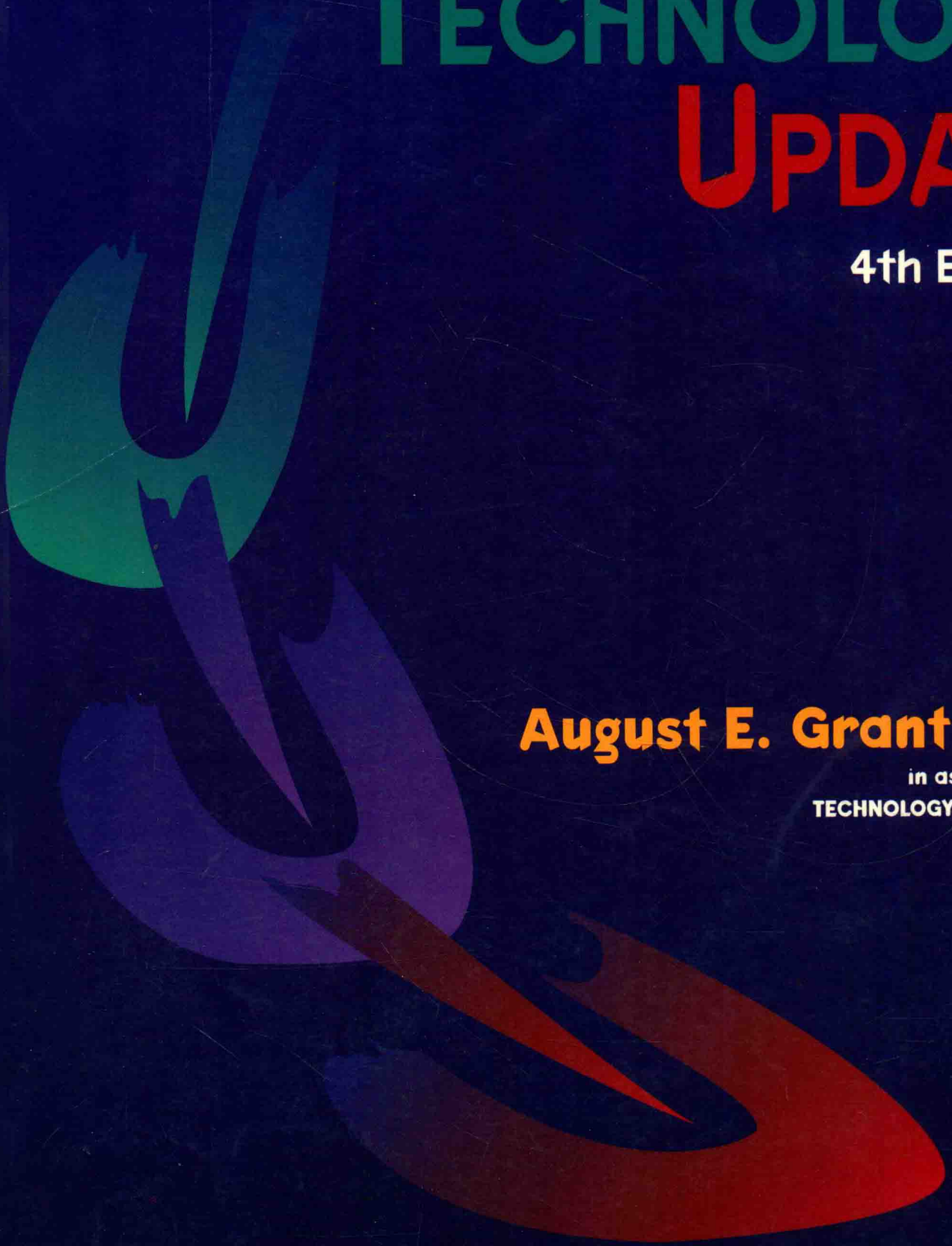
COMMUNICATION TECHNOLOGY UPDATE

4th EDITION



August E. Grant, Editor

in association with

TECHNOLOGY FUTURES, INC.

Communication Technology Update

4th Edition

August E. Grant, Editor
Jennifer Harman Meadows, Assistant Editor

In association with
Technology Futures, Inc.

