DECISION SUPPORT FOR MARKETING NEW PRODUCTS

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Abstract. The control of new product growth and market penetration is a key task for corporate management. The concept of Decision Support Systems is applied to this field of problem solving. A general model of innovation diffusion is presented and used to study market response and profit impact of different strategies. Its analysis suggests a marketing approach which aims at rapidly gaining sales volume. Attractive prices and fast capacity built-up take effectively into account the dynamic environment.

INQUIRING SYSTEMS FOR INNOVATION MANAGEMENT

Corporations, ranging from rather small ones to those with multi-billion-dollar turnovers, frequently point out that a substantial amount of their sales - fifty percent or more - is made with goods introduced to the market only during the last few years. Through their sheer size, these dimensions emphasize the importance of the problems associated with controlling new product growth and market penetration.

A key framework in business management is the concept of a product life cycle. It applies biological analogies to describe the time pattern of a product through subsequent market stages like growth, maturity, and decline. Though this framework has its merits as a powerful heuristic, most models presented in the literature, exhibit a significant lack of policy content. They generate the characteristic sigmoid behavior mode on the basis of quasi-natural laws and do not comprise relevant decision variables. They fail to indicate in an operational way, how managerial action can promote but also impede innovation diffusion and adoption.

Remarkable is the complete neglect of the intra-firm resource allocation. These decisions provide the basis for capacity installation, production and in-time delivery. Both, demand and supply side requirements are to be fulfilled in order to achieve and to defend a profitable competitive position.

Only rarely treated (Linstone and Sahal 1976), in reality, however, closely connected, are the substitution processes of an innovation by other even more advanced and/or more attractive products. For at least a significant fraction of businesses the time span between individual substitution sequences has been reduced. Together with a sharp decline in prices, this has shortened the period over which cash flow can be generated; delivery delays can lead to a permanent loss of revenues.

Innovation management is a complex and highly dynamic task; it requires decisions, whose effectiveness is crucial for the firm's survival. It relies heavily on managerial judgment and experience. It cannot be replaced by automated decision making procedures, but nevertheless it can be substantially supported by formalized models and computerized inquiring systems. It is this kind of managerial problem solving, where Decision Support Systems (DSS) can successfully be applied.

In the terminology of Peter Keen and Michael Scott Morton (1978) Decision Support Systems are concerned with

(1) the provision of computer assistance beyond the classical areas of programmed decision making;

(2) the uphold, rather than the replacement, of managerial judgment;

(3) the improvement of the effectiveness of decision making rather than its efficiency.

From a System Dynamics perspective, major aspects of this characterization sound familiar; it resembles Forrester's (1961) early definition, when he describes the field as "...the use of models for the design of improved organizational form and guiding policy". Both approaches imply notions like learning, interaction, and evolution rather than solutions, procedures, and automation (Morecroft 1984).

There are, however, additional features associated with Decision Support Systems, especially with respect to the employed computer methods. Within the same software environment, different types of problems can be handled in a man-machine dialogue. Data are kept available, a collection of tools for the design, analysis and presentation of models allows the modular composition of decision models. The approved traditional effort in System Dynamics to develop a base of "cardinal" or "generic" structures as building blocks of complex systems indicates in the very direction.

Launching new products into the market is not a completely unique and unprecedented task, its process exhibits at least a certain amount of structure. A product - even an innovative one - is characterized by a rather limited number of general attributes like investment or consumption good, short versus long lived, high technology versus low technology, etc. These similarities together with the knowledge about generic model structure and behavior form the basis for interactive decision support.

A GENERAL FRAMEWORK FOR INNOVATION DIFFUSION

In the following the coarse structure of a model generating the life cycle of a new product is presented and analyzed in its dynamic implications (Milling 1986). It focuses either at a whole class of products - like color tv sets, dish washers or CD players - or at a particular good without direct competition between different suppliers, due e. g. to patent or copyright protection. Figure 1 shows the model's main components and transfer rates.

