

**THE DYNAMICS OF A FLEDGLING
HIGH-TECHNOLOGY GROWTH
MARKET: UNDERSTANDING AND
MANAGING GROWTH CYCLES**

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THE DYNAMICS OF A FLEDGLING
HIGH-TECHNOLOGY GROWTH MARKET*

Understanding and Managing Growth Cycles

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THE DYNAMICS OF A FLEDGLING HIGH-TECHNOLOGY GROWTH MARKET

Abstract

This paper presents a system dynamics model of the fledgling market for automated storage and retrieval AS/RS systems based on a case study of a leading firm in the industry. The model examines how marketing effort, capacity expansion, and industry reputation interact to produce growth cycles of 8 to 9 years' duration in demand and capacity for AS/RS systems. A series of partial model simulations is used to explain how the growth cycles are generated by the feedback structure and behavioral assumptions of the model. A policy experiment is presented to show how a mature firm in the industry can influence the growth cycles to improve its financial performance. Finally, the feedback structure governing market diffusion and capacity expansion is generalized to other high-technology products and markets.

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INTRODUCTION

Innovative products based on new technology often meet considerable market resistance before they are widely accepted and adopted by users. It takes time to persuade customers that the new technology is a worthwhile advance on the technology it supercedes. The product may not, in the minds of customers, be clearly superior to the older-technology product. The reputation of the product may suffer during the early phases of market growth due to inexperienced or unscrupulous producers who turn out inferior and unreliable versions of the product. Companies in such a fledgling industry face the difficult task of assessing the growth potential of the market. They must discern whether market resistance to the adoption and sale of the product is due to genuine limitations in the size of the market or to temporary setbacks in the product's image and perceived usefulness. Failure to distinguish temporary setbacks from true market saturation can easily lead a company into overly pessimistic sales forecasts, which become self-fulfilling as the company restricts capacity expansion in line with the forecast.

This paper examines the long-term dynamics of one particular fledgling high-technology growth market, the market for automated material handling systems. A system dynamics model of the market is presented that was developed for a leading company in the industry. The model focuses on technology diffusion and the dynamics of capacity expansion resulting from the entry of new firms into the industry. New firms tend to operate as parasites on the demand created by more mature companies. They expand

capacity on rather speculative grounds and can damage the reputation of the industry by producing unreliable systems. These characteristics of the competition are shown by the model to produce 8- to 9-year growth cycles in the fledgling industry, which can greatly distort an accurate assessment of market potential. Policy experiments with the model show that a mature company should be prepared to expand promotional marketing effort during periods of market stagnation while excess competitive capacity is worked off and industry reputation recovers. Such a "leadership" marketing policy tends to stabilize the growth cycles and increase the industry's growth rate.

The model may be viewed as a self-contained behavioral theory of market diffusion and capacity expansion in emerging industries that produce technically complex products. A number of high-technology industries might fit this description, particularly those making sophisticated equipment for the office and factory of the future. The model-based theory represents an addition to the market diffusion literature of Bass (1968), Dodson and Muller (1978), Mahajan and Peterson (1978), and Rogers (1962) by showing market structure that can create an illusion of saturation in a growth market.

A BEHAVIORAL MODEL OF FLEDGLING MARKET DYNAMICS

Background on the Automated Material Handling Industry

Automated material handling systems (also known as automated storage and retrieval AS/RS systems) are used by manufacturers, distributors, and

retailers to store and retrieve components from factory, warehouse, and point-of-sale inventories. A typical example of such a system would include a rack-storage structure (essentially a large matrix of storage bins) and an automatic mechanical device for moving up and down the storage isles to locate, select, and retrieve components from designated locations. Systems are technically sophisticated. They involve a blend of advanced mechanical, electrical, and computer-systems engineering. They are also expensive and time-consuming to make. An automated storage and retrieval (AS/RS) system to be used in a manufacturing plant might cost several million dollars and take more than a year to build and install once the design and specifications have been agreed to.

AS/RS systems are intended to replace manual material handling methods, in which human operators locate and retrieve components from storage areas (sometimes with mechanical assistance from cranes and forklift trucks). Their primary virtue, therefore, is in labor savings. Those savings, however, must be traded off against the reduction in flexibility of automated storage and retrieval (the machine cannot readily cope with errors in component location) and the inherent complexity of the technology. It takes a highly skilled workforce to manufacture, service, and maintain a reliable system. Moreover, the large capital cost of a system makes automation difficult to justify. For these reasons automated material handling technology has not yet been greeted with unanimous enthusiasm. It is still a fledgling technology.

Marketing of AS/RS Automated Material Handling Systems

Marketing of AS/RS systems is generally thought of as a three-stage process. In the first stage, called conditioning, customers learn about the technology and become interested in the product. Automated material handling systems are complex, and a considerable amount of time can be spent in conditioning customers before they are ready to make a commitment to purchase. In the second stage of marketing, customers request studies to identify their system needs. Studies can take six months or more and lead to the definition of a material handling system tailored to the customer's needs. In the third and final stage, completed studies are opened to competitive bidding.

Competition in the AS/RS market is particularly strong from new companies in the industry, which are inexperienced and compete aggressively for contracts, often by underbidding both on price and lead time. Further, new companies are parasites on the market created by the more mature companies. They enter the bidding process but do little to generate and foster interest in AS/RS technology in the early stages of marketing. By contrast, mature companies establish their own base of interested customers and operate as though mutually independent in the market.

Industry reputation is an important aspect of the market. Many inexperienced companies have entered and left the industry during the last decade. Some of these companies have survived for four or five years on contracts that have been unrealistically bid. In many cases the final