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DISCOUNT PRICING STRATEGIES FOR SMART PHONE USING SYSTEM DYNAMICS MODELLING

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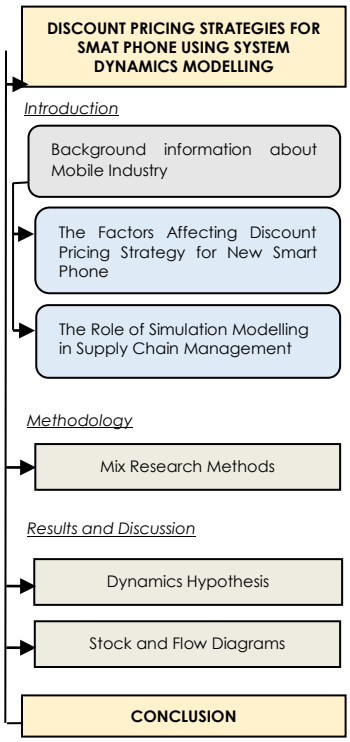
Graphical abstract



Abstract

Nowadays, retailers of highly demanded products such as fashion goods and high technology electronic devices (smart phone) are aggressively competing with one another in order to increase revenue and to maintain their position in the market place. Rapid introduction of new smart phone into the market has resulted in shorter product life cycle and intensified competition, which force retailers to enhance their strategic management and creates competitive advantages. The challenge is in designing a suitable pricing strategy and discount offerings. Thus, the aim of this research is to develop a dynamic model to understand the relations between factors influencing the discount-pricing decision, to analyze performance of the discount-pricing strategy and to present an insight on the effects of the strategy implemented. Hence, to help achieve all the purposes, system dynamics approach is chosen to model the discount-pricing strategy for new smart phone. System dynamics modelling simulates the behavior of complex systems over time. Data used in the research is collected from literature review and email interview. The email interview focuses on the information of discount-pricing strategy normally used by retailers. The simulation results show that the value of cumulative sales within introduction phase is the highest as compared to other phases. Based on the survey, it is proposed that suitable discount level to be offered for new smart phone ranges from 10% to 30%. Furthermore, the study suggests that retailers can start a discount promotion early of the month of new smart phone released and, in addition, the discount-pricing strategy model of new smart phone is also produced as one of contribution of this study.

Keywords: Decision making, system dynamic modelling, discount pricing, smartphone

1.0 INTRODUCTION

Technology advancement in mobile industries nowadays has benefited mobile manufacturers in many ways. One of the ways is contribution to a new idea for new product development. Rapid new products development means more new products will be introduced in the market. For instance, major mobile manufacturers like Apple and Samsung respectively whom in year 2013 hold about 12.1 %

and 32.1% of smart phone market share, had almost every year introduces their new product generations of iPhone and Samsung Galaxy in the market.

But despite the benefits, both technology advancement and rapid new product introduction have shortened the product life cycles Short product life cycle usually tends to happen in high technology products because the rate of technological change in high technological industries is fast. The element of product life cycle is important as it describes the sale's pattern of the new product over time. Fundamental basic of product life cycle is that every new products will pass through its renowned stages; Introduction, Growth, Maturity and Decline. These four stages are different with one another as dissimilar event occurs within the stages starting from the very beginning of product introduction to the market place until the end with obsolescence or replacement.

In time, the existence of the new smart phone in the market place has been acknowledged by the customers. Due to the acknowledgement, the intensity of the competition between the retailers has increases because more retailers are now interested to participate in selling the new smart phone and consequently, starting a price competition among the retailers. The intensity of the price competition had forced retailers to build up a competitive advantage to secure their place in the business. One of the ways to survive the competition is through strategic discount promotions.

To begin with, when there are a lot of retailers in the market selling the same products, it signifies that the product has very good demands from the customers as high demands mean high sales but indeed price competition cannot be prevented. The popularity of the new smart phone among customers and high level of demands for this high tech product has led more retailers to take this opportunity to also providing the product to the customers. More retailers signify more shops or online websites selling exactly the same products and also, it means that the probabilities in winning the customers become smaller.

Hence, to levitate the probability values, every retailer has to strategically planning the discount promotion strategy for the smart phone because it is proven that the customers like to search and to compare smart phone's prices until they find the acceptable selling price that meets with their preference [1]. This kind of consumers is extremely optimizing their purchasing time to have maximized payoff values [2]. In another hand, it means that the more attractive retail's selling prices can be provided by the retailers the more customers they can steal form their competitor and increase number of customers can directly increases the demands, sales and also profit. Later on, the profits can also be used as an investment to the retailers to buy more new products in the future.

Thus, retail managers need to understand the discount-pricing strategy to help in maximizing company's sales [3] and strengthen the reliability and stability of retail firms in the market place.

