Open Innovation: Researching A New Paradigm

Book · January 2008

CITATIONS
3,108

READS
45,514

3 authors:

Henry William Chesbrough
University of California, Berkeley
91 PUBLICATIONS **50,667** CITATIONS
SEE PROFILE

Wim Vanhaverbeke
University of Antwerp
253 PUBLICATIONS **18,261** CITATIONS
SEE PROFILE

Joel West
Keck Graduate Institute
128 PUBLICATIONS **13,705** CITATIONS
SEE PROFILE

Open Innovation

The New Imperative for Creating and Profiting from Technology

Henry W. Chesbrough

HARVARD BUSINESS SCHOOL PRESS
Boston, Massachusetts

Printed in the United States of America

07 06 05 04 03 5 4 3 2 1

Library of Congress Cataloging-in-Publication Data

Chesbrough, Henry William.
Open innovation : the new imperative for creating and profiting from technology / Henry W. Chesbrough.
p. cm.
Includes index.
ISBN 1-57851-837-7
1. Technological innovations—Management. 2. Research, Industrial—Management. 3. Diffusion of innovations. 4. High technology industries—Technological innovations—United States—Case studies. I. Title.
HD45 .C469 2003
658.5'14—dc21

2002151060

The paper used in this publication meets the requirements of the American National Standard for Permanence of Paper for Publications and Documents in Libraries and Archives Z39.48-1992.

Contents

Foreword *ix*

Acknowledgments *xiii*

Introduction *xvii*

1. **Xerox PARC** 1
   The Achievements and Limits of Closed Innovation
2. **The Closed Innovation Paradigm** 21
3. **The Open Innovation Paradigm** 43
4. **The Business Model** 63
   Connecting Internal and External Innovation
5. **From Closed to Open Innovation** 93
   The Transformation of the IBM Corporation
6. **Open Innovation @ Intel** 113
7. **Creating New Ventures out of Internal Technologies** 135
   Lucent's New Ventures Group
8. **Business Models and Managing Intellectual Property** 155
9. **Making the Transition** 177
   Open Innovation Strategies and Tactics

Notes *197*

Index *217*

About the Author *227*

I

Xerox PARC

The Achievements and Limits of Closed Innovation

The Xerox Corporation, the leading copier company, has a storied history of innovation. Much of that innovation arose from Xerox's Palo Alto Research Center (PARC), which was aimed at a new market for Xerox, the computer industry. While Xerox's problems with capturing value from its investments in innovation at PARC are well known, few know the whole story.

For Xerox's experience with PARC poses a challenging puzzle: How could a company that possessed the resources and vision to launch a brilliant research center—not to mention the patience to fund the center for more than thirty years, and the savvy to incorporate important technologies from it—let so many good ideas get away? Did Xerox mismanage PARC? Did PARC pursue the wrong projects? Did it abandon the wrong projects? Why did so many of PARC's computer industry innovations yield so little for Xerox and its shareholders?

The answers to these questions point both to the accomplishments and the problems associated with the way that Xerox managed its research and technology. Xerox's approach was consistent with the best practice of most leading industrial corporations in the twentieth century. A brief history of Xerox illustrates the many benefits of this approach and the increasing difficulties that it has recently encountered.

Xerox's Innovation Achievements

In 1970, the Xerox Corporation was riding high. It had grown from a tiny company called Haloid in the 1950s into a *Fortune* 500 colossus.

With a dominant share of the booming office copier market, Xerox was growing fast and was very profitable. Its stock was a darling on Wall Street, one of the so-called Nifty Fifty.

To the company's credit, Xerox realized that this good fortune would not continue indefinitely. If the company wanted to ensure its future, it realized that it would need to make important investments to position itself for that future. In 1969, its chief executive, Peter McColough, commissioned Jacob Goldman, who was then the head of research at Xerox, to build a new laboratory within the corporate research organization. This new laboratory would provide the company with the technology necessary to realize McColough's vision of "the architecture of information." McColough's vision was that Xerox would transcend its current business of being the leading office copier company to become the leading office equipment supplier of information-intensive products.

