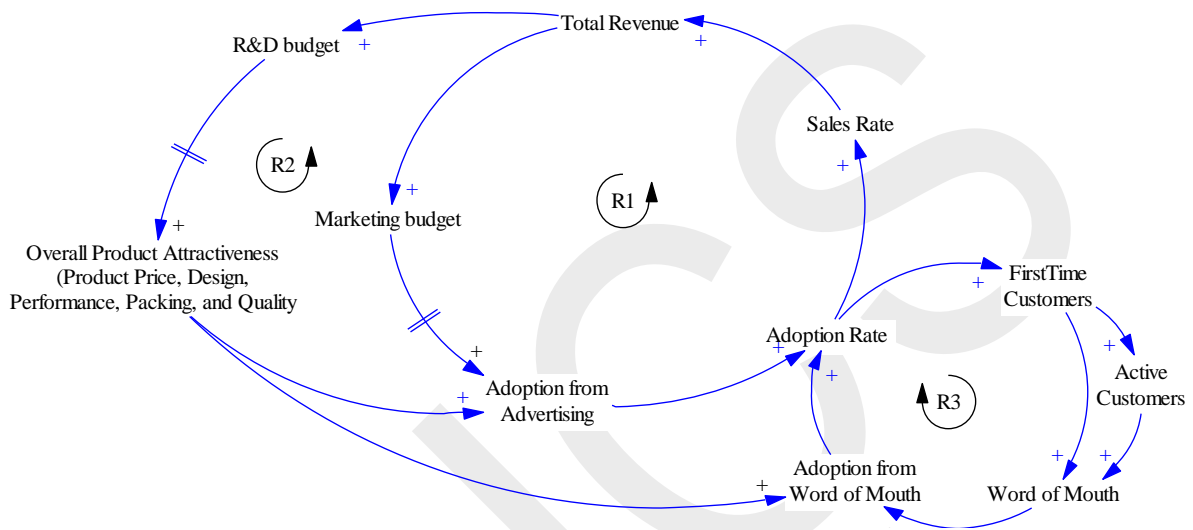


Fig3. Cause and Effect Loops Associated with Word of Mouth Advertising

The following figure shows the effect of repurchase of active clients on corporate income, marketing mechanisms and product development. The total number of repeat customers repurchases will lead to higher company earnings. Also it should be noted that the main effective variable is attractiveness of product which will increase the effectiveness of official advertising and mouth to mouth advertising.

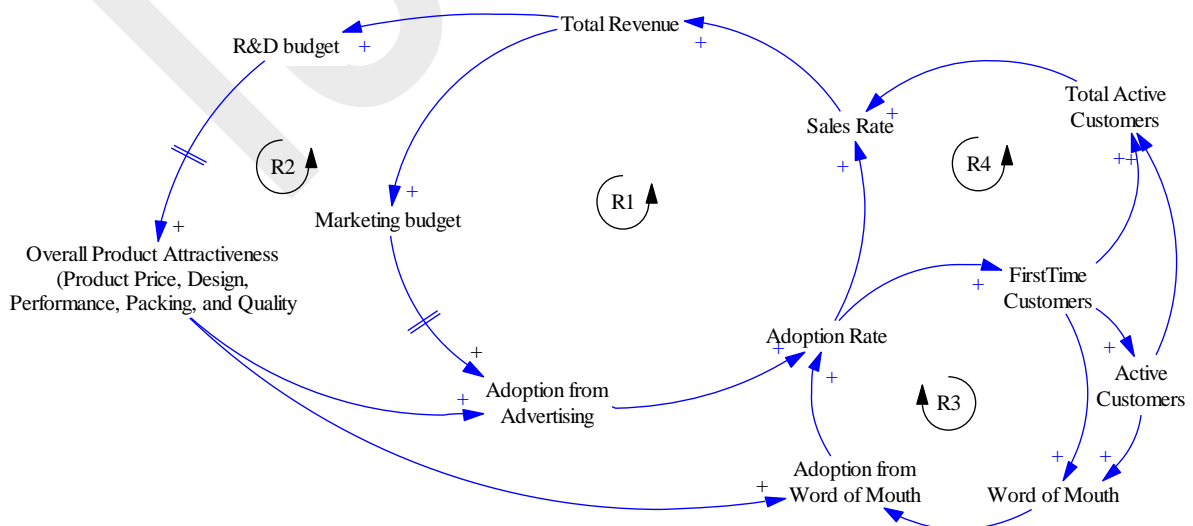


Fig4.Cause and Effect Loops Associated with Repurchasing of Active Customers

#### **2.4. Stock and Flow Diagrams**

Stock- flow diagram is the translation of the variables used in cause and effect diagrams cumulative variables (stock) and changing variables (rate). The stock variables are variables that over time will change, more or less, and have ability to be drawn over time. The behavior of these variables is visible. Figure 6 shows a flow chart model. According to the cause and effect loops described in the previous section, the mechanism of research and development, the official publicity, mouth to mouth advertising and a chain of dedicative customers, first time buyers and active customers has been modeled. Therefore, this model has 3 mode variable, 3 rate variable and 46 auxiliary variables (including mediating variables and table functions). State variables include: potential customers, clients and active first customers, and rate variables include acceptance rate, the rate of repurchase and loss rate and the remaining variables shown in Figure 6 are co-variables.