1.2 The Role of Simulation Modelling in Supply Chain Management

The simulation modelling is used to help eases the design of the supply chain and to carry out the assessment on supply chain management prior to implementation. Furthermore, the capability to perform what if analysis that lead to the best configuration and permit the comparison of various operational decision without interrupting the real system has further strengthens the case for the approach [4], [5]. Other advantages of simulation modelling in supply chain management are [4], [6]:

1) Produces visual in graphics or animation that helps in understanding the overall supply chain processes
2) Captures the dynamics system by using probability distribution which helping the modeller to model unpredicted events and to understand the effects of these events on the supply chain.
3) Minimizes the changes of planning process: by using what if analysis, modeller can test variety of alternatives before changing the plan.
4) Reduces the experiments time by simulating the model using computer.
5) Effective in training managers to understand the effects of decisions making on the important performance metrics of the system.

1.3 System Dynamics Modelling

System Dynamics (SD) modelling is a computer aided approach, which effectives for solving dynamic management problems [7]. System Dynamics approach focuses on the design and analysis of policies in a complex system comprising of interdependencies across variables, mutual interaction, information feedback and circular causality. In supply chain field, this method has been used to create an understanding and to forecast the behavior of the market, to establish a structural framework for decision making, challenging industrial assumptions, reducing delivery times, improving customer service quality and discovering new strategies [8].

Several works have been done by the past academia using System Dynamics. For example, works from Kanyalkar and Adil, [9]. Their research proposed to investigate the service supply chain behavior with the presence of varying demand and information sharing. Next is Shukla *et al.* [10]. His works is about analyzing the operation of supply chain networks by focusing on measurement of supply chain performance in term of key metrics.

Meanwhile, Ivanov and Sokolov [11] work on the optimization of distribution point and stock in production planning.

Furthermore, Mula *et al.* [12] study on the determination value of information coordination and its impacts on the supply chain operation. While, Ranganathan *et al.* [13] has developed System Dynamics model to measure the performance and stability for long term supply chain management. Shafieezadeh *et al.* [14] has developed SD model to analyze and to make a selection on the collaboration policy to enhance the performance of supply chain partnership.

2.0 METHODOLOGY

Figure 1 shows the framework of the research methods used for the study. The study used both qualitative and quantitative system dynamics methods suggested by Wolstenholme [15]. His research has concluded that mix methods system dynamics is vital in management problem solving and related to the intention of analysis. It is also suggested that the power of mix methods system dynamics in solving the problem lies in a cautious blend and intertwining of both qualitative and quantitative concepts and ideas.

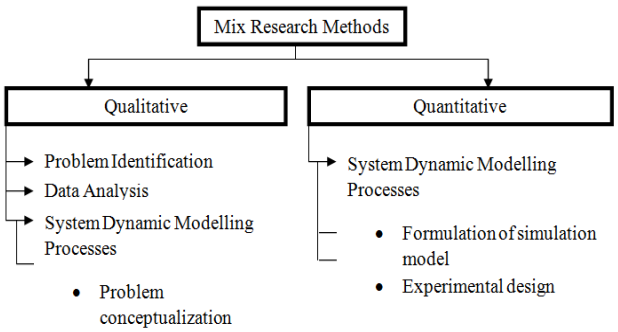


Figure 1 Framework of research methods

Luna-Reyes and Anderson [16] have stated that although system dynamic model is a mathematical representation of the problems or also known as quantitative model of strategic problems [17], it is recognized that most information needed to develop a system dynamics model is not naturally numerical, but it is in the form of qualitative information. Thus, both qualitative and quantitative research aspects are useful to conduct this study.

The aspect of qualitative research is used starting from an in depth exploration about the phenomenon or issues being faced in the retail industry through literature search. Through this process, researcher can identify narrative information that helps in constructing important questions needed to analyze or to solve the problem regarding retailers pricing strategies.

In addition, since the problem is a dynamic problem, qualitative study seems to be an ideal approach to emphasize the understanding of the dynamical problem by investigating all the important components, factors or variables that reflects the real causal relationship of the problem [15]. Furthermore, qualitative data is needed to assist in intuitive thinking for structuring the causal loops and stock and flow diagram. 'Causal loops' qualitative system dynamics [15] helps providing insight into discount pricing strategies issues by inferring the behavior of the systems or problems and meanwhile, 'stock and flow' quantitative system dynamics requires additional skills for adding the dimension of the causal relationships into analysis.

On the other hand, quantitative research method is used in the part of computer simulation. Computer simulation gives more value to the qualitative mapping enabling more precise analysis. It helps to simulate the stock and flow diagrams to verify the hypotheses created and building confidence of the system dynamics model.