Goldman eagerly accepted the assignment. He strongly felt that such investments were needed if Xerox were to avoid the fate of companies such as RCA. RCA had been a pioneer in consumer electronics, both in radio and later in television. The company had developed strong capabilities in vacuum tube technology to give its products the best quality at low cost. When William Shockley and his colleagues at Bell Laboratories produced the transistor, RCA responded by deepening its investments in vacuum tube technology. Although RCA did achieve further improvements, it failed to foresee the tremendous potential in solid-state electronic technology.[1] By the 1960s, RCA had lost all of its technology edge in the market and had become a hollow shell of its former greatness. In Goldman's view, only vigilant investment in leading-edge technologies could protect Xerox from a similar fate in its own business.[2]

The Creation of PARC

Goldman recruited Xerox scientist George Pake to lead this new research facility. Pake received his assignment at a fortuitous time, when government research spending on computer technology was declining. As a result, Pake and his staff were able to recruit many of the world's best researchers in the field. In 1970, Pake established the Palo Alto Research Center in Palo Alto, CA, to house this group.

PARC would turn out to be a true research success. It led the discovery of a variety of important innovations that today are a critical part of the personal computer and communications revolution. The graphical user interface originated at PARC. The bit-mapped screen, which replaced the green ASCII characters on terminals, was also born there. The Ethernet networking protocol was developed there, as were other, higher-speed networking protocols. The leading font rendering program, PostScript, descends directly from PARC. Later PARC projects included document management software, Web searching and indexing technologies, and online conferencing technologies.

PARC also made important research contributions in semiconductor diode lasers and in laser printing, developments that would prove highly important to Xerox's copier and printer businesses. But, with the benefit of hindsight, much of PARC's research and technology would create tremendous economic value for society, yet yield little value for its parent company.

PARC's inability to capture value from its technology for Xerox has been debated at length. Some accounts fault Xerox's corporate management in Stamford, CT, for failing to perceive the value of the technology being created at its West Coast laboratory. Other accounts fault the politics and infighting within the PARC facility, in addition to errors at corporate headquarters, for the problems in capturing value from PARC technology.[3]

These reasons seem unsatisfying. The Xerox Corporation had the vision to create and generously support PARC for more than thirty years. If the corporation were truly unaware of the value of the lab, it is hard to believe that this support should have continued for so long. And PARC scientists were not simply creating technology. They were building highly advanced systems that integrated many different types of hardware and that ran very complex software applications. Accomplishing this integration required cooperation and connection across a variety of scientific disciplines, which seems at odds with the notion of a research center riven by dysfunctional infighting.

These proffered accounts miss the root cause of PARC's problems. The research center was not mismanaged; rather, it was managed according to the best practices of the leading industrial research laboratories. Nor were PARC's leaders ignorant; they were intelligent, reasonable people who were up to date on good R&D management practice.

And PARC was not ineffective; indeed, it contributed much of the systems architecture and technology behind the personal computer and communications industries. Nor was the research center irrelevant to the rest of Xerox; the laser printers and advanced copiers sold by Xerox came directly out of PARC research breakthroughs.

We can learn a great deal by identifying the root cause of Xerox's problems with PARC, because it determines the lessons we learn from Xerox's experience. Some observers attribute Xerox's problems to corporate management's ignorance or to internal politicking. The implications are that the rest of us have little to learn from Xerox's experience. If, however, Xerox managed its R&D according to the best practices that were typical of most leading industrial organizations, then the lessons from Xerox's difficulties are vitally important for every innovating organization to understand. Understanding PARC's situation more deeply may illuminate a different way to manage innovation activities going forward.

The Root Cause of Xerox's "PARC Problem"

After carefully reviewing many projects within Xerox and interviewing nearly one hundred current and former managers, I have concluded that Xerox's problems with PARC arose from the way Xerox managed its innovation process. Xerox managed PARC through a Closed Innovation paradigm: The corporation sought to discover new breakthroughs; develop them into products; build the products in its factories; and distribute, finance, and service those products—all within the four walls of the company. This paradigm was hardly unique to Xerox; it was used to manage all the leading industrial R&D facilities operating in the U.S. economy after World War II.

The greatest technological achievements that emerged from PARC, by contrast, could only take root—and create real economic value—when pursued in a far different context, a context of Open Innovation. Most of these achievements were realized only when key PARC researchers left Xerox and went to other, smaller companies or went out on their own to start up new companies. These companies could not afford to pursue the model of deep vertical integration that Xerox followed. Instead, they had to define a business model to commercialize their own technologies. They had to create systems and architectures that enabled their products to work with other companies' products to build a system. Those start-ups that achieved commercial success did so

by applying their technology quite differently from how the researchers had originally envisioned when they left Xerox.