Focal Press
Boston Oxford Melbourne Singapore Toronto Munich New Delhi Tokyo

University of Texas at Austin

Editor	August E. Grant
Assistant Editor	Jennifer Harman Meadows
Cover Design	Deborah Morrison
	Peter-J. E. Noble
	Marc Smith

Technology Futures, Inc.

Managing Editor	Julia A. Marsh
Production Editor	Debra R. Robison
Art Director	Helen Mary V. Marek

Focal Press is an imprint of Butterworth-Heinemann.

Recognizing the importance of preserving what has been written, Butterworth-Heineman prints its books on acid-free paper whenever possible.

ISBN 0-2408-0238-1

The publisher offers discounts on bulk orders of this book.
For information, please write:

Manager of Special Sales
Butterworth-Heinemann
313 Washington Street
Newton, MA 02158-1626

10 9 8 7 6 5 4 3 2 1

Printed in the United States of America

Communication Technology Update

4th Edition

Preface

If you've read previous editions of the *Communication Technology Update*, you'll notice a few changes in this year's edition. Many related chapters have been condensed into single chapters, and other technologies have been added for the first time. The number of graphics and illustrations has almost doubled, and the glossary is much larger. The biggest change is a no-cost supplement to the *Update* that will make the information even more timely than before.

The biggest problem with editing a textbook such as this one is trying to keep the information presented in the text as up-to-date as possible. I began this series with a commitment to revise the text once a year so that the information in this book would be as current as possible. We also developed a novel publishing arrangement with Technology Futures, Inc. that allowed this book to be printed and available for adoption less than three months after the manuscript was finalized, cutting up to a year or more off the turnaround time between manuscript completion and publication.

This year, we're adding another innovation to this text—a supplementary Internet "home page" for the update book. This home page will contain supplementary information, including a list of trade organizations and publications to contact for more information on any of the technologies discussed in this book. The home page will be under development throughout 1995 and 1996, and we want your suggestions on what should be included in order to make the book as useful as possible to you. We hope that this effort will be bidirectional, with readers sharing their own information and expertise on the *Communication Technology Update* home page. The last paragraph of this preface has information on how to reach the home page.

Our readers have always consisted of professionals in government and industry, and students who are studying communication technology. The goal has always been to provide information that is more current than that provided by a textbook, and more comprehensive than found in trade magazines.

I'm grateful to a fantastic group of authors that kept laboring to update their chapters well after the initial deadlines so that the book would be as current as possible when printed. As before, unless otherwise noted, all authors are students in the Communication Technology and Policy sequence in the Department of Radio-Television-Film at the University of Texas at Austin. Julia Marsh and Debra Robison from Technology Futures, Inc. played a critical role in refining and packing the contributions of over three dozen authors into a coherent whole. As Assistant Editor, Jennifer Meadows did double duty, working with individual authors to create a uniform writing style (and in the process taking the writing abilities of many authors to a much higher level). In their role as distributor, Marie Lee and others at Focal Press have given the *Update* a wider audience than ever.

My e-mail address is included below. I hope you will use it to:

- Request the Internet home page address. (We couldn't print the address in the book, because it had not been finalized when the book went to press.)
- Make suggestions for future editions of the book, such as chapters to include or delete, glossary terms which should be added, etc.
- Propose a contribution to next year's *Communication Technology Update*. (Proposals should be submitted by December 1, 1995, and manuscripts must be complete by March 15, 1996.)

Augie Grant
Department of Radio-Television-Film
CMA 6.118
The University of Texas at Austin
Austin, TX 78712
Phone: 512/471-6640; Fax: 512/471-4077
Internet: AUGIE@MAIL.UTEXAS.EDU

Communication Technology Update

4th Edition

Table of Contents

1

The Umbrella Perspective on Communication Technology

August E. Grant, Ph.D.

Communication technologies are the nervous system of contemporary society, transmitting and distributing sensory and control information, and interconnecting a myriad of interdependent units. Because these technologies are vital to commerce, control, and even interpersonal relationships, any change in communication technologies has the potential for profound impacts on virtually every area of society

One of the hallmarks of the industrial revolution was the introduction of new communication technologies as mechanisms of control that played an important role in almost every area of production and distribution of manufactured goods (Beniger, 1986). These communiciation technologies have evolved throughout the past two centuries at an increasingly rapid rate. The evolution of these technologies shows no signs of slowing, so an understanding of this evolution is vital for any individual wishing to attain or retain a position in business, government, or education.

