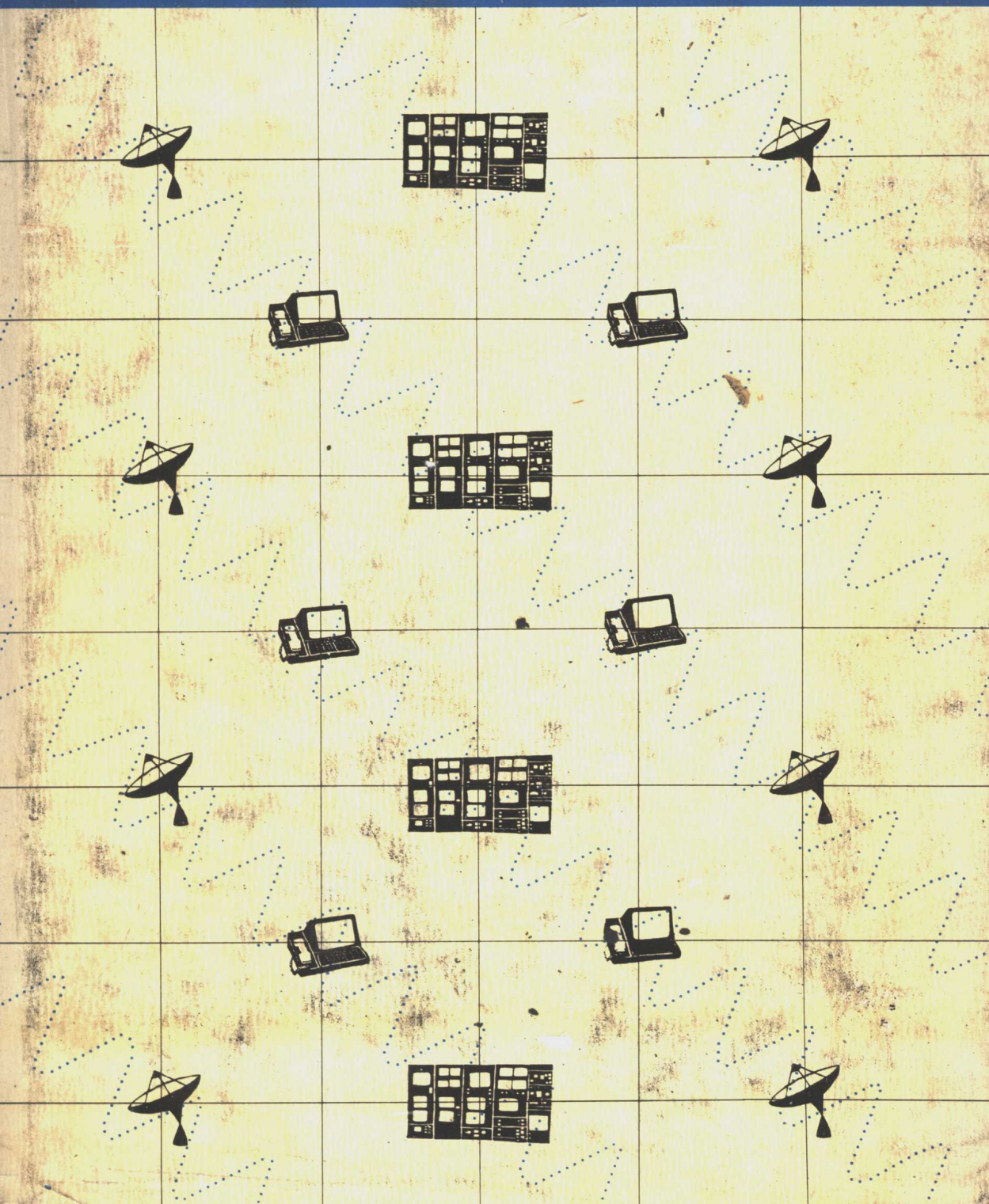


# TELECOMMUNICATIONS FOR MANAGEMENT

Charles T. Meadow  
Albert S. Tedesco



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DIALOG Information Services, Inc.