Some of the technologies took root through the departure of key employees to Apple, where the Macintosh computer embodied many of the user-interface design concepts created at PARC. Other technologies were commercialized at Microsoft. For example, the Bravo word processor was the precursor to Microsoft Word. Despite their present-day size, both Apple and Microsoft were themselves very young companies when they absorbed some of PARC's technologies, and neither had any internal research capability at the time.[4]

The majority of technologies that left PARC, however, did so via newly formed, independent start-up companies, which were staffed by departing PARC researchers and funded by venture capitalists.[5] Table 1-1 shows twenty-four of these PARC "spin-off companies" that were created to commercialize one of Xerox's technologies from 1979 through 1998. As one would expect, many of these companies soon withered and died. Some companies, though, managed to prosper. Ten went public, and a few (such as 3Com, Adobe, and Documentum) were still operating as independent companies in 2002.

Table 1-1 also debunks another myth that has grown up around Xerox's management of its spin-off technologies. Most of these technologies did not "leak" out of Xerox through inadvertence and neglect on the part of Xerox's research managers. Instead, Xerox gave its explicit permission for most of these technologies to leave—via a nonexclusive technology license from Xerox—and Xerox maintained an equity stake in many of them in return for that license.

If Xerox didn't fumble these spin-offs, then why did it allow them to leave? Although the specific answer varies with every spin-off company, the general answer is that Xerox saw little further potential for each technology within Xerox. Continuing to develop each technology was expensive and took money away from other new initiatives that might be more important to Xerox. When Xerox's research managers judged that a research project had little more to contribute to Xerox's fundamental knowledge or to its businesses, they cut off further funding of the research. In many cases, the researchers chose to work on new research projects with greater discovery potential or value to Xerox. Sometimes, though, the researchers wanted to continue with the project. Xerox chose to allow these researchers to gracefully exit the company and take the project with them.[6]

TABLE 1-1

Xerox PARC Spin-Off Companies from 1979 to 1998

Company Name	Did Xerox Grant a License to Spin Off?	Spin-Off Date	Disposition Event	Disposition Date	Technology Description	Original CEO or General Manager
3Com	Y	6/79	IPO	3/84	Hardware, network	Robert Metcalfe
VLSI	N	8/79	IPO	3/83	Other	Jack Balletto
GRiD	N	12/79	Acquired	7/88	Hardware, software	John Ellenby
Aurora	Y	2/80	Chapter 11	12/88	Hardware, software	Richard Shoup
Optimem	Y	6/80	Sold off	6/91	Hardware	George Sollman
Metaphor	N	10/82	Sold off	10/91	Hardware, software, network	Don Massaro
Komag	Y	6/83	IPO	3/87	Hardware, other	Tu Chen, Steve Johnson
SDLI	Y	6/83	IPO	3/95	Other	Donald R. Scifres
Adobe	N	11/83	IPO	8/86	Software	John E. Warnock
Microlytics	Y	3/85	Chapter 11	11/96	Software, other	Michael Weiner
SynOptics	Y	10/85	IPO	10/88	Network	Andy Ludwick
StepperVision	Y	4/87	Licensed	10/88	Hardware, software	Worth Ludwick

Company Name	Did Xerox Grant a License to Spin Off?	Spin-Off Date	Disposition Event	Disposition Date	Technology Description	Original CEO or General Manager
ParcPlace	Y	3/88	IPO	2/94	Software	Adele Goldberg
AWPI	Y	6/89	Bought back	1/91	Hardware, software	Tony Domit
Documentum	Y	1/90	IPO	1/96	Software	Howard Shoa
Semaphore	Y	10/90	Acquired	4/98	Hardware, software, other	Charles Hart
Document Sciences	Y	10/91	IPO	9/96	Software	Tony Domit
LiveWorks	Y	8/92	Shut down	7/97	Network	Richard Bruce
CTI	N	5/94	Going concern		Software, other	Henry Sang
X ColorgrafX	Y	10/94	Going concern		Printer	Barry Lathan
DpiX	Y	3/96	Sold off	7/99	Diode, other	Malcolm Thompson
PlaceWare	Y	11/96	Going concern		Software	Richard Bruce
Inxight	Y	12/96	Going concern		Software	Mohan Trikha
Uppercase	Y	1/98	Going concern		Hardware, software	Frank Halasz

Although some of these departing technologies later became highly valuable, they did not start out as clear winners. The success of some of these departing spin-offs was largely unforeseen—and unforeseeable. When they left, these spin-offs were far more like ugly ducklings than elegant swans. The projects underwent significant development—and even transformation—on their journey to market after leaving Xerox. If they had stayed inside Xerox, this transformation would never have occurred and the value of these spin-offs likely never would have materialized. Their success arose more from their response to subsequent external events than it did from the initial promise of the technology or the people. The path of this transformation is illustrated in the evolution of SynOptics, a successful, though lesser known, Xerox PARC spin-off company.

