
Behavioural dynamics of marketing technology-based
products

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ABSTRACT

The technology-based products are marked by the severity of learning requirements for the users. Marketing efforts should, therefore, represent not only promotional but detailing activities as well, to overcome the behavioural, technological and related marketing constraints faced by the products. Sales, though a significant factor, does not, by itself, explain the intricacies of the dynamics of marketing. The study tries to explain the nature of interactions amongst behavioural variables that contribute to the successful marketing of technology-based products.

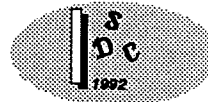
INTRODUCTION

The innovation diffusion and adoption process is too complex to allow realistic models to be evaluated analytically and so these models must be studied by simulation. System dynamics simulation methodology is based on the idea that managerial problems should be examined in terms of the total system and complex interactions that take place over time in the system. The simulation part aims to demonstrate the characteristic behaviour of the system rather than to predict specific events. It can be used as a kind of synthetic test market to be investigated under alternative specifications of the values of the instruments of the marketing mix.

System dynamics is preferred for the following reasons:

- * ability to incorporate time lags
- * ability to handle irregular functions conveniently
- * empirical data is not the foremost requirement
- * easy to model qualitative behavioural relationships.

This report presents the details of the development of a generic system dynamics model to study the innovation



diffusion and adoption process of an evolving technology-based product in the Indian context namely, the personal computer.

PRODUCT INNOVATION

Anderson and Ortinau (1988) have adopted an innovation classification scheme based on behavioural interpretations. The product innovation when perceived by consumers as being a new product established by a major technological advancement it is known as a discontinuous innovation. This type of innovation represents a major change in the benefits offered to consumers and in behaviours necessary for them to own and use the product. Such product innovations are marked by the severity of learning requirements for the adopters. The product search attributes can be highlighted by product display and advertising. The experience attributes can only be acquired by constant use of the said products. Using customer needs as the foundation for marketing in technology-based products is problematic, because potential customers often cannot articulate what they need. Hence it is difficult to forecast the diffusion rates since it may be necessary to 'educate' potential customers about the new technology before they can evaluate it and deduce a judgement of desirability (Robertson and Gastignon, 1987).

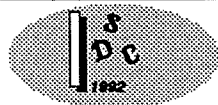
Many products of discontinuous innovation type actually establish entirely new product categories (Personal Computer). There is no history or comparable products on the market. Hence there is no experience curve on which to make decisions concerning the appropriate marketing programs.

A discontinuous innovation tends to be initially manufacturer (or supply) driven and not market driven. Hence perceptual differences to the innovativeness of the product may exist between marketers and consumers.

Marketing programs and strategies must be designed to

- * enhance consumer's acceptance of the innovation
- * overcome consumer's resistance to change
- * develop primary demand for the innovation and
- * create new consumer consumption habits.

A more realistic perspective of new innovations within consumer markets might be that innovativeness do have the propensity to change from being discontinuous in nature to continuous based on consumer's needs/wants, usage levels and their degree of comfort or capability with the innovation.



OBJECTIVES

The objective of the model analysis are to

- (1) develop an understanding of the relationship between the structure of the model and the behaviour it produced.
- (2) verify the adequacy of the model as a representation of the real system relative to the problem under study.

METHODOLOGY

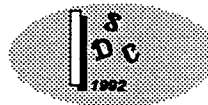
Details and data have been taken from various Indian computer magazines and business newspapers. Wherever needed, the data have been assumed based on judgment and the model's ability to reproduce the historicity. The values for table functions and constants are based on informal discussions and interviews reported. Since the model accommodates behavioural variables also, a number of switches have been provided throughout the program, written in DYNAMO language, to toggle between sectors. The model depicts, inter alia, the corporate growth and provides useful summary statistics.

Parameter variations were carried out to determine the basic model. The subsequent model improvement was done in two ways. Firstly by simulating the model for all combinations of values of the parameters which provided some improvement and the second by modifying the system structure based on an understanding of the causes of the problems and of the general principles of information feedback system behaviour which had a greater potential for system improvement. The interactions being complex, total system behaviour could not be determined directly. A personal computer with PROFESSIONAL DYNAMO+ software was used to produce the results over a series of small intervals and updating the various states of the system each time. The projections were made till the year 1995. Though the model works well for periods beyond 2000, the ever changing dynamics of marketing may nullify the findings.

Sensitivity tests were conducted for the initial values, table values and values for constants. Partial model testing was also done to check the intended rationality of the decisions.

BEHAVIOURAL DYNAMICS

A policy simulation model is goal oriented since, by definition, it is designed as an aid to decision making.



The extent to which a policy simulation is capable of providing some solution to the stated problem is a technical characteristic of the model; it is a precondition to successful application. The fact that there are so many cases of technically valid models that are unused suggest that there are important behavioural factors that determine successful application.