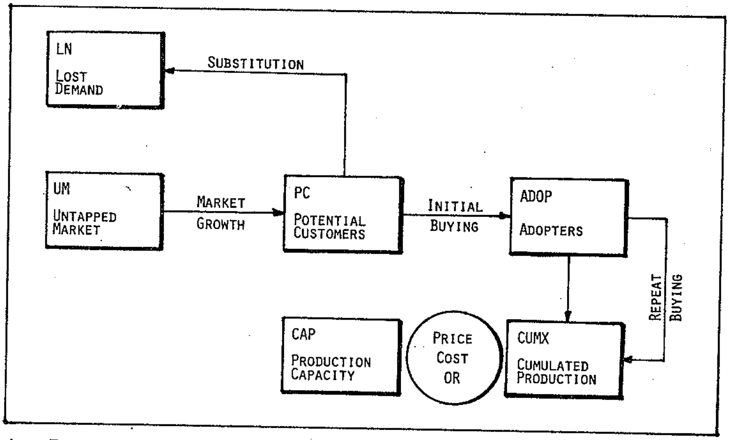

Fig. 1: Coarse structure of the innovation diffusion model

Three buying categories in the process of innovation diffusion are distinguished:

(1) "Innovative trials". Innovators are not influenced in their purchasing decision by the people who already adopted the product; they are solely a function of the number of Potential Customers (Bass 1969).

(2) "Imitative trials". Imitators have in some sense learned from those who have already adopted the good, i. e. they are influenced by the number of previous buyers. Their size depends upon the communication between Potential Customers and those who actually purchased (Rogers 1983).

(3) "Repeat buying". While both innovators and imitators are initial buyers, the final category of replacement purchasing is a function of earlier sales delayed by the product's average life time.

These three flows of buyers constitute the core model of innovation diffusion. It is largely composed of generic modules, whose isolated dynamics are understood from related studies, e. g. in connection with the spread of epidemics. Without interfaces to other sectors, this structure generates the typical logistic pattern over time with its stages interpreted as introduction, growth, maturity, and decline (Figure 2).

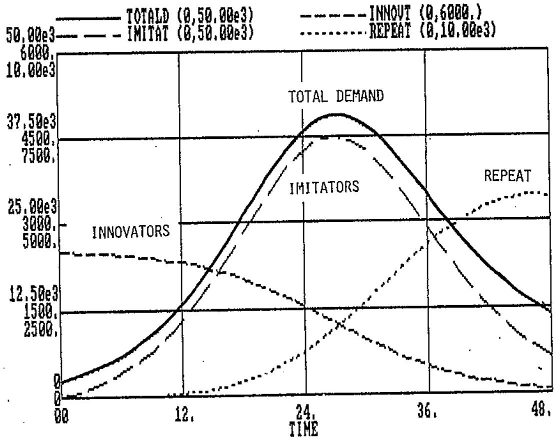

Fig. 2: Behavior of the core model

To be used as a decision support tool, relevant managerial variables have to be included. The core model is expanded through sectors defining (i) market development and technological substitution, (ii) capital investment, production volume and cost, and (iii) product price and operating result.

AN APPLICATION TO PRICING STRATEGIES IN A DYNAMIC ENVIRONMENT

Pricing new products is an essential but largely unresolved problem of innovation management. Peculiar difficulties result from the dynamics in demand interrelations, cost development, and the risk of early substitution through more advanced products. In spite of this complex framework for decision making, the development of formal simulation models is considered to be generally inferior to analytical approaches (Friedman 1984). Attempts to derive and to actually apply optimal pricing policies, however, are faced with difficulties, both mathematical and practical. Their results (Abel and Jeuland 1982) indicate factors to be considered, but the proposed pricing rules appear by far too complicated to support actual pricing decisions.

In the innovation diffusion model four price setting mechanisms are included for direct investigation:

(1) Myopic profit maximization where there is perfect information on the current state of cost and demand. The optimal price is derived from elasticity of demand $\epsilon(t)$ and per unit cost $c(t)$ which depends on long run experience effects and on short term capacity utilization: $p^{opt}(t) = c(t) * \epsilon(t) / [\epsilon(t) - 1]$.

