

CATCHING UP WITH THE COMPUTER REVOLUTION

HARVARD BUSINESS REVIEW



HARVARD BUSINESS REVIEW EXECUTIVE BOOK SERIES

CATCHING UP WITH THE COMPUTER REVOLUTION

LYNN M. SALERNO

Editor

JOHN WILEY & SONS INC.

New York • Chichester • Brisbane • Toronto • Singapore

4084308

Articles copyright © by President and Fellows of Harvard College; all other materials copyright © 1983 by John Wiley & Sons, Inc.

All rights reserved. Published simultaneously in Canada.

Reproduction or translation of any part of this work beyond that permitted by Section 107 or 108 of the 1976 United States Copyright Act without the permission of the copyright owner is unlawful. Requests for permission or further information should be addressed to the Permissions Department, John Wiley & Sons, Inc.

This publication is designed to provide accurate and authoritative information in regard to the subject matter covered. It is sold with the understanding that the publisher is not engaged in rendering legal, accounting, or other professional service. If legal advice or other expert assistance is required, the services of a competent professional person should be sought. *From a Declaration of Principles jointly adopted by a Committee of the American Bar Association and a Committee of Publishers.*

Library of Congress Cataloging in Publication Data:

Main entry under Title:

Catching up with the computer revolution.

(Harvard Business Review Executive Book Series)

Includes indexes.

1. Business—Data processing—Addresses, essays, lectures. 2. Information storage and retrieval systems—Business—Addresses, essays, lectures. 3. Management information systems—Addresses, essays, lectures. I. Salerno, Lynn M. II. Series.

HF5548.2.C37 1983 658'.054 82-21899
ISBN 0-471-87594-5

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

Foreword

For sixty years the *Harvard Business Review* has been the farthest reaching executive program of the Harvard Business School. It is devoted to the continuing education of executives and aspiring managers primarily in business organizations, but also in not-for-profit institutions, in government, and in the professions. Through its publishing partners, reprints, and translation programs, it finds an audience in many languages in most countries in the world, occasionally penetrating even the barrier between East and West.

The *Harvard Business Review* draws on the talents of the most creative people in modern business and in management education. About half its content comes from practicing managers, the rest from professional people and university researchers. Everything *HBR* publishes has something to do with the skills, attitudes, and knowledge essential to the competent and ethical practice of management.

This book consists of 29 articles dealing with the problems and opportunities managers face in keeping pace with developments in computer technology and its application to the organization. Neither abstruse nor superficial, the articles chosen for this volume are intended to be usefully analytical, challenging, and carefully prescriptive. Every well-informed businessperson can follow the exposition in its path away from the obvious and into the territory of independent thought. I hope that readers can adapt these ideas to their own unique situations and thus make their professional careers more productive.

Kenneth R. Andrews, Editor
Harvard Business Review

CATCHING UP WITH THE COMPUTER REVOLUTION

Contents

Introduction, Lynn M. Salerno, 1

Part One Sizing Up the Problem

An Overview, 11

1. *Management in the 1980s: A View From 1958*, Harold J. Leavitt and Thomas L. Whisler, 13
2. *Managing the Four Stages of EDP Growth*, Cyrus F. Gibson and Richard L. Nolan, 25
3. *Problems in Planning the Information System*, F. Warren McFarlan, 44
4. *Management Audit of the EDP Department*, F. Warren McFarlan, 67
5. *Managing the Crises in Data Processing*, Richard L. Nolan, 86
6. *An Unmanaged Computer Can Stop You Dead*, Brandt Allen, 104
7. *Catching Up with the Computer Revolution*, Lynn M. Salerno, 122

Part Two Designing and Managing the System

An Overview, 137

8. *The Information Archipelago—Maps and Bridges*, James L. McKenney and F. Warren McFarlan, 141
9. *Information Archipelago—Plotting a Course*
F. Warren McFarlan, James L. McKenney, and Philip Pyburn, 160
10. *Portfolio Approach to Information Systems*, F. Warren McFarlan, 178
11. *Managing Information Systems by Committee*, Richard L. Nolan, 194
12. *Managing International Information Systems*, Martin D. J. Buss, 206
13. *Computer Data Bases: The Future Is Now*, Richard L. Nolan, 225

