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A Decision Support System for evaluating operations investments in high-technology business

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Abstract

The evolution in the way that businesses approach markets has been a frequent literature topic in the last few years. In the high-tech industry, even the most successful companies have been mainly focused on the features of their products and processes, trying to develop their technology to gain a price/performance advantage, and thereby protect or increase market share. However, this approach is disconnected from their beliefs about what target customers really care about, nor does it is consider which of those underlying assumptions are most critical to business growth in share, revenue, and profit. This paper proposes a Decision Support System (DSS) to connect customer value to business targets, providing scenarios to show the customer responses and business results that will enable future funding, with optimization techniques to compare alternatives.

The first step is for business planners to characterize their target market by formalizing what are often informal but deeply held beliefs about what drives their customers' purchase decisions. They create a list of attributes that together define customer value, the basis on which customers in the target market compare and select from competing products. With that attribute list, planners sometimes are able to go further and segment their market by grouping customers together who put top priority on the same attributes. This system dynamics model connects planned investments to expected improvements in the customer's perception of those critical attributes, (relative to the competition), and thus increase sales, revenue, and market share.

Keywords: Decision Support Systems; System dynamics models; Investments evaluation; Product life cycle management; Supply chain management; Channel strategy; New product introduction; Solution selling; Solution integration; Product awareness; Pricing

1. Introduction

Decision Support Systems (DSSs) are tools that an organization uses to support and enhance decision-making activities [1]. Early use of decision support analysis was marketing Decision Support Systems (MDSS), defined [11] as a coordinated collection of

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data, system, tools and technology, with supporting software and hardware by which an organization gathers and interprets information from business and environment and turns it into a basis for marketing action.

Within the field of marketing, Higby and Farah [6] found that in the US, 32% of the companies have installed some form of marketing DSS (based on a survey among 212 executives.); In the Netherlands, Van Campen et al. [25] estimated the penetration of Decision Support Systems in marketing at 37% (based on a survey of 525 companies with over 10 employees and marketing manager present). The fact that current formal marketing plans incorporate information resources in 95.2% of the firms, compared to incorporation in 76.2% of the firms' strategic business plans [10], illustrates about the importance of MDSS at present.

Companies and business planners have recognized the strategic importance of MDSS and are stepping up their investments in information technology for marketing [21] Adoption of MDSS is higher in companies with consumer products compared to industrial (business-to-business) products companies, and in companies with more market information available [27].

Their objective is to support a decision making process which is primarily a matter of reasoning (using the mental models of the manager) and analogizing (based on stories about similar events retained in mind). For instance, Van Bruggen et al. [24] found that managers who use a DSS are less inclined to anchor their decisions on earlier decisions compared with managers who do not use the system. Similarly, these authors found that the incorporation of model-based results into a DSS is especially beneficial. Prominence effects, overconfidence and other biases are reduced for managers who use model-based DSSs relative to managers who do not. In the literature, we find that although the applicability of some marketing models to real-world problems has been questioned [22], there have been many examples of successful marketing model applications (see, for instance, Refs. [12,14]).

Beyond marketing, others of these model applications are within the new products area [9], trying to understand the dynamics between changing demand and the entry and exit behaviors of competitors in the market place. These works model demand and number of competitors simultaneously and empirically investigates some high-tech markets. Still other models try to bridge between new product introduction and marketing to understand the relationship between the number of competitors and the rate of technology diffusion [2], or to tie conceptual design in a new product introduction with cost modeling and marketing considerations [26].

In this paper, however, we go further to model product design and marketing innovations to anticipate and explain the way collaborative teams, both within firms and between partner businesses, may gain and retain customers in a very competitive high-tech marketplace. The model also considers the expected response of a changing set of competitors. In this work, we pay special attention to the characterization of the customer behavior, and we use system dynamics to build our simulation model[2]. The simulation model confirms through team review that we have captured the behaviors that explain their customer segment response to changes in product attributes and price, creating collective understanding of the existing business environment, and able to be validated by historical data when available. This can

[2] System Dynamics is a methodology that was born at the MIT in the late 1950s. Developed by Jay W. Forrester, it is focused to the observation of the behavior patterns, instead of concrete events, of the systems. System dynamics models help to understand the relationship between behavior patterns and system structure. Problems related to system behavior, can be then solved by changing the system structure. The models are constructed using cause–effect relationships among the variables. Frequently, relationships may result in feedback loops involving different endogenous model variables. The feedback loops are deeply studied in system dynamics, their gain, delay and dominance (of one loop among other) will explain the observed system behavior patterns. At the same time, feedback loops help to make visible different system variables life cycles (technology cycle, business cycle, industry cycle, etc.), and also may represent managerial behavior over time conveniently. The initial focus was on the application of SD to management issues, but was soon extended to the analysis of environmental, social and macro-economic problems (see for instance, Ref. [5]). In [17] can be found a collection of early papers. Since the mid-1980s, there has been renewed interest in applying SD to business policy and strategy problems. This interest has been facilitated by the availability of new, user friendly, high level graphical simulation programs (such as *ithink*, *Powersim* and *Vensim*). Easily accessible books describing the SD approach (for example, Refs. [13,20,23]) have also played a key role.