(2) Skimming price strategy serving first customers with high reservation prices and subsequent price reductions (Clarke and Dolan 1984). The model applies a simple decision rule

modifying $p^{opt}(t)$ through an exponential function with time constant T: $p^{skim}(t) = p^{opt}(t) * (1 + a*e^{-t/T})$.

(3) Full cost coverage plus a profit margin π to achieve positive results even during the early stages of the life cycle: $p^{fcc}(t) = c(t) * \pi$.

(4) Penetration pricing aims at rapidly reaching high production volumes to benefit from the experience curve and to increase the number of adopters. It sets prices according to: $p^{pen}(t) = c(t) * \pi * (1 - a*e^{-t/T})$.

To evaluate these policies, the firm's operating result is used as the measure of performance.

With respect to the market and environmental scenario, it is assumed that the level of Potential Customers can be increased by activating demand from the currently untapped market through price reductions . The speed of this process depends also on the already achieved market penetration. On the other hand, in period t = 15, a substituting product is launched by other firms, starting a life cycle of its own and thereby drawing away demand from the good under consideration.

For all four pricing strategies, figure 3 compares the simulated market responses. The lower set of curves presents the firm's operating result per period, the upper range of the figure gives the corresponding synopsis for the cumulated and discounted performance.

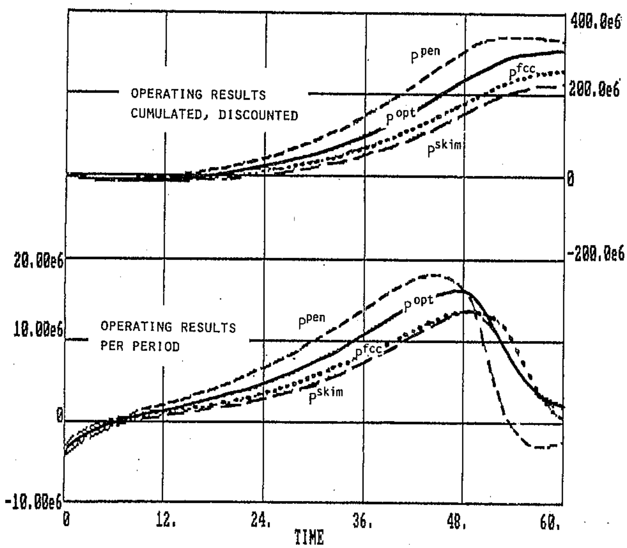

Fig. 3: Synopsis of operating results for different pricing strategies

Figure 3 indicates that in a dynamic environment the classical pricing rule for profit optimization leads to a result which is superior to both full cost pricing and the skimming strategy. The appropriate strategy - as suggested by these results - constitutes the attempt to rapidly penetrate the market. This objective is achieved by setting relatively low prices, especially in the early stages of the life cycle, and by providing sufficient production capacity for immediate delivery. Temporary excess capacity hurts the financial performance less than longer delivery delays. The combined price and diffusion effect stimulates the environmental demand dynamics and reduces the risk of loosing potential customers to upcoming substitution products.

CONCLUSIONS

The model introduced is a modularly composed representation of the product cycle dynamics. It offers the flexibility to be adopted to different innovation types. It allows the analysis of alternative marketing policies for new products. Proposed price strategies serve as examples to demonstrate the model's viability. A strategy of rapid market penetration is suggested to be most promising in a dynamic demand situation where prices influence market growth, where substitution can occur, and where delivery delays eventually accelerate the decision of potential buyers to turn to other products.

Extensions of the model should include direct competition between suppliers of the same or similar products, allow the consideration of different levels of product quality, and the impact of advertising on market behavior.

Linked to a data base with market information and controlled by a dialogue system, a collection of such models provides effective decision support for innovation management.

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