14. *Costs and Benefits of a Data Base System*, Fred R. McFadden and James D. Suver, 249

Part Three Keeping Control

An Overview, 263

15. *Personal Privacy Versus the Corporate Computer*, Robert C. Goldstein and Richard L. Nolan, 265
16. *Embezzler's Guide to the Computer*, Brandt Allen, 278
17. *Managing the Costs of Information*, Paul A. Strassmann, 294
18. *Controlling the Costs of Data Services*, Richard L. Nolan, 307
19. *Penny-wise Approach to Data Processing*, Martin D. J. Buss, 325
20. *How To Rank Computer Projects*, Martin D. J. Buss, 336

Part Four Involving the User

An Overview, 353

21. *Understanding Distributed Data Processing*, Jack R. Buchanan and Richard G. Linowes, 357
22. *Making Distributed Data Processing Work*, Jack R. Buchanan and Richard G. Linowes, 373
23. *Who Needs the Office of the Future?* Harvey L. Poppel, 399
24. *New Promise of Computer Graphics*, Hirotaka Takeuchi and Allan H. Schmidt, 415
25. *Coping with Computer Proliferation*, Frederic G. Withington, 432
26. *New Worlds of Computer-Mediated Work*, Shoshanah Zuboff, 451

Part Five The Executive and the Computer

An Overview, 467

27. *Chief Executives Define Their Own Data Needs*, John F. Rockart, 469
28. *The CEO Goes On-Line*, John F. Rockart and Michael E. Treacy, 491
29. *Doing Your Office Over—Electronically*, Louis H. Mertes, 500

About the Authors, 513

Author Index, 519

Subject Index, 521

Introduction

LYNN M. SALERNO

It is by now a commonplace that computers are becoming cheaper, smaller, and more powerful every year. Also familiar to many readers are the grand, if not grandiose, promises of the futurists and others who have foreseen, from a 10- or 20-year advance view, the marvels that would come to us all from computers.

Some prognosticators had it right; some had part of it right but had the timing wrong. This book begins with two of these: Harold J. Leavitt and Thomas L. Whisler, who, writing in 1958, envisioned top managers of the future sitting at their desk terminals playing games, "trying to simulate (their) own behavior in hypothetical future environments." Though many executives today may be more familiar with the popular video space war games than computer-generated corporate strategy, we see the beginning of the scenario described by Leavitt and Whisler in Rockart and Treacy's article written in 1982, "The CEO Goes On-Line."

As Leavitt and Whisler saw it in 1956, future top executives, using their own computers, would be less dependent on subordinates for information and would have better control over decisions made at lower levels. More than 25 years ago, they predicted that, with the new information technology, there would be "fewer experience and judgment areas in which junior men have more working knowledge" than top managers.

In this new corporation, run with the aid of precise and accurate information, middle managers would be largely phased out, programmers and other "technocrats" would move to the top, and "groupthink" would characterize the decisions of the tight oligarchy at the top.

The 1982 article by Brandt Allen, "Technology Is Not Enough," might have been written in answer to Leavitt and Whisler's optimistic forecast. As Allen points out, the economics of computers have turned around. Though technological improvements still lower costs by almost 25% per year, staffing costs are rising steadily. According to Allen, the very programmers who would be so central to the new technologically managed corporation of Whisler and Leavitt have put the brake on the advance of computer technology. Furthermore, far from rising to the top to be admitted to the inner

councils of management, most programmers find themselves not only stuck at a lower level but distrusted and ignored by senior managers.

Role of Top Managers

Allen's is not the first, and it surely won't be the last, plea for top management involvement in corporate information systems. Richard Nolan and Cyrus Gibson, writing about 10 years before Allen, had already proposed that the MIS manager, as they called the information systems executive, report close to the top.