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## **TELECOMMUNICATIONS FOR MANAGEMENT**

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**This book is dedicated  
by CTM to his son, Ben,  
and  
by AST to his parents,  
Pasquale and Marie Tedesco.**

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# PREFACE

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Communication is far more than just another technology. The way we communicate among ourselves is fundamental to our culture, indeed it may even be defined as our culture. Communication involves not just gadgetry, but spoken, written, and symbolic language, art, and music, and how we *use* such technological devices as the telephone, printing press, or television. More specific to the purposes of this book, the technology of communication affects the way we do business. Communication (of which transportation is a form) enables decentralization of organizations and also centralized control over physically dispersed divisions. Because of new methods of internal communication, most employees are better informed about their organization than they were, say, a generation ago. This means the manager is no longer the only one with information, and it means he or she must make managerial decisions more openly than before. This changes the role of the manager and is one of the forces encouraging more participative management. Customers are both better informed and more demanding. They want good information about products and “hotlines” for asking questions. Lawsuits by consumer groups or government regulatory bodies may make a corporation’s entire internal communication system open to public scrutiny.

Thus, telecommunications has invaded the domain of just about all managers, not just the corporate telecommunications manager. Today, a marketing manager, for example, has to buy Wide Area Telephone Service (WATS), digital communication service from a data communication network, and perhaps teleconferencing software to keep in touch with field managers. Most such managers will not have had formal training in telecommunications, yet they must make the decisions.

This book should help the nontechnical manager cope with modern telecommunications and its effects. It is not aimed at the telecommunications manager or engineer, who should already know most of this material. Rather, it is aimed at people in marketing, accounting, manufacturing, planning, personnel, purchasing—almost any traditionally nontechnical occupation—who are facing

the need to buy telecommunications equipment or services, who must restructure their organizations around new ways of communicating among elements of the company, and whose traditional ideas on how managing is done are being challenged in part by the new technology.

Our primary intended audience is the student of management, probably in a business school, but possibly in a department of engineering administration, industrial engineering, or information science. We were both in academic life when this project started, and we were convinced that there are too few courses on this subject, in any department on a typical campus. One reason for this might have been the lack of appropriate text material. We hope we have filled that gap.

A secondary audience is the practicing manager, out of school, and now facing the kinds of problems we describe herein.

Because the field is so diverse, we have assembled a panel of authors specializing in the various disciplines and technologies. As editors, we have contributed some of the chapters and have attempted to keep all the writing on a reasonably constant level and integrated in usage and coverage.

In each of our chapters on a specific technology, we begin with a background or historical review, to provide a context in which to understand how this technology was developed and nurtured. Understanding technology is *not* merely a matter of understanding physical principles.

The book is organized into six main parts, each with a brief introduction. They are:

Part One, "Elements of Communication," covering the nature of communication, some of the underlying scientific concepts, and how people communicate with machines.

Part Two, "Basic Technology," concerned with how things work. Emphasis is on the technologies used by working telecommunications systems: transmission systems; the telephone system, which is important in itself but also because it is used as a carrier by so many other systems; and digital communication networks, which have enabled the recent rapid growth in remote computer use.

Part Three, "Applications," in which we survey some of the more important uses of telecommunications in today's industry: television and other video techniques, electronic mail, teleconferencing, mobile communication, and videotex, the new combination of computers and video.

Part Four, "Management of Telecommunications," in which we consider the manager's point of view and cover such topics as cost-benefit analysis, particularly as applied to equipment procurement; regulation in the United States and internationally; and the problems of the corporate telecommunications manager.

Part Five, "Case Histories," containing two studies of the use of telecommunications by large, geographically widespread organizations, and how communications has affected them.