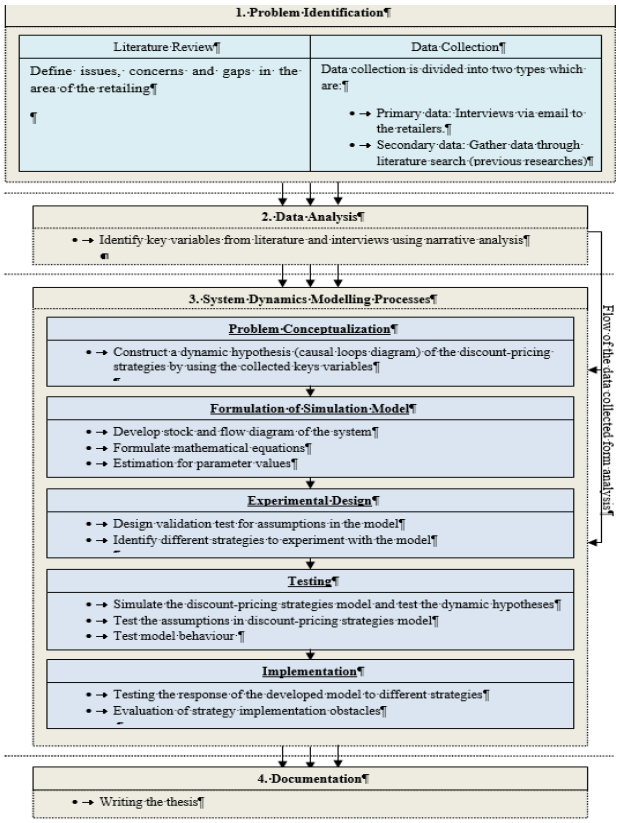


Figure 2 Research flow

Meanwhile Figure 2 shows the research flow of the study which is constructed into four phases. The first phase is problem identification. This phase consist of two processes; literature review and data collection. In literature review process, any issues, concerns and gaps arises in the area of interest is gathered to recognized any problem that is considered fruitful to

be investigated. Whereas, the data collection process helps to provide certain information needed for the research. There are two types of data used in this process. The data are primary data and secondary data. Meanwhile the second phase which is data analysis phase shows exactly how the important information gathered from the first phase is being analyzed. The result from this phase is then incorporated into the third phase of the research flow. For an instant view, the data collected from the data analysis phase is used in the processes of developing the System Dynamics model for the study. Lastly, a documentation phase is about the construction of the thesis from the day the study begins until the end. All the information regarding the study is recorded or documented in the thesis.

Figure 3 shows the source of data for the primary data comes from the email interviews and observation of discount rate on the websites, while for the secondary data it is comes from the literature review of the study

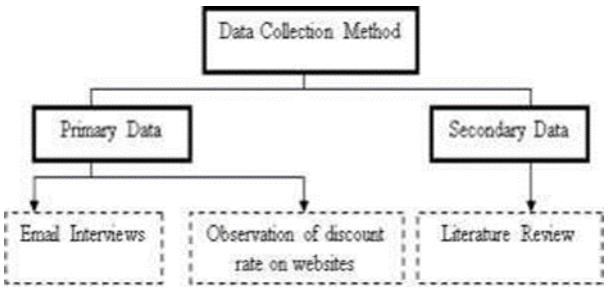


Figure 3 Data Collection

3.0 RESULTS AND DISCUSSION

The next step in conceptualization stage is deciding on the basic mechanisms of the discount-pricing strategy model which is specifically known as the feedback loops. The feedback loops of the final model represent the causes and the effects relations that able to generate the reference mode.

When deciding on the feedback loops of the system, a modeller must first decide on a dynamic hypothesis. A dynamic hypothesis can be defined as a description of the model behaviour that must be tally with the reference mode and the model purpose. It is used by the modeller to generate the consequences of the feedback loops in the form of causal loop diagram.

In creating the causal loops diagram of the discount-pricing strategy model, the reference modes and the variable listed in the model boundary are being referred. As illustrated in the Figure 4, the causal loops diagram of the final model is started with the "Technological Advancement" variable.

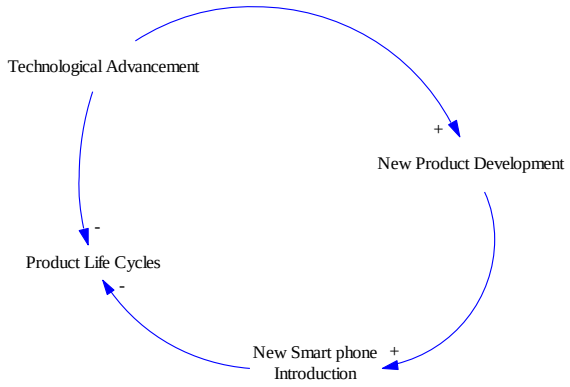


Figure 4 First part of causal loop diagrams of the final model

The "Technological Advancement" influenced the "New Product Development" and later on, the "New Product Development" variable influenced the "New Product Introduction". Meanwhile, both "Technological Advancement" and "New Product Introduction" has influenced on the "Product Life Cycles". A rapid advancement of technology in mobile industries has triggered the frequency of new product development and in turn, boosts up the frequency of new product introduction. An increase of "Technological Advancement" has increased the level of "New Product Development" and on the other hand, an increase in frequency of "New Product Development" has increased the frequency of "New Product Introduction". Thus, the sign on the link from "Technological Advancement" to "New Product Development" and from "New Product Development" to "New Product Introduction" is positive. The positive sign explains that both relationships are change in the same direction. Furthermore, a growing number of "New Product Introduction" in the market and rapid "Technological Advancement" in mobile technology have shortened the "Product Life Cycles". Both links from "New Product Introduction" and "Technological Advancement" to the "Product Life Cycle" show negative sign (indicates that the relationship between the variables is change into opposite direction). The next element to be discussed can be seen in Figure 5.