By 1974, when these authors were writing, corporate EDP had become complex and the gap between the data processing manager and others, especially senior managers, had widened considerably. Nolan and Gibson wanted top management not only to become involved but to understand what was happening as computers became entrenched in the corporate structure. Thus they explained the four stages of evolution of computer systems in a corporation, a concept they and others would later build on to help managers broaden their understanding and thus overcome their fear of the computer and the new technology that it has brought with it.

But even as some managers became more comfortable with computer technology, they saw their problems compounded when minicomputers and microcomputers became cheap enough to allow their spread throughout the organization. Today the economies of scale that led companies to use one large computer in a central data processing center no longer apply. In addition, new technology makes linking up these smaller computers both practical and sensible.

With increasing use of computer networks come changes in responsibility. Authority tends to be withdrawn from the DP manager as users gain familiarity with and control of their own machines.

In "Understanding Distributed Data Processing," Jack Buchanan and Richard Linowes point out that the new complexities of computer systems require more than ever that managers change their simplistic view of data processing as a collection of machines and technical issues. The most important assumptions that managers should make, say these authors, are that information systems should match a company's strategy and that various individuals can execute or control these systems.

Need for Planning

Besides a broader view of computer-based information systems, most HBR authors have advocated a strong commitment to planning for these systems. More than 10 years ago, Warren McFarlan, after examining some companies with a reputation for effective use of computers, concluded that such organizations usually had a comprehensive written plan for their IS activities

that spanned several years (Chapter 3). Elsewhere, however, he discusses the desirability of a "planned clutter" in information systems.

Has the passage of 10 years removed the need for careful planning? Probably not, since the number and variety of computer-based systems has increased over that period. What seems to argue for the more flexible approach is that diversity of systems and the fact that many companies today have a mix of the various technologies.

They may have several years' experience with some, such as batch processing, while their familiarity with others, such as word processing and office automation, may be slight.

The broader array of computer technology that many organizations now deal with may explain why, after business's more than 20 years' experience with computers, information systems projects sometimes still end as fiascoes. The authors in this book have developed various approaches to address these new situations. In his "Portfolio Approach to Information Systems," Warren McFarlan suggests that no one right way of managing a project exists; rather, a company should adopt a "contingency" approach that takes into account the risk of a project and its technological complexity.

Thus, as *HBR* authors recognize the need for continual planning in the management of information systems, they recognize too that the new approaches have to be more sophisticated. These two concerns—for planning and for increased sophistication—show up in an area that has grown in importance as computer-based technology has spread in the organization: financial control.

A Broader View

In "Managing the Costs of Information," Paul Strassmann emphasizes that management of information systems now goes far beyond just dealing with computers. He divides information processing into three parts; (1) data processing, (2) what he calls administrative processing, which covers typewriters, word processors, various copiers and duplicators, and all the other equipment and processes for handling information, including mail and office supplies; and (3) nonmanagerial and nonprofessional office labor. I mention this detail to suggest a view held more and more by thinkers at the leading edge of information technology management—The manager's job now is one of data or information management rather than simply computer management. Richard Nolan reiterates this notion in "Controlling the Costs of Data Services," pointing out that seeing where computer-based technology is located in the total organization structure versus where it should be placed is one of the prerequisites to establishing adequate cost control.

In this piece we encounter again the sharp distinction between the jobs appropriate for the DP department and those that should be handled elsewhere. Nolan thinks control of expenditures for data processing belongs

with the accounting department, not with technical personnel. This is a good idea, but one that some managers will readily accept for the wrong reasons. Because they will not, or cannot, adopt the broader view of information technology and services that we have been discussing, which sees computer-based technology as an integral part of the whole organization, or perhaps just because they still fear and fail to understand what's going on in those areas of the corporation, such managers use cost control as their chief means of keeping the upper hand.

This narrow viewpoint, instead of ensuring an orderly growth and development, can lead to sudden dislocations in service and eventually to catastrophic system breakdowns. Martin Buss, in his very practical article "Penny-Wise Approach to Data Processing," points out that rigid cost control can lead to underinvestment in that area so that vital software becomes outdated and has to be replaced at high cost over a short time span.