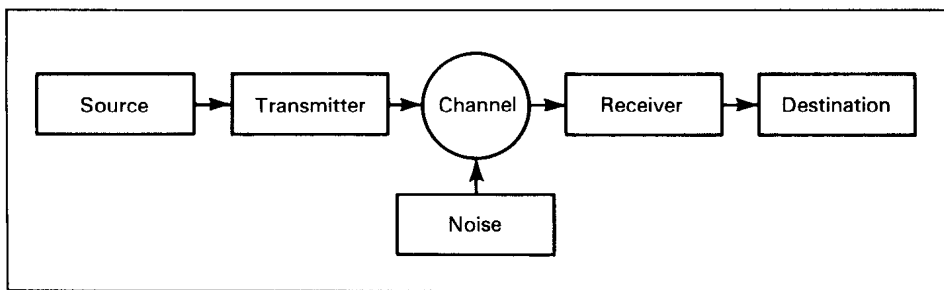
Part Six, "The Future," reviewing some of what has gone before and looks forward in time, not to forecast technology, but to consider its effect on managers and the nature of work itself.

A collection of brief biographies of our authors is found following Chapter 19.

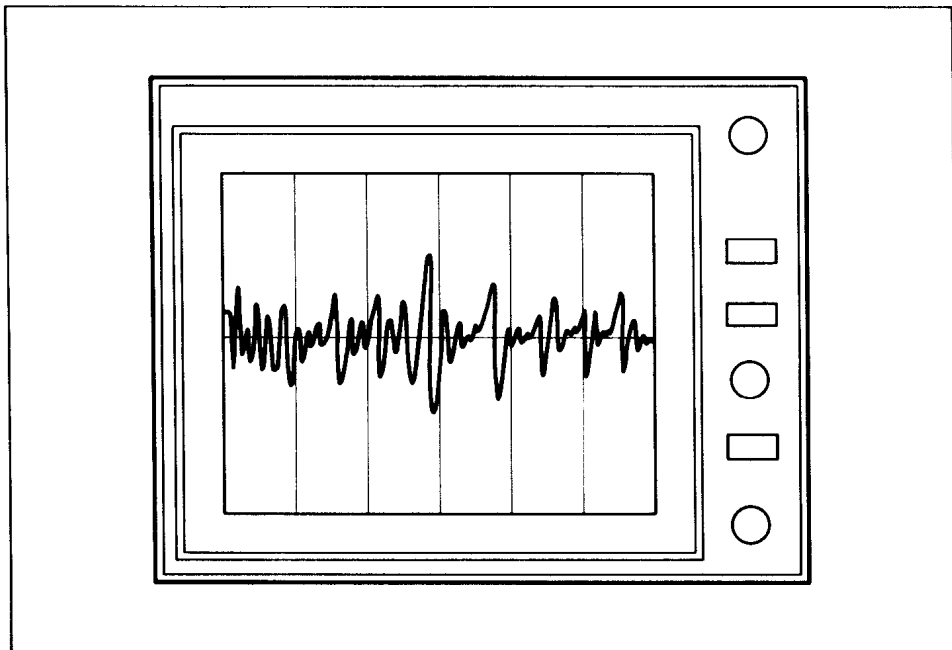
We are deeply appreciative of the help of many people in the conception, writing, and production of this book: Giulana Lavendal and Dr. Allen L. Brown of Xerox Corporation; Marilyn Ruell of Hewlett-Packard; Bill Gross of Radio Broadcasting Company; Larry Miller of Schwartz, Woods, and Miller; Harry Jenny and Tony Evasew of WWSG-TV; Joe Roizen of Telegen, Margaret Goya of DIALOG Information Services; and Mary A. Navarro. A special thanks to the staff of the wonderful AT&T photo library, and to Joyce Weiner of E. R. Squibb & Sons, Inc., for her helpful comments and suggestions.