Smart phone is a gadget that falls under the high tech products and is generally priced using skimming strategy.

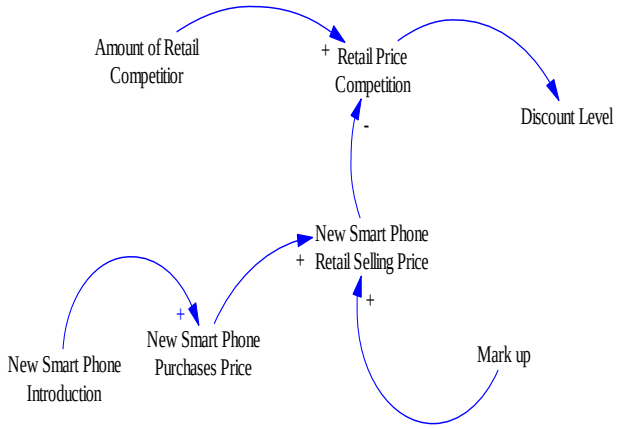


Figure 5 The second part of causal loop diagrams of the final model

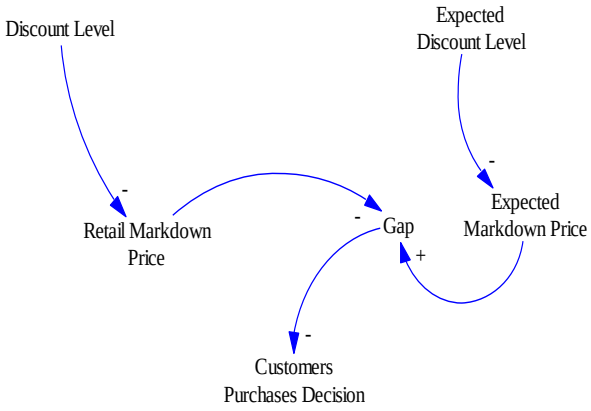


Figure 6 The third part of causal loop diagrams of the final model

Figure 6 shows that, the frequent level of the "New Smart phone Introduction" has produced a variety range of "New Smart Phone Selling Price" meanwhile the "Mark up" variables is used by the retailer to calculate the "New Smart Phone Retail Selling Price". When weincrease the value of the "Mark up", the value of "New Smart Phone Retail Selling Price" also increases. That is the reason that the link between both variables shows positive relationship.

As time goes by, the new smart phone becomes a hit among the customers and slowly grows to become a matured product which cause the market place to be crowded with more retailers which intensifies the competition. As shown in the Figure 6, when the "Amount of Retail Competitor" is high, the "Retail Price Competition" becomes intense (a change in "Amount of Retail Competitor" produces a change in "Retail Price Competition" in the same direction). In turn, to survive in the market, retailers need to create a competitive advantage and as have been discussed earlier in model boundary section, one of the ways is through the setting of "Discount Level". This means, the more intense of "Retail Price Competition" in market, the more "Discount Level" (the causal link between "Retail Price Competition" and "Discount Level" shows that both variables changes towards the same direction) will be used as part of the marketing strategy of retailers.

Figure 6 shows that, the causal links between "Discount Level" and "Retail Markdown Price" has negative sign which means that an accretion of "Discount Level" in the model can decrease the value of "Retail Markdown Price"(Both variable changes in the opposite direction). Next, to know the value of "Customers Purchases Decision" (customers' decision to buy the smart phone with the provided price), the variable "Gap" is used.

"Gap" is the difference between the "Expected Markdown Price" and the (actual) "Retail Markdown Price". From this definition, it follows that an increases in "Retail Markdown Price" decreases "Gap", and therefore the sign in the link between these two variables is negative. Thus, a bigger value for "Gap" apparently leads to decrease of "Customers Purchases Decision" (the link between these two variables is negative). There is one additional link in Figure 7, from "Expected Markdown Price" ("Expected Discount Level" is used with "New Smart Phone Retail Selling Price" to calculate the "Expected Markdown Price") to "Gap". From the definition of "Gap" given above, the influence is in the same direction along with this link, and therefore the sign on the link is positive.

Figure 8 show that, the "Customers Purchases Decision" is added to the "Adoption Rate". This addition means that, the value of "Adoption Rate" is not only determined by the value of "Adoption from Advertising" and "Adoption from Word of Mouth" but also determined by the "Customers Purchases Decision" whether in negative or positive ways.