The IS Manager

Following short-term goals with a bias toward financial benefits can also have poor results when managers set their priorities for computer projects. Martin Buss addresses this problem in "Squaring the Circle—A structured Approach to Setting Project Priorities." He thinks the information systems manager has to take the most active role in deciding which projects a company should pursue—at last a significant mission for the experienced DP professional!

Since such persons are in increasingly short supply and the outlook for improvement in their numbers is not favorable, authors are beginning to give some attention to their plight. Writing about executive steering committees, Richard Nolan notes that the number of DP managers chairing such committees has declined noticeably in the companies he has studied while the number of CEOs who are chairmen has increased (Chapter 11). The good news is that more top managers apparently now recognize the importance of their involvement in planning for information systems. But the bad news is that DP professionals are losing the voice they once had. In addition, Nolan's survey showed that the steering committee usually did not concern itself with staffing problems, such as the choice of top computer managers, and when they did they ranked this task as lowest in importance and least effective of their functions.

Brandt Allen would see a lesson in all of this. In "Technology Is Not Enough" (Chapter 6) he says that senior managers don't have confidence in their ability to manage information resources and they don't have confidence in DP management either. He concludes that top managers will have to educate themselves about computers and the new information technologies and that most companies should bring to executive rank persons with substantial experience in information systems. If companies heed this advice,

the IS function and especially the IS professional may finally gain the benefit of informed attention from above. In addition, DP personnel may feel less stuck in dead-end positions if some of their colleagues make it to the top and the games of musical chairs for more desirable positions on the outside may slow down.

Executives and the Computer

If chief executives have ignored the needs of the information managers below them, the IS staff and others have not, perhaps understandably, neglected their superiors' wants. In this information era, when data are more readily obtainable than ever, most executives find themselves with a surfeit of reports and other material sent on by their subordinates. But in this, as in other ways, computers have failed to live up to their promise, at least in the eyes of many executives. Far from producing meaningful data for their use, computers have simply multiplied the paper output and added to the mass of information they must sift through. In two pieces concerning executive information (Chapters 27 and 28), we learn how so-called critical success factors can determine what data managers really need to help them fulfill organizational goals and how a few executives are obtaining their own information by going on-line at personal terminals. To be sure, some executives have taken to the computer in self-defense, to free themselves from the frustrating information gaps I've just described, but there are equally compelling reasons to explain this phenomenon. First, minicomputers have become less expensive so that it is now easier to justify their purchase at various levels in the organization. Second, and perhaps more important, the development of so-called user-friendly machines, which are interactive, that is, which can carry on a "conversation" in ordinary English with the user, make the learning period minimal. For these reasons some CEOs have overcome their fears or their ignorance of computers, perhaps to become the vanguard of the new computer-literate managers.

Moving Toward the User

Executive use of computers may be a special case of a trend most experts believe is beneficial—moving control of computers out into the organization and closer to the users of information services. As Richard Nolan says, "The heart of the matter is when and how to decentralize, not whether to do so." As computers have spread willy nilly throughout most organizations, DP departments have found it impractical if not impossible to maintain effective control. Thus arises one of the most critical problems in IS management today: where to place responsibility for the various aspects of a company's information resources.

Frederic G. Withington finds that the answer lies partly in distributing

the company's experts along with its computers.¹ Although he, like Richard Nolan, advocates an executive steering committee for project review, Withington sees many advantages for an arrangement under which users, with help from DP professionals, take responsibility for their own systems.

The spread of computers both horizontally and vertically throughout the organization has brought new problems along with many new opportunities. I have already mentioned one of the most obvious of the difficulties that many machines in many hands can produce: lack of control and suitable placement of responsibility. First to be noticed are usually the headaches of ballooning expense. In the short history of corporate computers, stories of near-skulduggery in the acquisition of machines are fast becoming legend.

Despite fiat from on high aimed at limiting untrammelled growth, determined and creative prospective users have managed to obtain and set up closet computers, some of which were described as "clerical enhancements," "data sorters," and the like on requisition requests. And even though minicomputer costs have come down, overall costs of information services, including staff salaries, have risen almost as much as the others have fallen, so companies must make choices among the competing bids for IS budget money.