*Charles T. Meadow*

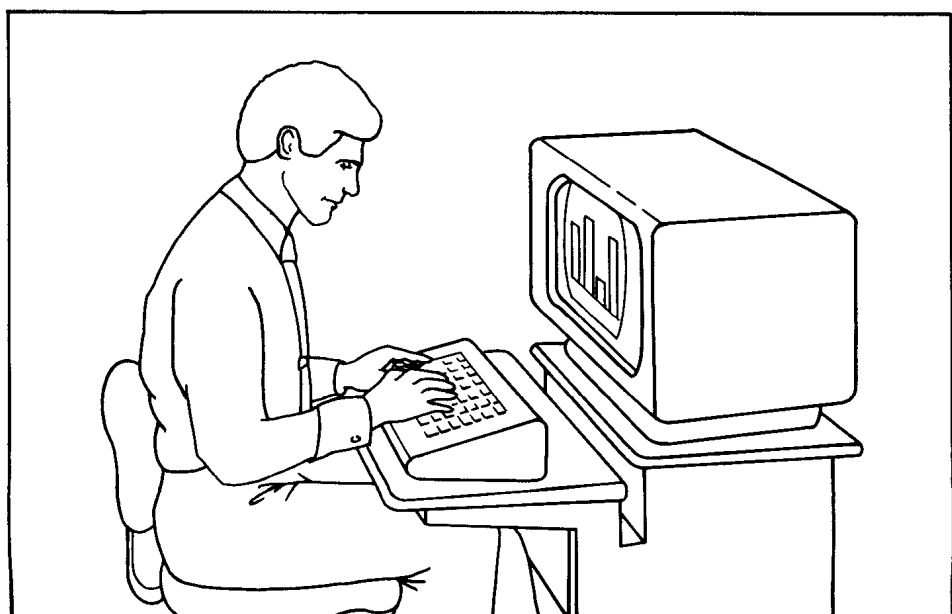
*Albert S. Tedesco*



Chapter 1: Introduction



Chapter 2: The Basics of Communication



Chapter 3: Communication between People and Machines



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# CONTENTS

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## PREFACE

xiii

## PART 1 ELEMENTS OF COMMUNICATION

<b>1</b>	<b>Introduction, by Charles T. Meadow</b>	<b>3</b>
1.1	WHAT IS COMMUNICATION?	3
1.2	COMMUNICATION IN MANAGEMENT	5
1.3	COMMUNICATION TECHNOLOGY	6
1.4	THE SOCIAL EFFECT OF TELECOMMUNICATIONS	8
1.5	PLAN OF THE BOOK	9
<b>2</b>	<b>The Basics of Communication, by Charles T. Meadow</b>	<b>12</b>
2.1	THE NATURE OF COMMUNICATION	12
2.2	SYMBOLS AND CODES	14
2.3	THE ELECTROMAGNETIC SPECTRUM	22
2.4	TRANSMISSION OF SIGNALS	24
2.5	NOISE	27
2.6	SWITCHING, MULTIPLEXING, AND NETWORKS	30
<b>3</b>	<b>Communication between People and Machines, by Charles T. Meadow</b>	<b>37</b>
3.1	THE CONCEPT OF HUMAN-MACHINE COMMUNICATION	37
3.2	THE BASIC MECHANICS	39
3.3	STYLES OF INTERACTION	46
3.4	THE SOCIAL IMPACT OF HUMAN-MACHINE COMMUNICATION	50