This text provides you with a snapshot of this evolutionary process. The individual chapter authors have compiled facts and figures from thousands of sources to provide the latest information on 35 sets of communication technologies. Each discussion explains the roots and evolution, the recent developments, and the current status of the technology, as of mid-1995. In discussing each technology, we will deal not only with the hardware, but also with the software, the organizational structure, the political and economic influences, and the individual users.

Although the focus throughout the book is on individual technologies, these individual snapshots comprise a larger mosaic representing the communication networks that bind individuals together and enable us to function as a society. No single technology can be understood without understanding the competing and complementary technologies and the larger social environment within which these technologies exist. As discussed in the following section, all of these factors (and others) have been considered in preparing each chapter through application of the "umbrella perspective." Following that discussion, an overview of the remainder of the book is presented.

Defining Communication Technology

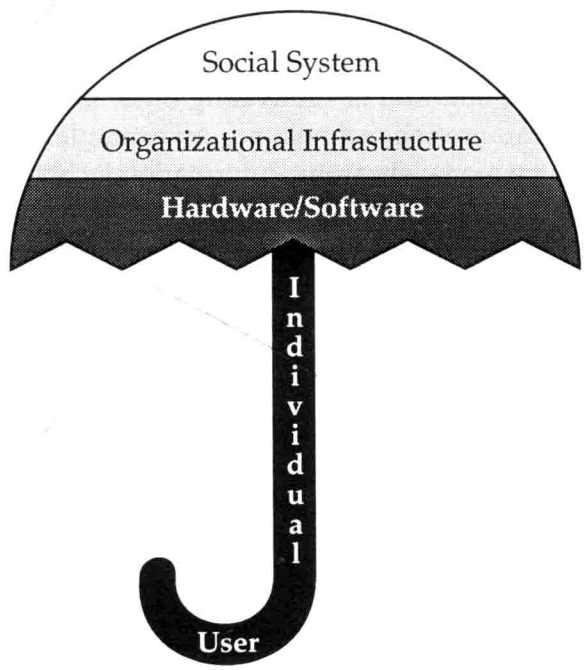
The most obvious aspect of communication technology is the hardware—the physical equipment related to the technology. The hardware is the most tangible part of a technology system, and new technologies typically spring from developments in hardware. However, understanding communication technology requires more than just studying the hardware. It is just as important to understand the messages communicated through the technology system. These messages will be referred to in this text as the "software." It must be noted that this definition of "software" is much broader than the definition used in computer programming. For example, our definition of computer software would include information manipulated by the computer (such as this text, a spreadsheet, or any other stream of data manipulated or stored by the computer), as well as the instructions used by the computer to manipulate the data.

The hardware and software must also be studied within a larger context. Rogers' (1986) definition of "communication technology" includes some of these contextual factors, defining them as "the hardware equipment, organizational structures, and social values by which individuals collect, process, and exchange information with other individuals" (p. 2). An even broader range of factors is suggested by Ball-Rokeach (1985) in her "Media System Dependency Theory," which suggests that communication media can be understood by analyzing dependency relations within and across levels of analysis, including the individual, organizational, and system levels. Within the system level, Ball-Rokeach (1985) identifies at least three systems for analysis: the media system, the political system, and the economic system.

These two approaches have been synthesized into the "Umbrella Perspective on Communication Technology" illustrated in Figure 1.1. The bottom level of the umbrella consists of the hardware and software of the technology (as previously defined). The next level is the organizational infrastructure, the group of organizations involved in the production and distribution of the technology. The top level is the system level, including the political, economic, and media systems, as well as other groups of individuals or organizations serving a common set of functions in society. Finally, the "handle" for the umbrella is the individual user, implying that the relationship between the user and a technology must be examined in order to get a "handle" on the technology. The basic premise of the umbrella perspective is that all five areas of the umbrella must be examined in order to understand a technology.

(The use of an "umbrella" to illustrate these five factors is the result of the manner in which they were drawn on a chalkboard during a lecture in 1988. The arrangement of the five attributes resembled an umbrella, and the name stuck. Although other diagrams have been used since to illustrate these five factors, the umbrella remains the most memorable of the lot.)