As machines proliferate, so naturally do the data they produce. And many companies watch with growing alarm and frustration the multiplication of data files, some usable only by one department and some accessible only to one person who has developed the programming to handle a particular application. Though the problem of redundancy of data has troubled corporations for some time, the growing number and broader use of computers has made the potential loss of productivity that can result from the uncontrolled spread of information more obvious.

HBR authors have consistently pointed to the advantages of data-base systems for the orderly management of a company's information. Richard Nolan, writing 10 years ago, wanted companies to adopt what he called a data-base approach. Using this concept, they would consider data as a corporate resource to be managed systematically, and the definition of data would include all the information significant to the company, not just data that are computer readable. Following a structured approach, managers could begin to eliminate some of the redundant data as they prepared to convert appropriate data to data-base form.

In the years since Nolan alerted managers to the need for data-base planning, as many companies have adopted data-base systems, the problems as well as the benefits have become clearer. Though both hardware and software to support such systems have become increasingly sophisticated, many corporations now see that this is an area of computer management where planning must be paramount. Though few companies would be likely to rue the day they decided to convert to a data-base management system (DBMS) some say they would give their plans more careful thought if they had it to do over again. A step-by-step scenario for analyzing the costs and

benefits of a DBMS can be found in a piece by McFadden and Suver, who emphasize that installing such a system is a major undertaking.

From the time computers first came into the corporation, some persons have been troubled by the possible problems of maintaining privacy for the data these machines would handle. For them, especially if they knew little about data processing, the stacks of key-punched cards being read by the computer contained information for the company was locking up and it was, in effect, throwing away the key. There is no question that the computer does raise questions about an individual's right to privacy. And the company has increasing concerns in this area as well. Now that anybody and everybody in the corporation can use the minicomputer, at least to call up data, the need to "lock up" some files becomes clear.

In some companies, such as retail chains that have large credit operations, the personal data can be extremely sensitive, but even smaller companies maintain personnel files that may be computerized and thus unprotected. In addition, as has always been the case, companies maintain many files containing information that would be useful to competitors and thus should be considered sensitive.

Fortunately, some help has come from the computer itself. By use of a data-base management system, a company not only gains control over the data it needs to protect but also limits access to those with a "need to know." In addition, the computer can have a steady eye out for those who do view the restricted files, noting who saw what and when. But readers should not become overconfident—on the contrary. A few years ago, to shake them up a bit, HBR published an "Embezzler's Guide to the Computer" to show companies that the job of overcoming computer security was all too easy. For by then even the average newspaper reader had heard of another way to use computers—to steal not information but money. This most modern of crimes now takes place not just in banks, an obvious target, but in companies with every kind of product, just as long as the important records are automated. Though computer fraud may be one of the hottest games in town, the "Embezzler's Guide" will tell you how to beat the thief by understanding the rules he plays by.

Office of the Future

If computers are growing like rank weeds, causing privacy problems and even sometimes a leakage of funds, we might by now expect to see businesses turning away from automation or at least limiting its spread. This has not happened, however. Despite the very real difficulties that have surfaced, many if not most companies are exploring new ways to use computers because of the possible enhancements they expect, especially in efficiency and productivity. One of the areas that has most needed the benefits of automation—the office—has been the last to receive them.

While CAD/CAM and robots have come into the factory, the most modern equipment in many offices is a high-speed photocopier. Since businesses spend more each year for salaries and benefits for white-collar workers, the fastest growing segment of the labor force, they should welcome the automated office. So far, however, the office of the future is just that, except in some banks, which were among the first to automate many of their functions. At Citibank in New York and Continental Illinois of Chicago, computers have moved beyond the routine banking functions to the back office.

At Continental Illinois, Louis Mertes, author of "Doing Your Office Over—Electronically," greets the visitor in an office that looks more like a living room than a place to do business in. No paper is in sight and no computer or other electronic gadgetry, yet his could be the prototype of the automated office. Seated on one of the couches that surround the central "coffee table," he flicks a switch and a terminal rises from the surface in front of him. When he is not in his office, he and other bank executives can dictate to the bank's word processing machines from airports, hotel rooms, or wherever a telephone is available. These and other features have made Continental Illinois probably the best known and most successful pioneer in the electronic office.