The balancing loop of the model explains the process on how "Adoption from Advertising" has influences the changes between "Potential Customers" into "Customers". Firstly, the positive interaction between "Potential Customers" and "Advertising Effectiveness" contributed to the value of "Adoption from Advertising", which then positively influences the value of the "Adoption Rate". Whilst, an increase in the value of "Adoption Rate" will decrease the value of "Potential Customers" (the link connected both variables show negative sign)

Meanwhile, the reinforcing loop of the model defined the process on how "Adoption from Word of Mouth" followed by an interaction of other variables changes the "Potential Customers" into "Customers". The value of "Adoption from Word of Mouth" comes by the positive influences (all the links that connected to "Adoption from Word of Mouth" changes in the same direction) of "Potential

Customer", "Contact Rate", "Adoption Fraction" and "Total Population".

Figure 9 illustrates the last part of the final causal loops diagram which consist two parts of interactions. The first one is the interaction between "Customers", "Demands" and "Sales", while the other one is the interaction between "Sales", "Profit", and "Investment" back to the "New Product Introduction".

The number of "Customers" has influenced both "Demands" and "Sales". An increase in "Customers" number can increase both "Demands" and "Sales". On the other hand, an increase in "Demands" can also increase the value of "Sales". All the causal links in this first interaction possessed positive sign which by definition, the links change in the same direction.

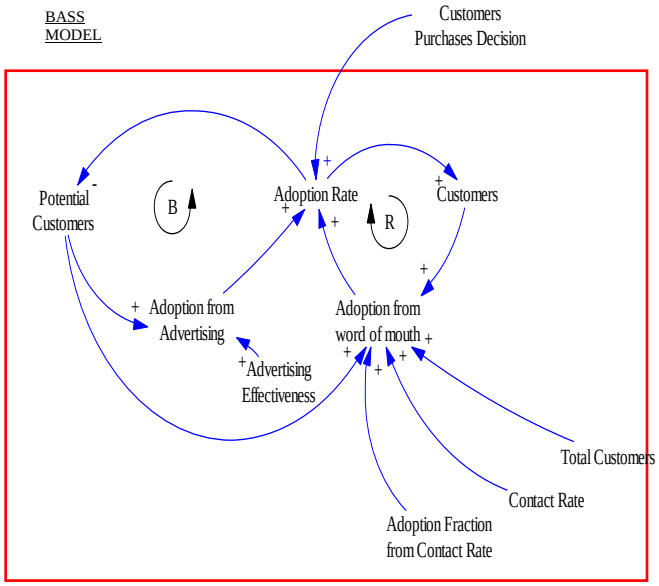


Figure 7 The fourth part of causal loop diagrams of the final model

The number of "Customers" has influenced both "Demands" and "Sales". An increase in "Customers" number can increase both "Demands" and "Sales". On the other hand, an increase in "Demands" can also increase the value of "Sales". All the causal links in this first interaction possessed positive sign which by definition, the links change in the same direction.

The second interaction illustrated in the figure describes a positive interaction among the variables. It shows that, an increase in Sales also increase the "Profit", which by then, directly increase the value of "Investment". Finally, the "Investment" money can be used to obtain another new smart phone in the future.

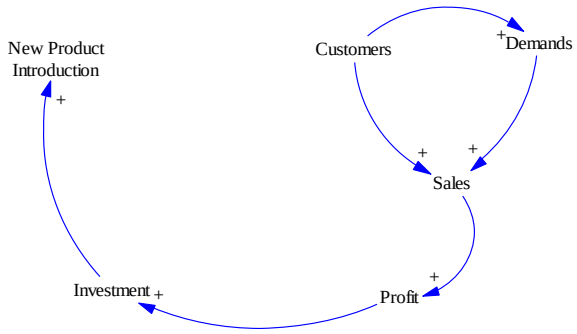


Figure 8 The last part of the causal loop diagrams of the final model

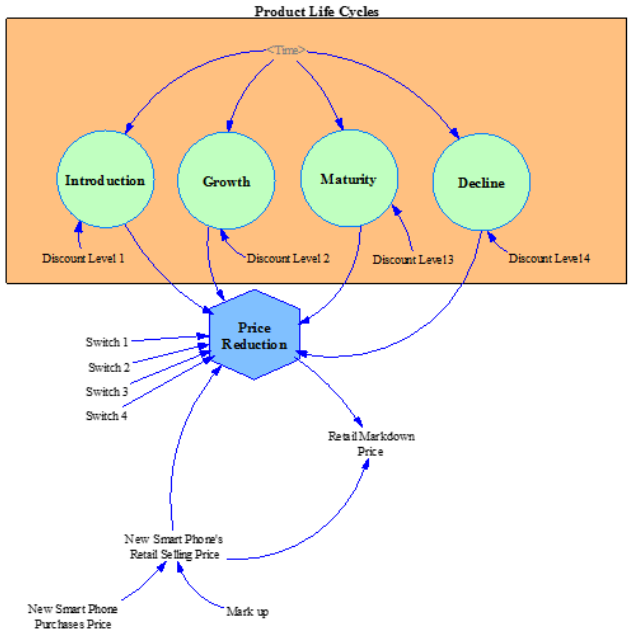


Figure 9 Stock and flow diagram of retail markdown price

Figure 9 shows the application of discount levels into four phases of Product Life Cycles. This application is used to observe the impact of discount-pricing strategy on cumulative sales of smart phone. The value of "New Smart Phone Purchases Price" and "Mark up" is set to constants. Meanwhile discount levels is used as lookup function to calculate the "Price Reduction" which also be used for calculating the "Retail Markdown Price".