Figure 1.1
The Umbrella Perspective on Communication Technology



Source: A. E. Grant

Factors within each level of the umbrella may be identified as enabling, limiting, motivating, and inhibiting. *Enabling* factors are those which make an application possible. For example, the fact that coaxial cable can carry dozens of channels is an enabling factor at the hardware level, and the decision of policy makers to allocate a portion of the spectrum for cellular telephone is an enabling factor at the system level (political system).

Limiting factors are the opposite of enabling factors. Although coaxial cable increased the number of television programs which could be delivered to a home, most coaxial networks cannot transmit more than 54 channels of programming. To the viewer, 54 channels might seem to be more than is needed, but to the programmer of a new cable television channel who is unable to get space on a filled-up cable system, this hardware factor represents a definite limitation. Similarly, the fact that the policy makers discussed above permitted only two companies to offer cellular telephone service in each market is a system-level limitation on that technology.

Motivating factors are those which provide a reason for the adoption of a technology. Technologies are not adopted just because they exist. Rather, individuals, organizations, and social systems must have a reason to take advantage of a technology. The desire of local telephone companies for increased profits, combined with the fact that growth in providing local telephone service is limited, is an organizational factor motivating the telcos to enter the markets for new communication technologies. Individual users who desire information more quickly can be motivated to adopt electronic information technologies.

Inhibiting factors are the opposite of motivating ones, providing a disincentive for adoption or use of a communication technology. An example of an inhibiting factor at the software level might be a new electronic information technology that has the capability to update information more quickly than existing technologies, but does not use that capability to provide continuously-updated messages. One of the most important inhibiting factors for most new technologies is the cost to individual users. Each potential user must decide whether the cost is worth the service, considering his or her budget and the number of competing technologies.

All four types of factors—enabling, limiting, motivating, and inhibiting—can be identified at the system, organizational, software, and individual user levels. However, hardware can only be enabling or limiting; by itself, hardware does not provide any motivating factors. The motivating factors must always come from the messages transmitted (software) or one of the other levels of the umbrella.

The final dimension of the umbrella perspective relates to the environment within which communication technologies are introduced and operate. These factors can be termed "external" factors, while ones relating to the technology itself are "internal" factors. In order to understand a communication technology or to be able to predict the

manner in which a technology will diffuse, both internal and external factors must be studied and compared.

Each communication technology discussed in this book has been analyzed using the "umbrella perspective" to ensure that all relevant factors have been included in the discussions. As you will see, in most cases, organizational and system-level factors (especially political factors) are more important in the development and adoption of communication technologies than the hardware itself. For example, political forces have, to date, prevented the establishment of a world standard for high-definition television (HDTV) production and transmission. As individual standards are selected in countries and regions, the standard selected is as likely to be the product of political and economic factors as of technical attributes of the system.

Organizational factors can have similar powerful effects. For example, the entry of a single company, IBM, into the personal computer business resulted in fundamental changes to the entire industry. Finally, the individuals who adopt (or choose not to adopt) a technology, along with their motivations and the manner in which they use the technology, have profound impacts upon the development and success of a technology following its initial introduction.

Each chapter in this book has been written from the "umbrella perspective." The individual writers have endeavored to update developments in each area to the extent possible in the brief summaries provided. Obviously, not every technology experienced developments in each of the five areas, so each report is limited to areas in which relatively recent developments have taken place.

Overview of Book

The technologies discussed in this book have been organized into four sections: electronic mass media, computers and consumer electronics, satellites, and telephony. These four are not necessarily exclusive; for example, direct broadcast satellites (DBS) could be classified as either an electronic mass medium or a satellite technology. The ultimate decision regarding where to put each technology was made by determining which set of current technologies most closely resembled the technology from the user's perspective. Thus, DBS was classified with electronic mass media. This process also locates a telephone-based technology, video dialtone, in the electronic mass media section, and a cable television technology—point-to-point cable services—in the telephony section.

Each chapter is followed by a brief bibliography. These reference lists represent a broad overview of literally thousands of books and articles available which provide details about these technologies. It is hoped that the reader will not only use these spe-

cific references, but will examine the list of source material to determine the best places to find newer information since the publication of this *Update*.

The final chapter attempts to draw larger conclusions from the preceding discussions, noting commonalties among the technologies and trends over time. It is impossible for any text such as this one to ever be fully comprehensive, but it is hoped that this text provides the reader with a broad overview of the current developments in communication technology.