vii

**PART 2 BASIC TECHNOLOGY**

<b>4</b>	<b>Transmission Systems</b> , by Herbert S. Dordick and Ronald E. Rice	<b>55</b>
4.1	INTRODUCTION	55
4.2	BASIC TRANSMISSION FACTORS	56
4.3	MODULATION AND MULTIPLEXING	60
4.4	NETWORKS AND SWITCHING	71
4.5	CURRENT MAJOR TRANSMISSION MEDIA	78
4.6	SYSTEM COMPARISONS	85
<b>5</b>	<b>The Telephone System</b> , by Howard R. Turtle	<b>91</b>
5.1	THE TELEPHONE	92
5.2	THE SWITCHED NETWORK	99
5.3	TELEPHONE SERVICES	105
5.4	REGULATORY ENVIRONMENT	112
5.5	TELEPHONE COMPANIES	116
5.6	FUTURE OF THE TELEPHONE SYSTEM	122
<b>6</b>	<b>Digital Communication Networks</b> , by Alan E. Negus	<b>124</b>
6.1	HISTORICAL INTRODUCTION	124
6.2	PACKET SWITCHING	128
6.3	MORE ABOUT ARPAnet	131
6.4	THE TELENET NETWORK	133
6.5	THE EURONET NETWORK	134
6.6	OTHER PUBLIC NETWORKS	136
6.7	STANDARDS FOR PACKET-SWITCHED NETWORKS	137
6.8	LOCAL AREA NETWORKS	138
<b>7</b>	<b>Local Area Networks</b> , by Juan Bulnes	<b>143</b>
7.1	THE MOTIVATION	143
7.2	THE REQUIREMENTS	145
7.3	THE CHARACTERISTICS OF LANs	147
7.4	ETHERNET	151
7.5	FUNCTIONAL INTEGRATION	152
7.6	OPEN SYSTEMS INTERCONNECTION	153
7.7	THE FUTURE OF LANs	156

**PART 3 APPLICATIONS**

<b>8</b>	<b>Television in the Corporate Environment</b> , by Albert S. Tedesco	<b>161</b>
8.1	INTRODUCTION	161

8.2	THE SCOPE AND DEVELOPMENT OF CORPORATE TELEVISION	161
8.3	A TAXONOMY OF ELECTRONIC VISUAL TRANSMISSION: A GUIDE TO ADOPTION	162
8.4	MOTIVATIONS TO USE ELECTRONIC VISUAL TRANSMISSION SYSTEMS	166
8.5	AN OVERVIEW OF SPECIALIZED EVT TECHNOLOGIES	167
8.6	TELEVISION: THE DOMINANT EVT TECHNOLOGY	171
8.7	THE TECHNOLOGY OF TELEVISION	173
8.8	TRADE-OFF ANALYSIS: VIDEO VERSUS OTHER MEDIA	184
8.9	INSTITUTIONAL PERSPECTIVE	185
8.10	TELEVISION IN THE MANAGEMENT ENVIRONMENT: AN OVERVIEW	185
8.11	CONCLUSION	187
<b>9</b>	<b>Electronic Mail, by Ruann Pengov</b>	<b>189</b>
9.1	HISTORICAL INTRODUCTION	189
9.2	ELECTRONIC MAIL	193
9.3	ELECTRONIC MAIL DELIVERY SYSTEMS	201
9.4	COMPARISON OF SYSTEMS	204
9.5	THE FUTURE	206
	APPENDIX: Sample Dialogue from a Computer-Based Message System	209
<b>10</b>	<b>Teleconferencing, by Patrick S. Portway</b>	<b>213</b>
10.1	THE GROWTH OF TELECONFERENCING	213
10.2	TYPES OF TELECONFERENCING	219
10.3	ALLSTATE LEADS THE WAY: A CASE STUDY	223
<b>11</b>	<b>Mobile Communication, by Jerry Orloff</b>	<b>227</b>
11.1	HISTORICAL INTRODUCTION	227
11.2	THE SYSTEM	229
11.3	CLASSES OF MOBILE COMMUNICATION SERVICE	230
11.4	THE USERS	231
11.5	THE CAPABILITIES OF MOBILE COMMUNICATIONS EQUIPMENT	232
<b>12</b>	<b>Videotex, by Albert S. Tedesco</b>	<b>249</b>
12.1	HISTORICAL INTRODUCTION	249
12.2	VIDEOTEX SYSTEM COMPONENTS	251
12.3	VIEWDATA SYSTEM DESIGN AND ARCHITECTURE	254
12.4	TELETEXT SYSTEM DESIGN AND ARCHITECTURE	255

12.5 RETRIEVAL CHARACTERISTICS: WHAT THE USER CONFRONTS	259
12.6 IMAGE-CREATION CHARACTERISTICS	261
12.7 USER APPLICATIONS	263
12.8 BARRIERS TO ADOPTION	265
12.9 BUSINESS AND PUBLIC POLICY ISSUES	266
12.10 A FINAL WORD	267