Most retailers set prices by marking up the product's cost to yield a profitable gross margin. The "Mark up" value acts as a benchmark of discount levels, so that when the times comes for the discount promotion, retailers will not loss the gross margin due to the exceeds in giving discounts.

In knowing whether the active "Customers" will adopt the new smart phone based on the discount level offered by the retailers we need to formulate the value of the "Customer Purchased Decision" by

involving the interaction between two variables; "Gap" and "Customer Perceived Sacrifies." These interaction can be found in Figure 10 belows.

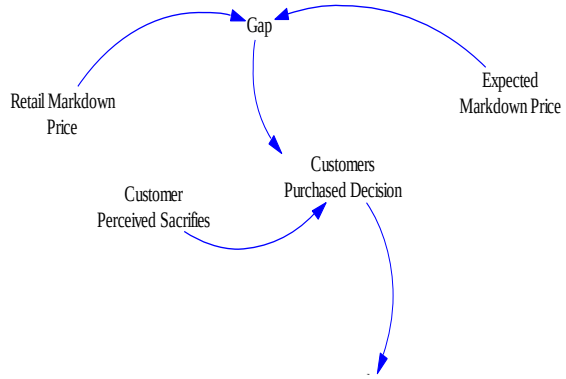


Figure 10 Stock and flow diagram of customers purchased Decision

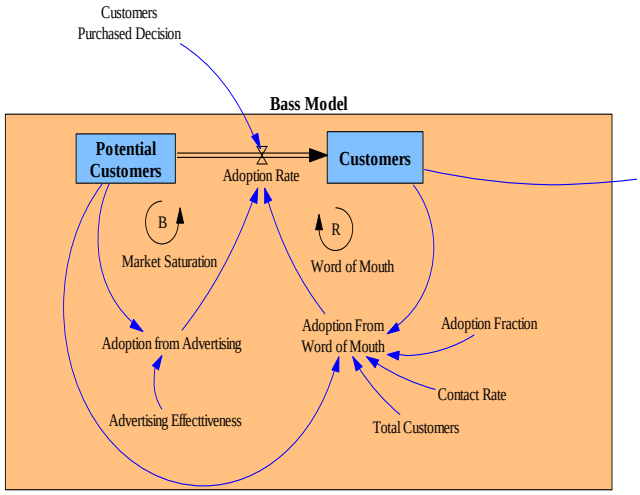


Figure 11 Stock and flow diagram of customers' Bass model

Next, Figure 11 describes the Bass Model used in discount-pricing model. This model has two main stocks; "Potential Customers" and "Customers". Even though the reinforcing feedback loop "Word of Mouth" dominates after an early growth phase, the first "Customers" are induced through advertisement. The conversion from "Potential Customers" into "Customers" is generated through the number of "Contact Rate" between "Customers" and "Potential Customers" and the probability that a contact is successful in attracting a new adopter ("Adoption Fraction"). The number of "Customers" compared to the "Total Customers", where the innovation takes place, dilutes this effect. As the number of "Customers" increases, the number of "Potential Customers" decreases and the balancing feedback loop "Market Saturation" takes control. "Market Saturation" feedback loop reduces gradually the growth rate until there are no more "Potential Customers". The equation and the value of the mathematical equation are based on the Bass Model.

Figure 12 shows the accumulation stock of "Cumulative Sales for every discount-pricing strategy offered within four different phase of Product Life Cycles. The value of "Cumulative Sales" is calculated through integration of "Sales Revenue" which the value is based on two auxiliary variables; "Demands" and "Average Retail Markdown Price". Thus, the mathematical equations involved in the model are:

