Introduction

This is the story of RCA's VideoDisc, a systems innovation by a company, once an industrial pioneer, that was trying to innovate again after a generation of inactivity.

VideoDisc was in two senses a "systems innovation": its technology was founded on several interdependent science-based products and processes, and the coordinated efforts of several different RCA product divisions were required to bring it to market. Like other innovations that originated as science-based systems – the telephone, radio, television, and more recently, videotex – once the elements were in place, parts of it could be sold as individual products, but no piece of it could exist alone in the marketplace.

An innovation is considered to be science based when either the components that it comprises, or the configuration of the innovation itself, require scientific research to bring them into being. Such innovations are generally dependent on some form of industrial research organization either to generate the missing knowledge or to apply already existing knowledge to the problem raised by the innovative system concept. Many argue, for this reason, that science-based systems innovations can best be carried out in a large corporate setting. Few small companies have the resources, the varied production capabilities, or the necessary technical support required for this type of project. Nor can small companies, however innovative, develop and manufacture the specialized components and materials, or assemble the complicated business relationships, to market technology-based systems. Joint ventures, which sometimes attempt to mount systems innovations by combining the complementary skills and resources of several companies, are

notoriously cumbersome and difficult to coordinate and are rarely flexible enough to bring uncertain projects to completion.

Innovation in large companies

Most of what is known about innovation as a managerial activity accurately reflects the experiences of small companies but is wholly unrepresentative of the experience of most large companies. This is unfortunate, for by far the lion's share of the spending for research and development (R&D) and much innovative activity in the United States is performed in large corporations. How does the process of innovation differ in large companies, and what does it take to manage that process effectively?

The standard notion of the innovation process is that it matches a technical capability to a market need. In a small company, where most successful innovations take place, the match between a technical capability and a market need is undertaken and pushed to completion by an individual entrepreneur. A small company rarely has more than a few novel technical capabilities; it is therefore the role of the small-company entrepreneur to identify and define a market need that his or her enterprise can meet with the technical capabilities at its disposal.

The differences between the small-company version of innovation and what passes under that name in large companies are more than simply matters of scale; they are qualitative in nature. In a large company, particularly a diversified one, many considerations intrude upon the simple act of matching technical capability to a market. The large technology-based and diversified company has manifold technical capabilities, often represented by specialist engineering and research organizations, and it frequently has two or three different technical approaches for any given problem. One reason that large companies have in-house research organizations is to acquire or create technical capabilities not already available within the corporation; often rival parts of the company's technical com-

munity are behind different technical approaches. Under such circumstances, the choice of technical approach to a given innovation often relies more on the internal needs and preferences of various parts of the corporation than on a sense of a need in the marketplace. Jobs, retention of key skills, use of readily available equipment, shared characteristics with other projects, and fulfillment of individual organizational goals all are legitimate internal needs that can influence the choices made about a technology as much as, or more than, information about the market.

In any case, if a proposed innovation is really new, little information about the market can be trusted. Often other factors, such as the behavior of key competitors, or the predictions of the press, provide the only information available. It may be distorted, but it is in some sense real. The more diversified a company becomes, the more competitors there are to influence behavior and to filter or distort market information, and the more interested the press is in reporting, and possibly influencing, the innovation process.

Documented examples of the development of science-based systems innovations are rare. Large-scale innovations of any kind, from first inventive idea to full-scale commercialization, are such major undertakings that only a few are carried to completion in any industry. Moreover, because systems innovations generally involve the efforts of several organizational entities within a company and frequently take place over a prolonged period of time, even people who have managed pieces of such projects for years often are surprised to learn what has gone on at other periods or in other parts of the company.

Examples of innovations that have not succeeded are even rarer than those of successful ones, though the former category is many times larger than the latter. Companies, like individuals, are often unwilling to allow themselves, or anyone else, to learn from their experiences. Yet such is the perversity of existence that plans gone awry can teach us more about the way things work, and the way they ought to work, than plans fulfilled without a hitch. We are indebted, therefore, to RCA for allowing this inside look at one large and very complex

systems innovation that lasted nearly twenty years, involved the efforts of thousands of people, required the investment of hundreds of millions of dollars – and ultimately failed.