Roger's (1976) five dimensions of innovation-relative advantage, compatibility, complexity, divisibility and communicability were expanded to include characteristics such as financial cost, social cost, return to the investment, risk associated with the product and efficiency of the product in terms of time saving and avoidance of discomfort (Dickerson, 1983).

The most effective means of conceptualizing adoption and diffusion behaviour is to view this behaviour in its most basic and elementary form.

- (1) Behaviour is oriented towards attaining ends or goals.
- (2) It takes place in situations
- (3) It is normatively regulated.
- (4) It involves an expenditure of effort or motivation.

In order for adoption to occur the individual must perceive that the potential rewards for adoption outweigh the expected efforts required for adoption.

Following Bernhardt and Mackenzie (1972), the diffusion process for economic goods can be defined as the adoption over time of a specific product, by customers who are linked by channels of communication to a given social structure and by a given system of values or culture. The adoption process is influenced by the product, the potential adopter's characteristics, his linkage to a social structure, change agents and the adopter's culture. Different assumptions regarding these may lead to different diffusion models.

If adoption of an innovation is plotted against time from introduction to complete diffusion they will assume the characteristics of a normal distribution, or if plotted cumulatively assume the familiar S-shaped curve which characterises the product life cycle curve.

The diffusion process can be characterized in terms of three dimensions: the rate of diffusion, the pattern of diffusion and the potential penetration level. The rate of diffusion reflects the speed at which sales occur over time. The diffusion pattern concerns the shape of the diffusion curve. The potential penetration level is a



separate dimension indicating the size of a potential market. That is, the maximum cumulative sales (or adoption) over time (Gastignon, 1985).

A potential adopter may be viewed as engaging in activities that convert inputs, including the potential adopter's time into benefits. The inputs and benefits are evaluated in terms of the potential adopter's objectives.

Two aspects of changes are induced by adoption.

- (1) The nature of the changes consisting in the difference between the pre-adoption set of activities and the post-adoption set.
- (2) The consequences of the change consisting in the difference in value.

The potential adopter will be uncertain regarding both the nature and the consequences of the changes due to adoption. It is reasonable to assume that people avoid risk if possible. One way to model such conservative behaviour is to assume that potential adopters apply safety margins to their estimates of the nature and the consequences of changes due to adopting an innovation. Only if the perceived value of the post-adoption activities, and their value modified by safety margins, exceeds the value of the pre-adoption activities will an innovation be adopted. The size of the safety margin depends on the degree of uncertainty, regarding the innovation and the importance of the affected activities in terms of the potential adopter's objectives. The stranger the innovation and the more important the activity, the larger the safety margin. We may define a potential adopter of an innovation as an entity that would adopt an innovation if its uncertainty were reduced sufficiently for its safety margin to be zero.

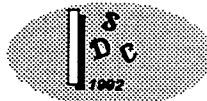
For potential adopters, adoption usually requires a reduction in initial safety margin. This reduction takes time. The adoption process can be conceptualized in terms of stages;

AWARENESS INTEREST EVALUATION TRIAL ADOPTION

The time interval between awareness and adoption may range from minutes to decades. Movement from one stage to next requires an information search and a decision. Different information sources are more potent at different stages although this is not uniform for all innovations.

INDIAN MICRO MARKET

The personal computer was introduced to the Indian market



at the end of 1985. In terms of volume, the number of PCs sold in India during 1985-86 is 15000; 1986-87 is about 20000; 1987-88 is 22000; 1988-89 is 50000; 1989-90 is 75786 and 1990-91 is 91308.

The gross industry turn over for 1990-91 is Rs.2214/- crores, a 32 percent growth rate from 1989-90. The micros alone accounted for Rs.495/- crores, a 16 percent increase over 1989-90. The average price of micros (including PC/XT/AT/386/386SX) came down from Rs.0.62 lakh in 1988-89 to Rs.0.54 lakh in 1990-91.

The 1987-88 import-export policy provided a number of sops for the hardware industry. While the imported computers attracted only 90 percent duty, the duty level on imports of inputs to Indian-made systems went up to 98 percent. The year 1988-89 saw a transition in product cycles, shifting standards, take overs and strategic realignment of products and markets. The year 1989-90 was a bleak period. The value of goods and services on IT-related goods which grew by 44 percent in 1988-89 fell down to 32 percent in 1989-90 due to socio-political environment. However, the overall picture is bright with 32 percent growth rate.

Selling PCs to Indian customers can be exceedingly complex. The pattern of buying is significantly different across regions. The customer support function has its own woes-changing products, mobile manpower, hostile environment (dust, frequent interruption in power supply and not-so-confident after-sales service. On the manufacturing side, obsolescence is the main problem. It is also not possible to fix any stable kind of a price/volume relationship due to varying governmental regulations. Then, of course, the R & D problems.

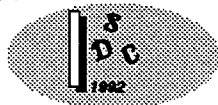
The market is dominated by a few companies as indicated in the Tables. The Tables provide a snap shot of the present Indian Micro Market.