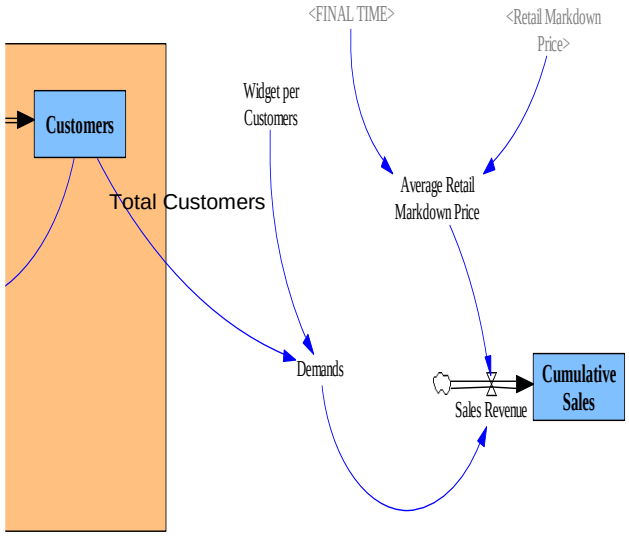


Figure 12 Stock and flow diagram of cumulstive sales

As shown in Figure13, the colored curves represent the simulation results for "Potential Customers" in different phases of product life cycle. By referring to the figure, the grey curve of "Potential Customers" that represented the "Introduction" phase is the first one to decreased more rapidly as compared to the green curve (Growth), red curve (Maturity), and blue curve (Decline) of "Potential Customers", where it started to decrease from the 1st month being introduced to the market, with the total number of potential customer of 87 person/month. The rapid decrease of the grey curve shows rapid new product adoption when the discount id offered at the "Introduction" phase, meaning that the drop in price in the early month of the new smart phone released has attracts more "Potential Customers".

The rapid decrease of "Potential Customers" depicted by the grey curve of "Introduction" phase has directly increased the number of "Customers". This means that, discount promotion offered in within this phase has successfully converted the potential customers into real customers to buy the new smart phone within this phase. This result can be seen in Figure 15, where the grey curve slightly increased higher than the green curve, red curve and blue curve.

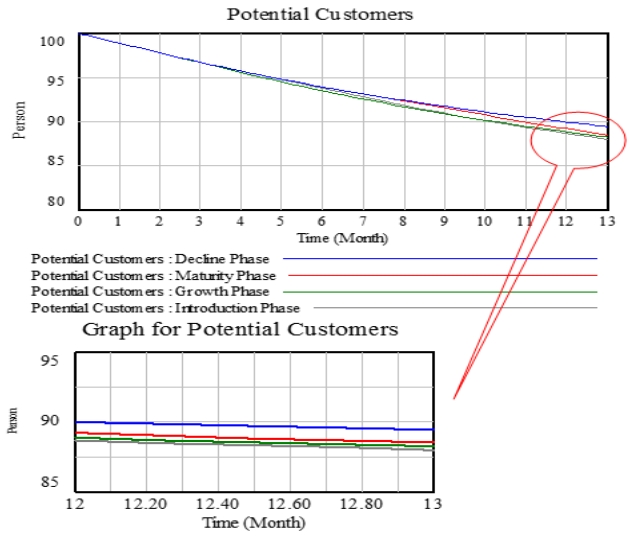


Figure 13 The cumulative behavior of "Potential Customers"

The rapid decrease of "Potential Customers" depicted by the grey curve of "Introduction" phase has directly increased the number of "Customers". This means that, discount promotion offered in within this phase has successfully converted the potential customers into real customers to buy the new smart phone within this phase. This result can be seen in Figure 14, where the grey curve slightly increased higher than the green curve, red curve and blue curve.

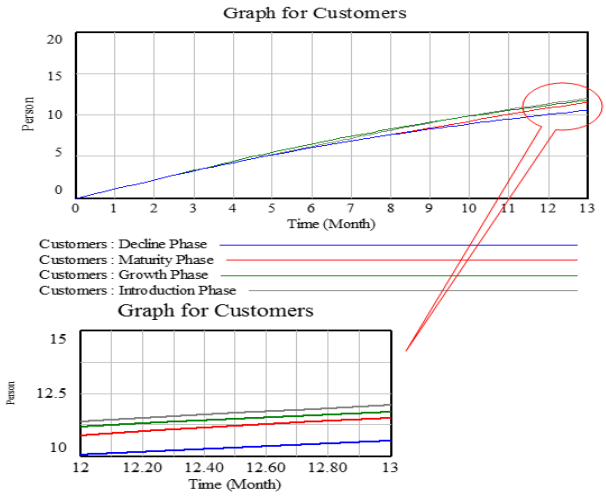


Figure 14 The cumulative behavior of "Customers"

Thus, when the number of the customers within introduction phase increases the cumulative sales of introduction phase also increase. Figure 15 shows the pattern of behavior of "Cumulative Sales" for each phase within product life cycles. Based on the figure, we can see that the grey curve which represents the value of "Cumulative Sales" at introduction phase is slightly increase than other curves, by definition, the highest sales for new smart phone is when the discount is offered at introduction phase, respectively followed by growth phase, maturity phase and decline phase.

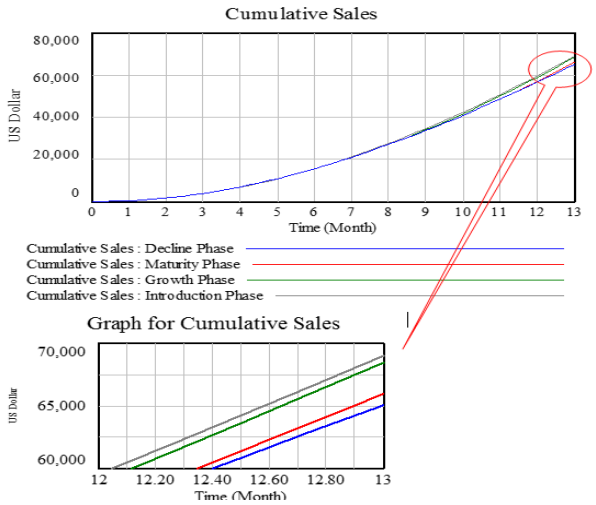


Figure 15 The comparative behaviour of "Cumulative Sales"