## **PART 4 MANAGEMENT OF TELECOMMUNICATIONS**

<b>13 Cost-Benefit Analysis in Telecommunications Management,</b> by Lawrence F. Young	<b>273</b>
13.1 COST AND BENEFIT IMPACTS ON THE ORGANIZATION	273
13.2 THE TELECOMMUNICATION MANAGEMENT PROBLEM AND DECISION ANALYSIS TECHNIQUES	280
<b>14 Regulation of Telecommunications in the United States,</b> by Michael Botein and Michael J. Sprague	<b>291</b>
14.1 PRELUDE TO REGULATION OF THE ELECTRONIC MASS MEDIA	291
14.2 THE PARAMETERS OF FEDERAL JURISDICTION	294
14.3 THE JURISDICTION OF THE FEDERAL COMMUNICATIONS COMMISSION	298
14.4 PLAYERS IN THE COMMUNICATIONS POLICY GAME	303
14.5 CONCLUSION	306
<b>15 International Telecommunications, by Alan E. Negus</b>	<b>308</b>
15.1 INTRODUCTION	308
15.2 PROVISION OF DOMESTIC SERVICES	309
15.3 INTERNATIONAL TELECOMMUNICATIONS	311
15.4 TECHNICAL ISSUES	312
15.5 INTERNATIONAL REGULATORY ISSUES	313
15.6 AGENCIES DEALING WITH REGULATION	318
<b>16 Managing a Telecommunications Facility,</b> by Charles J. Schweis	<b>324</b>
16.1 ORGANIZATION OF THE TELECOMMUNICATIONS FACILITY	324
16.2 VOICE AND DATA SYSTEM DESIGN	327
16.3 TRAFFIC AND NETWORK ENGINEERING	330
16.4 FINANCIAL ANALYSIS GROUP	332
16.5 SYSTEM SERVICE AND IMPLEMENTATION	333
16.6 MANAGING AND MEASURING PERFORMANCE	336

**PART 5 CASE HISTORIES**

<b>17</b>	<b>A Management Information System, by Roger L. Schelm</b>	<b>341</b>
17.1	BACKGROUND OF THE INA CORPORATION	341
17.2	DATA COMMUNICATIONS	342
17.3	ELECTRONIC INSURANCE SYSTEM	342
17.4	GROWTH	345
17.5	1978	346
17.6	1979	347
17.7	1980 AND 1981	348
17.8	PLANNING FOR THE FUTURE	349
<b>18</b>	<b>Telecommunications and the News, by Elizabeth Loker and Donald Till</b>	<b>351</b>
18.1	BACKGROUND	351
18.2	OVERVIEW OF NEWSPAPER PRODUCTION	352
18.3	TELECOMMUNICATIONS AND NEWSGATHERING	352
18.4	CONSTRUCTING THE APPROPRIATE COMMUNICATIONS COMPLEX	353
18.5	MANAGING THE COMMUNICATIONS COMPLEX	355
18.6	PRODUCTION AND DISTRIBUTION OF THE NEWSPAPER	355
18.7	DISTRIBUTION OF THE NEWS SERVICE	357
18.8	THE ELECTRONIC LIBRARY	358
18.9	EMERGING ISSUES	358

**PART 6 THE FUTURE**

<b>19</b>	<b>Management and Telecommunications in the Future, by Charles T. Meadow and Albert S. Tedesco</b>	<b>363</b>
19.1	INTRODUCTION	363
19.2	SOME TRENDS AND OBSERVATIONS ON MANAGEMENT AND TELECOMMUNICATIONS	363
19.3	MANAGEMENT IN THE TELECOMMUNICATIONS WORLD	365
19.4	IS IT UTOPIA?	366
	INDEX	369

# **PART ONE**

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## **ELEMENTS OF COMMUNICATION**

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The first part of this book has a two-fold purpose: to establish the conceptual framework within which the reader may view current developments in telecommunications and to provide the vocabulary to assist in understanding what follows.