Attracting customers to words of mouth is determined by the product's multiplication of effectiveness or customer absorption results (which take effect from attractiveness of product) and the number of customer encounter with the total target population about the product. In continuation relevant equations to word of mouth advertising are listed below:

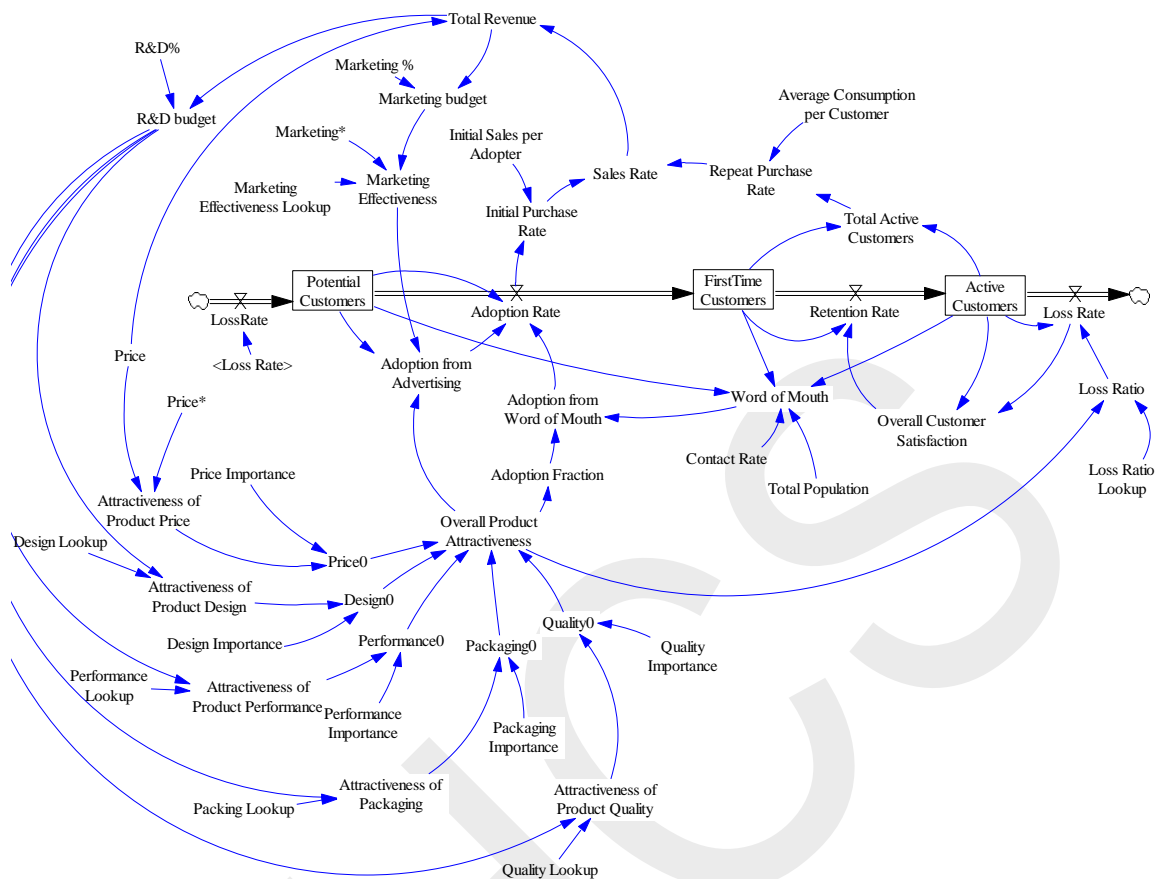


Fig6. Stock and Flow Diagram

### 5. Conclusion

This research was conducted based on system dynamic detection and the method used is survey. Four different scenarios were introduced. To summarize the results suggests that an increase in budget funding for research and development and marketing at the same time will be more effective. With regard to the implementation of the four scenarios and their results we conclude that the best scenario is using combined investment and increased funding for research and development and marketing issues. Increased funding for research and development causes an increase in the overall attractiveness of products that include product pricing, product design, product performance, product packaging and product quality and this increase subsequently will increase product acceptance rate. Increasing marketing budgets causes an increase in product acceptance through advertising and this also results in increasing acceptance rate and ultimately increasing the number of first-time customers into active customers and an increase in word of mouth advertising. Product innovation will have a positive impact on the overall attractiveness of the product and its acceptance rate. Due to As an increase in active customers and reduction of loss rate customer satisfaction will grow, which will have an effect in repeat customers rate.

Increase in the budget for research and development and its rapid performance, the fast changes (in a short timeframe) in product appearance like packaging causes rapid and significant effect in attracting customers. We have this increase in R & D budgets in scenarios 3 and 4. In scenarios 2 and 4 the rate of customer absorption are higher because the



share of marketing budget has been increased, also we emphasis on delay effect of the assessment. Marketing programs are time consuming and to achieve results we have delay and delay observed in the beginning of the charts is for this reason. Good performance of third scenario means paying attention to research and development will have positive effects that are evident in this graph. After investing in R & D with a minimal lag time an increase in customer rate to through word of mouth advertising becomes a reality.

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