Table 1 shows the results on the "Cumulative Sales" for each phase of the product life cycle. The cumulative value in the decline phase shows a slight decrease in sales as compared to the base model, due to the amount of the of the customers is lower as compared to the base model. This shows that the effectiveness of the discount promotion for the new smart phone in decline phase becomes less at the end of the product life cycle, the new smart phone become outdated and the attraction and the tendency to buy the smart phone has shifted to other new smart phone.

Table 1 Simulation results for "Cumulative Sales" for each phase in product life cycles

Phases	Value	Percentage change in comparison with the base model
Introduction	US Dollar 68, 963.00	+5.1 %
Growth	US Dollar 68, 443.00	+4.4%
Maturity	US Dollar 65, 962.00	+0.8%
Decline	US Dollar 65, 053.00	-0.6%

4.0 CONCLUSION

This exploratory research was conducted due to the problem arise in retailer's discount pricing strategies for new product within product life cycles. In current retailing world where everything is moving with the higher speed in term of production of new product and adoption process of the new product by customers, retail manager needs to strategically plan the discount –pricing strategies to create competitive

advantages for surviving the intense competition of modern retailing world. . Thus, three research questions and three research objectives have been used as research guidelines for conducting this research work. The following paragraphs explain how the research questions were answered and how the research objectives were achieved

Research Question 1: What variables should be included in the study?

The first element needed to develop the discount-pricing strategy model is the collection of important variables that when it works as one unit, it depicts or describes the real system of the discount-pricing strategy of smart phone. The interconnection or relationship between the variables must show the real pattern of behavior of the real system. The collection of the variables is identified through the reading of previous study. There are also comes from previous System Dynamics model and from the understanding of literature, including survey and reports. Thus, all the variables used in the model can be found in the form causal loops diagram of discount-pricing strategy model and indeed the causal loops diagrams provided the evident that the first objectives has already been achieved.

Research Question 2: When and what phase exactly should the retailer provide discount for the new product within a product life cycle?

The result shows that the customer is more attracted to purchase new product when the discount is offered at introduction phase of product life cycle. This happened because, usually, customers tend to assume that discount promotion started when the new product comes to the maturity point until the end of product life cycle. Thus, they like to wait until the price of the new product is reduced to the acceptable level of their expected discount price. But in this case, we utilized the advertising effort by the retailer to start early discount promotion instead of waiting to the end of product life cycle. Generally, at the beginning of introduction phase until growth phase, there will be heavy advertising about the new products to build up product awareness in the market.

Therefore, when the level awareness of customers started to rise, we grab this opportunity to start the discount promotion to the customers. As price is one of the most influencing factors for customer to buy new product, the customer will make a comparison between the discounted prices offered by the retailer with their expected discount price. If the customers perceived value is high, which mean the perceived benefits they get from the discounts, is higher than their perceived sacrifices, they will buy the new smart phone without any delay.

On the whole, once one customer aware of the discount promotion, there will be a spread of information between actual customers and potential customers. Thus, there will be more customers attracted to buy the smart phone at Introduction phase. This situation is precisely explained by the Bass Diffusion model used in this model. Bass Diffusion model described the theory of communication regarding how information is dispersed within a social system over time. Due to people place different emphasis on how much they rely on media and interpersonal communication for new ideas and information, they adopt new products either in early phase or at the end phase of product life cycle [80].

Besides, delays in offering the discounts (offered discounts at Maturity phase and Decline phase) can leads to the loss in sales because smart phone market will eventually become saturated with other new products and other retailers who may be able to offer much lower discounts which intensifies the competition and directly lowered the probability on winning the customers. In conclusion, the objective of identifying the suitable phases in product life cycles to offer discounts for new product, has been achieved by the results showing that the best phase to start offering the discounts is at introduction phase of product life cycle.

Research Question 3: How much discount should be given?

The second research question is answered based on results analysis from the email interviews, observations from retailers' websites and E-commerce blog. The analysis presents the suitable discount levels that need to be offered by retailers are from 10 % to 30 % for new smart phone. Therefore, the second objective of the study which to identify the level of discounts that should be offered for new product was achieved.

Research Question 4: What are the discount-pricing policies that is beneficial to be adopted by the retailer?

As shown by the analysis of the performance of smart phone sales with a variation discount level implemented in four stages of product life cycles. The beneficial discount-pricing policy has to be adopted at the introduction phase of the product life cycles. The cumulative sales in this phase shows the highest value compared to when the discount –pricing strategy is offered at the Growth phase, Maturity phase and Decline phase. Thus, with this result, the third objective; to analyze the performance of different discount-pricing strategies, has been achieved

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