BEHAVIOURAL PARAMETERS

The behavioural parameters are too many. However, an operational classification could be as follows:

(1) In user's perception

Overall image of the company, After-sales service, Dynamic management, Best talent available and the size of the company (large or small).



(2) In Professional's perception

Overall image of the company, Challenging work environment, Professionally managed, Dynamic chief executive, Remuneration and Career growth.

Sales, though a significant factor is seldom enough of a determinant about a company's intrinsic value and standing in the market. The inclusion of qualitative factors becomes necessary in an industry which is in the process of consolidation on the one hand, while witnessing rapid changes on the other, as new markets open and new technology appears with increasing regularity. The image and credibility of the company, its marketing clout, reputation have all been included in the model.

BEHAVIOURAL MODULES

The various behavioural modules in the model are user perception of product improvement, usage rate, functional capability, post-adoption behaviour, market acceptance and new product sector. For the sake of brevity, only the new product sector is discussed (Govindarajan and Ramaswamy, 1990, 1991).

- A $PINNEFF.K = TABHL(PINNEF, RATINP.KL, 0, 1, 1)$
B $RATINP.KL = DELAY3(DEINP.KL, DELINP) * PPC$
L $DEINP.K = DEINP.JK + (DT) (1/TRESSP) (NEDVNP.JK - DEINP.JK)$
R $NEDVNP.KL = TABHL(NEDVN, EFFSPER.K, -1, 0, 1) * SWNEED$
L $AVPAGE.K = AVPAGE.J + (DT) (1 - (RATINP.JK * AVPAGE.J) / NUM)$
N $AVPAGE = 1AVPAGE$
A $BENDIST.K = NOR * (PRELIAB.K + PEXPAND.K + PUSERF.K + PQUALITY.K + PAPPEAL.K)$
A $PRELIAB.K = TABHL(PRELIA, AVPAGE.K, 0, 10, 1)$
A $PEXPAND.K = TABHL(PEXPAN, FUNCAP.K, 0, 1, 1)$
A $PUSERF.K = TABHL(PUSER, EASEOP.K, 0, 1, -2)$
A $EASEOP.K = (IURATE.KL / URATE.K) * EEXPFC.K$
A $PQUALITY.K = TABHL(PQUALT, ESTREP.K, 0, 1, .5)$
L $ESTREP.K = ESTREP.J + (DT) (1/TEREP) (IREPUT.J - ESTREP.J)$
N $ESTREP = IREPUT$
A $IREPUT.K = (1 - FMKTLNC.K) * SWREP + (1 - SWREP) * 4/5$



The new product sector deals with the need to develop new products and the decision to introduce new products. The product innovation effect (PINNEFF) is a non-linear TABHL function of rate of introducing new products (RATINP). The RATINP is a function of decision to introduce new product (DEINP) delayed over a period of introduction (DELINP). This is multiplied by the probability of product development project completion (PPC) to give the RATINP. The DEINP is assumed to follow the need to develop new products (NEDVNP). The need to develop new products, in turn, depends on the effectiveness of sales performance. The perceived product development is thought of as a TABHL function of benefit distribution (BENDIST). The user's perception of an improved product in the personal computer class is probably a function of reliability, quality, expandability, user friendliness and aesthetics or all of these put together. This is divided by the rate of incorporation of product development into the existing product to give the value for BENDIST. Reliability (PRELIAB) in turn, is related to the average product age (AVPAGE). More the longevity of the product, the more is the reliability. Expandability (or flexibility) is linked to the functionality may be effected by both the characteristics of the product and the relative skill of user. Similarly the user friendliness (PUSERF), ease of operation (EASEOP), quality (PQUALTY) and appeal (PAPPEAL) have been defined. The average age of product is defined. The product's (personal computer) useful age period is assumed to be 5 years. The number of new products (NUM) introduced by the company is also known. Executives in mature companies believe a major factor in determining reputation is the average experience of firms in the industry. PC systems are so technically sophisticated that customers are rarely in a good position to judge the merits of systems offered by alternative vendors. The established reputation of a company (ESTREP), which is built over a period of years (TEREP) as a level variable. The indicated reputation (IREPUT) can be calculated in terms of fraction of market lost to new competition.

CONCLUSION

The evolution process of a technology-based product is subject to the dynamics of human behaviour and competition. A system dynamics framework has been suggested. Sales alone does not explain the intricacies of the dynamics of marketing. Hence the behavioural aspects are emphasized.



TABLE 2

INDIAN MICRO MARKET
NUMBER OF MICROS SOLD

COMPANY	1986-87	1987-88	1988-89	1989-90	1990-91
A	3920	5900	8284	12205	9764
B	4112	4885	7899	14562	18582
C	3344	5210	6834	8590	9662
D	1184	3053	3750	2640	1815
E	950	1800	2700	1448	2631
F	815	-	973	-	-
G	-	2100	4244	7800	14117
INDUSTRY		40000	52000	75786	91308
VALUE (in crores of Rupees)		200	340.13	424	495



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