The Transformation of SynOptics

SynOptics technology grew within PARC with the goal of making a fast version of Ethernet work over optical cables in the mid-1980s. The project continued the Ethernet research that Robert Metcalfe had commercialized out of PARC with his 3Com start-up five years earlier. But commercializing this technology required other technologies that were many years away from being widely available, such as optical cables for computer networks, to be installed at customers' locations. In order to use SynOptics technology, the customers would have to install networks with entirely new wiring to connect the computers, printers, and other devices—making the cost of installing and using the technology very expensive. Xerox decided that this was one technology it needn't pursue any further internally—it was too far ahead of customers' needs in the mainstream computer market.

Andy Ludwick and Ronald Schmidt decided to take this technology outside to see if they could make it into a company. They could afford to be patient for optical cabling media to become established in the market, and they thought that they could distribute their products through value-added distributors who were selling and installing optical gear. It might take a while and it might initially be expensive for customers to buy complete, optically wired networks, but once the market did get going, they would be well positioned to participate in the growth that would follow. A graceful exit from Xerox ensued, with Ludwick and Schmidt taking the technology outside, and Xerox retaining a 15 percent equity share of the company.

Once out on their own, though, Ludwick and Schmidt soon realized that they had an even more valuable opportunity: The software and protocols they were writing to drive Ethernet packets over optical cables could actually be applied to copper-wire networks. Their efforts therefore could make Ethernet run faster over copper-wire networks as well. (The acceleration of Ethernet transmission speeds enabled by SynOptics was only true initially for the particular topology of wiring known as IBM's token ring, though it would soon migrate to other types of local area networks.) Instead of continuing to pursue the technically challenging aspects of making high-speed Ethernet work on a new transmission medium (optical cables), the company chose to emphasize the more technically mundane approach of using its technology on copper-wire networks that were already installed and operating.

This insight changed the company's commercial prospects dramatically. Instead of selling its products into future networks that had yet to be installed, SynOptics could upgrade the speed and performance of thousands of networks already up and running. Customers could spend a small fraction of the costs of buying new optically wired networks, and get transmission speeds five or ten times faster on the networks they had already paid for. This was a compelling value proposition.

SynOptics did very well in commercializing this approach. It went public in October 1988, just three years after it was founded. A small development project that started within PARC on a shoestring budget soon became a billion-dollar company. It later merged with an East Coast firm, Wellfleet, to create Bay Networks. (Later, Bay was acquired by Nortel.)

It is too glib and simplistic to attribute the eventual success of SynOptics to the early lab work at Xerox. The source of the value realized by SynOptics wasn't simply embodied in the early software and hardware created inside PARC and let go by Xerox. It was the creative *recombination* of that technology, using a different type of cabling and joined to a different type of network, that yielded such a boost in value. Instead of helping Xerox systems products run faster in the distant future, SynOptics learned how to make IBM and other networks run faster *today*. Instead of focusing on entirely new networks, SynOptics added value to already installed networks. This happened only after the company left the cozy confines of the PARC lab within Xerox, which prompted SynOptics to conceptualize an alternative way to apply its technology.

Of course, many projects that left PARC never amounted to anything. For these projects, the search for an alternative approach to building value came to naught. But those companies that did prosper managed to do quite well for themselves and their shareholders. Their technologies helped fuel the personal computer revolution and also contributed to the complementary industry of computer networking and communications. Figure 1-1 shows the market value of these companies once they went public.[7] For comparison, Xerox's own market value is included as well. As shown, Xerox's own stock did very well in the 1990s and fell a great deal in 2000 and 2001. Xerox's spin-off companies, however, did even better in the 1990s, overtaking Xerox in 1995 and again in 1999. Though they too fell sharply in 2000 and 2001 as a result of the collapse in technology stock prices, the market value of these spin-off companies at the end of 2001 collectively exceeded that of their parent company, Xerox, by a factor of two.

FIGURE 1-1

The Market Value of Xerox PARC Spin-Offs, in Relation to Xerox