The research organization

An industrial research organization can be found at the source of many science-based innovations, but relatively little is known about this peculiar corporate institution. Research has been an in-house activity in a few leading American companies since before the turn of the century, and most large companies have had some form of research laboratory since World War II. Yet research remains an enigma in most management circles. R&D is a broader term, encompassing the activities of several forms of technical organization: research laboratory, advanced engineering group, product engineering, process engineering. It is partly because most major science-based innovations in industry involve so many different institutions, even within the same organization, that the process of innovation, from first inventive idea to full-scale commercialization, can take as long as it does, often more than a decade. The popular impression that an invention, once made, should be available for use within a few months' time, reflects public lack of awareness of the operating aspects of R&D. In fact, the act of invention, whether research based or spun off from some other activity, only begins a lengthy and complicated process of embodiment, design, and refinement collectively termed "development." Even in technology-based companies, non-technical employees or employees who work outside the R&D organizations can be unaware of the many ways that research feeds into and draws upon other more visible productive activities. For this reason we are concerned here with the role of the research organization. How has it evolved inside the corporation? And how has it contributed to the process of innovation?

In RCA it was David Sarnoff, the head of the company from 1930 to 1967, who created the corporate research center in a sense as his surrogate, to stand up for the long-term interests of

the corporation and to generate major new business opportunities based on technology. It was to carry out this mission that managers of RCA Laboratories became the wholly committed sponsors of the consumer videoplayer product during the 1960s, and during the 1970s chose to back one technical approach to that product, the capacitance videodisc system.

To manage a corporate R&D division is to encounter daily some of the central tensions of industrial life. Inside his or her own organization the director of an industrial research laboratory must manage research, an act of human creativity and perseverance, but the director must also make objective judgments about technologies, their quality and their utility. At the same time the director must manage the relationships between the research organization and all the different operating entities it serves. This is a delicate balancing act, for there is a natural and unavoidable tension between the immediate demands of current operations, often responsive to short-term profit needs, and the no less important but wholly different requirements for long-term research.

The case of VideoDisc illustrates well the contradictions between managing research and managing intercorporate relationships. The successive heads of RCA research for years had to orchestrate a competition between several videoplayer technologies inside the Laboratories, unsure which one would, or should, win out. At the same time, they had to promote the idea of a videoplayer system to top corporate management and to try to build support in the product divisions for whatever technologies the Laboratories ultimately selected for transfer. The latter task was made all the more difficult because several product divisions preferred videoplayer systems of their own devising, despite the fact that, from the corporate point of view, the Laboratories had primary responsibility for corporate technical decisions.

Why take a risk?

A project involving large-scale innovation would be too wrenching and too dangerous for any responsible corporate

management to undertake if new products were not central to the process of industrial renewal. How and when to renew its products and its organization is a major strategic choice that each company must make. Should it take the initiative, and be a pioneer, or should it wait until most uncertainty is gone and adopt a less risky me-too strategy? In some U.S. industries with a strong technology base, the role of pioneer has belonged historically to one company, one with strong in-house technical capabilities and structured to lead.

A rapidly changing scene has been an abiding feature of life in the consumer electronics industry since the early days of radio. New products based on new technologies diffused rapidly throughout the economy, saturating the market within a few years. Each new decade seemed to bring with it the need for a new generation of products with the potential for renewing and sustaining a multitiered industry. Each major product transition brought with it the need for industrial transformation; that is, the whole complex of related industries that had been created to produce, operate, and maintain radio, and then television, had to transform itself with new facilities, new operating technologies, new components, new products, and new types of software to stay in the market.

For decades, it was RCA that took the lead whenever an industrial transformation was required. It is in light of this pioneering legacy that RCA's experience with VideoDisc is especially interesting. For while VideoDisc was under development in the RCA Laboratories, RCA's corporate management was reconsidering and debating the company's role in future industrial transformations. The ambivalence within the organization led RCA to pursue the paths of leadership and followership at the same time. The course of the VideoDisc project reflected this internal schizophrenia.

The VideoDisc experience also demonstrates the problems of managing an important corporate resource, the central research laboratory. Paradoxically, the RCA Laboratories was both the chief agent of innovation and the major conservative force. Faced with the sole responsibility for RCA's future, but with little corporate direction and in the face of major uncertainty, the Laboratories pursued a course in VideoDisc innova-

tion that was shaped very much by RCA's earlier experience. The constraints placed on videodisc technology reflected the Laboratories' interpretation of RCA successes and failures with other science-based systems products, such as television and magnetic videocassette recorders.