Bibliography

Ball-Rokeach, S. J. (1985). The origins of media system dependency: A sociological perspective. *Communication Research, 12* (4), 485-510.

Beniger, J. (1986). *The control revolution.* Cambridge, MA: Harvard University Press.

Rogers, E. M. (1986). *Communication technology: The new media in society.* New York: Free Press.

II

ELECTRONIC MASS MEDIA

Never in the history of human communication have so many new media technologies been introduced in so short a time as during this decade. All areas of the media are affected, but none is expected to experience as profound a change as the electronic mass media. Together, the next 11 chapters paint a picture of media in transition. Virtually all of the media discussed are certain to be influenced by the introduction of digital video compression, which promises the capability of transmitting many channels of television in the amount of spectrum now used to transmit one. As discussed in the next chapter, digital compression is a key component of the newest generation of direct broadcast satellite services, and plans are underway to adapt it in one form or another in almost every other distribution technology. The key questions are how long it will take to make the transition, and how much it will cost.

The cable television chapter clearly illustrates the impact of regulation upon a technology. A few short years ago, most cable companies trumpeted plans for adoption of compression and other technologies to expand their service offerings. Many of these plans have since been put on hold as cable companies deal with the fallout of the Cable Television Consumer Protection and Competition Act of 1992. On the other hand, companies that produce programming for cable television are going strong. As pointed out in the chapter on pay cable services, the 1992 cable act did not affect pay cable services, and newer forms of pay cable, including video on demand and pay-per-view, promise to increase the revenues of both programmers and cable operators. Furthermore, the 1992 cable act guaranteed the new competitors cable access to cable's most desired programming, assisting the growth of direct broadcast satellite services (DBS) and "wireless cable" (MMDS). The chapters on these two technologies explain how these new distribution media are poised to challenge cable as the primary distributor of multichannel television services.

The telephone companies are also eager to enter the fray with their own video service, called video dialtone. This chapter illustrates a radically different technology for delivering television programming to the home, and it provides an illustration of the complexities of the regulatory process. Another technology that is hung up between the

regulatory process and technological innovation is high definition television (HDTV). As reported in Chapter 10, new innovations in broadcasting HDTV signals are being developed even as regulators attempt to test and approve existing HDTV standards.

This section also reports on three technologies experiencing less change. In 1994, a multitude of new television shopping channels were poised to enter the market. A year later, most of these efforts have been scrapped, leaving most of the market to two large operators which are going through their own transitions. Technological development and field trials of interactive television continue, but regular, large-scale service is not yet a reality. Low power television, once considered a revolutionary form of community-based broadcasting, continues to fill a specialized but small niche. On the surface, radio appears to belong in this group as a mature, stable medium, but the radio broadcasting chapter indicates the dramatic revolution in radio caused by changes in ownership rules and the advent of digital transmission technologies.

In reading these chapters, you should consider two basic communication technology theories. Diffusion theory helps us to understand that the introduction of innovations is a process that occurs over time among members of a social system (Rogers, 1983). Different types of people adopt a technology at different times, and for different reasons. The smallest group of adopters are the innovators who are first to adopt, but they usually adopt for reasons that are quite different from later adopters. Hence, it is dangerous to predict the ultimate success, failure, diffusion pattern, gratifications, etc. of a new technology by studying the first adopters. Diffusion theory also suggests five attributes of an innovation which are important to its success: compatibility, complexity, trialability, observability, and relative advantage (Rogers, 1983). In studying or predicting diffusion of a technology, use of these factors suggests analysis of competing technologies as being as important as the attributes of the new technology.

A second theory to consider is the "Principle of Relative Constancy" (McCombs, 1972; McCombs & Nolan, 1992). This theoretical perspective suggests that, over time, the proportion of aggregate disposable income devoted to the mass media is constant. In simple terms, people spend a limited amount of their income on the media discussed in this section, and that amount will almost never go up when new media are introduced. In applying this theory to the electronic mass media discussed in the following chapters, consider which media will win a share of audience income, and what will happen to the losers.

Bibliography

McCombs, M. (1972). Mass media in the marketplace. *Journalism Monographs*, 24.

McCombs, M., & Nolan, J. (1992). The relative constancy approach to consumer spending for media. *Journal of Media Economics, 5* (2), 43-52.

Rogers, E. M. (1983). *Diffusion of innovations, (3rd ed.).* New York: Free Press.