In Chapter 1 the goals and organization of the text are outlined. The reader is introduced to the central role of communication in managing and to some ideas about how telecommunication systems function. Chapter 2 deals with the fundamentals of communication for the nontechnical reader, with emphasis on the “common sense” as well as the technical interpretation of communications phenomena. While no background in physics or mathematics is required of the reader, this chapter includes sections on aspects of the physics of communication, such as wave mechanics and the electromagnetic spectrum, and noise, multiplexing, error detection and correction, and networking. The goal is to present and clarify basic concepts which reappear in subsequent chapters. In Chapter 3 we address the nature of communication between people and machines, with special attention to styles of discourse and the social impact of this form of interaction.



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# INTRODUCTION

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## 1.1 WHAT IS COMMUNICATION?

There are many views of what communication is, but they generally have the common concept that meaning or information is represented by symbols and that as we exchange these symbols, we can convey meaning from one person or organism to another. The more obvious symbols are the letters that make up printed words or the sounds that make up spoken words, but we must also include gestures, pictures, or the sound of a barking dog. To people interested in the humanities, the behavioral sciences, or the more human aspects of communication, the emphasis is on *meaning* or *feelings* and how these may be conveyed from one person to another, as well as on what happens when there is a failure to communicate. We talk of the generation gap as a crisis of communication between older and younger people. We call our advertising and public relations departments *communications* departments because their job is to convey impressions, attitudes, and feelings about an organization to the public.

Engineers are more likely to be concerned with the physical aspects of communication. How do we actually send a message from one point or person to another? How do we make sure it is accurately received or that the cost is low enough? In a formal sense, engineers may go so far as to say they are not concerned with meaning, that the technical goal of communication is to transmit the message, not the meaning.

Data processing people and most managers fall somewhere between these views. They are concerned with communication between computers, for instance, as well as between departments of an organization. They must be concerned with both the physical aspects of cost-effective, reliable transmission



and the content of what is being transmitted and received. We tend to follow this approach throughout this book. The ultimate purpose of communication is to convey meaning, but often we must have a great deal of knowledge and understanding of *how* this is done in order to insure that meaning is being effectively transmitted.

Claude E. Shannon (Shannon & Weaver, 1949) of Bell Laboratories, generally regarded as the originator of mathematical communication theory, proposed a model of the communications process that is simple yet elegant in its near-universal applicability. Shannon identified five major elements in the process of communication.

1 The *source* of a message, best typified as a human being intending to send a message to another—say by telephone or post.

2 The *transmitter*, which normally transforms the source's message into the form required for actual delivery. In a telephone system the transmitter is a part of the telephone instrument in the user's hand.

3 The *channel*, which is the physical means of moving the message from one point to another. Channels are rarely simple single elements. The entire telephone system may be viewed as a single channel, but it is actually a complex of transmitters, channels, receivers, and retransmitters, all seen as a single entity to most users.

4 The *receiver*, which receives the message from the channel and converts the message into a form that is useful to or able to be sensed by the person for whom it is intended.

5 The *destination*, which is the recipient or addressee or target of the communication, again typified by the person who answers the telephone or reads the letter.

We generally define *transmission* to include both the sending and receipt of a message. Transmission is said not to occur *unless the destination has received the message sent by the source*. This is an important consideration. It means that the person who utters a statement that is not heard cannot be said to have communicated or even transmitted a message. The business that sends out a letter stating, "Unless we receive payment by . . ." has not communicated unless the destination actually received the letter.

Almost any real communication system involves a series of transmissions and retransmissions: from source's mind to letter form, to mail box, to sorting office, to airline, to another sorting office, and so on. Often, as in the case of television signals, the "message" is recoded and transformed many times from its origin to destination, so that the Shannon model is used over and over again to describe the actual path of a "signal," such as the face of an actor on television. The pictorial image is transmitted to a television camera, transformed and transmitted to a telephone line, transformed and transmitted to a central television transmitter, transformed and sent "over the air," transformed and displayed on the home receiving set. Problems in the form of noise or distortions or complete