One of the most intriguing things about VideoDisc was the project's tenacity – its ability to survive several changes in top management as well as several revampings of RCA strategy. Yet each threat it survived had its effect on the project. The struggle that the VideoDisc caused to be waged inside RCA raises questions critical to the effective contribution of all research organizations. What is the proper role of the research function in the formulation and execution of corporate strategy? How can research be integrated into the mainstream of corporate life without sacrificing the long-term interests of the corporation? How can the corporate research organization be protected from the negative operating effects of shifts in corporate strategy, yet remain responsive to its changing needs?

VideoDisc was an important part of RCA life for more than fifteen years, especially in the Research Laboratories and in the divisional engineering groups. RCA has extended and applied in countless ways to many other RCA products and processes the knowledge and the know-how, technical and managerial, that came out of the project. This multiplier effect is a characteristic of R&D that is often forgotten, yet few long-term R&D projects are so specific that they do not generate learning for further applications.

It is the purpose of this book to examine aspects of the VideoDisc innovation experience from a management standpoint. The case of the VideoDisc has much to say about four major related themes: the nature of industrial research and how it differs from other forms of industrial activity; the role of the corporate laboratory as an industrial institution; the skills required to manage research and a research laboratory, particularly as it relates to other parts of the corporation; and the problem of integrating research and development into mainstream corporate activity.

1

Selectavision VideoDisc: opportunity and risk

It was a highly improbable match between promoter and product. RCA Chairman Edgar Griffiths was not by nature a keen risk-taker, and Videodisc was certainly not the product he would have chosen to make his first deliberate and large corporate wager. Yet in February 1981, Griffiths led the parade of RCA executives who appeared in front of NBC closed-circuit television cameras to announce the introduction of Selectavision VideoDisc to 14,000 RCA distributors and dealers, assembled in seventy-five cities across the United States via satellite.

The Selectavision launch was the result of more than fifteen years of painstaking effort and investment in technology and business development. RCA had embarked on its round of videoplayer development in 1965, in the midst of the "golden age of color television," partly because color TV had become a $3 billion industry and the mainstay of RCA's consumer electronics business only after a prolonged delay. From 1954 to 1960, the market had not welcomed color television, and RCA had spent most of the 1950s at a low level of profitability as a consequence. Only during the 1960s, when color TV finally caught on, did the company enjoy a period of prosperity comparable to its blue chip era of the 1920s.[1]

Naturally, after this experience, a major goal of RCA's top management in 1965 was to find a way either to sustain the prosperity of its television business through extensions to the product line or to identify a substitute product line that could be started up without putting the entire company through another intolerable period of austerity. In theory, it should be possible, for the company had superior technical resources, including 6,200 engineers and scientists. Yet the problem of

Selectavision VideoDisc

RCA's VideoDisc preview for the retailers via satellite from NBC studios.

renewing RCA's core business by selling new technology, never a simple one, had become more complex than it had been in the period when David Sarnoff was building the company. RCA's relationship with the industry and its ability to dominate the direction of development in its core technology had changed.

The computer failure

RCA had enjoyed a de facto monopoly in technology-related aspects of the industry up until World War II.[2] Its technical dominance was grounded in a pool of key radio-related patents that allowed it to influence the rate and direction of development of first radio, and then electronics, technology. In addition, RCA's integrated organizational structure, which gave it a presence in all aspects of consumer entertainment businesses, from hardware manufacture for consumer and professional broadcast markets to radio and television broadcasting, made it possible for the company to bring about systems innovation in entertainment technologies.

In the aftermath of the war, RCA experienced the losses of both its patent monopoly and its unique status as an entertainment systems company. In the battles over color television, RCA for the first time faced domestic competitors who rivaled its technical supremacy as well as its systems structure. Other areas of electronics technology had also attracted competitors. New entrants came from among the leading airframe companies, which had benefited, just as RCA had, from government support for R&D during the war. They were cutting deeply into the military electronics market and beginning to go after commercial markets as well.

RCA was successful in defending its position of leadership only in the entertainment market. After abortive attempts on the part of CBS and others to build a fully integrated, technology-based capability, RCA was still the only U.S. consumer electronics company able to pursue a pioneering strategy in a systems business during the 1960s, by combining R&D, manufacturing, marketing, and entertainment software. Other companies with equivalent integrated structures and leading-edge research could only be found in Europe and Japan. These included N.V. Philips, headquartered in the Netherlands with manufacturing divisions spread over Europe, Thorn based in England, Thompson Brandt based in France, and Telefunken and Siemens in West Germany. Several major Japanese firms, such as Matsushita and Toshiba, were in the process of attaining a large, integrated structure,