Meanwhile, back at the ordinary office, the paper shufflers are still awaiting the new age. To try to determine why electronic marvels are gathering dust on suppliers' shelves while managers remain frustrated with the lack of productivity both in their own and their staff's jobs, Harvey Poppel undertook a major study of white-collar working habits. He discovered that more than half of the time of the professionals he studied was spent in what they described as "less productive" activities. Matching the tasks of these workers to a computer solution, he concluded that office automation was a financially sound answer to their productivity problems.

Lessons for Managers

What conclusions can managers draw from the authors of this book? Despite the variety of their subjects and their approaches, they sound some recurring themes. One of the most striking is that there is a disturbing gap between promise and reality where the performance of computers is concerned. After the first much heralded management information systems (MIS) a decade ago failed to live up to anybody's expectations, many executives became wary about new computer-based solutions to their problems. The experts discovered many reasons for the downfall of MIS, but beyond the fact that they were certainly oversold from the beginning was the rapid pace of the development of technology, which made it difficult for any but those trained in electronic data processing to keep up with the ever-changing assortment of hardware and software that became available for business use. To com-

pound the problem, communications between DP professionals and the rest of the organization have never been especially good, so few companies had regular channels through which promising developments could come to top managers' attention, and requests from other departments for information on the state of the art were probably even less likely to find their way into the DP bastion.

In recent years, however, the situation of the beleaguered DP department—for this is how many computer professionals have seen it—has begun to change. Again, technology has been the driving force. With smaller, cheaper, and more powerful machines making their way into many departments that formerly depended on the central DP department for their data processing, managers are beginning to take care of their own information needs with their own small computers.

Though, as many of the authors of this book point out, this situation can cause problems for the organization, the broadening base of computer power may serve to narrow the gap between the expectations and the reality of computer solutions. Most important in this connection is the prospect of shortening the waiting time for development of computer applications, which recently has often reached several worker years. In addition, this user involvement with computers should bring about a wider understanding and appreciation of the potential of the computer for solving business problems.

With the smaller size and lower price tag of computers have also come, most fortuitously, new languages that are easier to learn and to use. Such "user friendliness" has also contributed to the number of eager applicants for a personal, desk-top machine. Thus we move closer and closer to the new office where a computer sits on every desk alongside the telephone. If this is to be the real office of the future, it makes sense for managers to pay heed to another admonition from these authors: plan your information services. As the IS budget grows, especially in businesses that are highly dependent on the computer, no one can afford to learn the hard way, when the system grinds to a halt, how crucial it is for companies to have written short- and long-term agendas for their computer projects.

We appear to be at the start of a new phase in the computer age—what might be called the communications era. As technology now permits easy linkage of computers into networks, a new dimension of opportunities and problems confront us. Now the data bases and their management systems, which several authors of this book see as both necessary and desirable in the evolution of computer systems, can easily be linked inside the company and across divisions, at home and abroad.

But this added layer of complexity also increases the need for planning and for technical staff. In the last few years, *HBR* authors have warned that data processing professionals are dwindling in number, with little hope of any significant increase in the next decade. Thus management may have to consider opening up for them better career opportunities at the top as well as more generally satisfying work situations.

Underlying most of the pieces in this book is the message to top executives that they must get involved with computers, if not yet personally at the keyboard, at least in informing themselves—in becoming computer-literate. And the corollary to that proposition is that information systems and services must fit in with an organization's goals and strategy. Thus managers, and especially top executives, will need to be familiar with both aspects.

The reader can draw another lesson from the writers represented here: computer-based technology seems to bring as many problems as benefits at every stage. But if computer management often appears to be just one more burden for the already overloaded executive, encouraging signs point to the possibility that the gains are beginning to be significant enough to outweigh the frustrations involved. In any case, there seems little doubt that, despite many disappointments, computers are in business to stay.

Notes

-
1. "Managing Information Systems by Committee," *HBR*, July–August 1982.
-