



Management of Telecommunications

BUSINESS SOLUTIONS TO BUSINESS PROBLEMS
ENABLED BY VOICE AND DATA COMMUNICATIONS

CARR | SNYDER

SECOND EDITION



The Management of Telecommunications

**Business Solutions to Business
Problems Enabled by Voice
and Data Communications**

Second Edition

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**McGraw-Hill
Irwin**

Boston Burr Ridge, IL Dubuque, IA Madison, WI New York San Francisco St. Louis
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THE MANAGEMENT OF TELECOMMUNICATIONS: BUSINESS SOLUTIONS TO BUSINESS PROBLEMS
ENABLED BY VOICE AND DATA COMMUNICATION

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This book is printed on acid-free paper.

domestic 1 2 3 4 5 6 7 8 9 0 DOW/DOW 0 9 8 7 6 5 4 3 2

international 1 2 3 4 5 6 7 8 9 0 DOW/DOW 0 9 8 7 6 5 4 3 2

ISBN 0-07-248931-6

Publisher: *George Werthman*

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Cover design: *Kiera Cunningham*

Typeface: *10/12 Palatino*

Compositor: *Carlisle Communications, Ltd.*

Printer: *R. R. Donnelley & Sons Company*

Library of Congress Cataloging-in-Publication Data

Carr, Houston H., 1937-

The management of telecommunications : business solutions to business problems
enabled by voice and data communications / Houston H. Carr, Charles A. Snyder.—
2nd ed.

p. cm.

Includes index

ISBN 0-07-248931-6 (alk. paper) - ISBN 0-07-119928-4 (alk. paper)

1. Business—Communication systems. 2. Telecommunication systems. I. Snyder,
Charles A. II. Title.

HD30.335 .C36 2003

384'.068-dc21

2002071850

INTERNATIONAL EDITION ISBN 0-07-119928-4

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This book is dedicated to . . .

- Our students who made the text necessary and worthwhile
- Managers who must have this knowledge to be competitive

and above all

- Our wives, *Genyth* and *Margrit*, who gave us the time and support to make the book a reality.

Preface

In the economy of the 21st century, almost everything is both global and mobile.

Telecommunications technology has become much more than a business tool. It has now become an essential feature of the business environment and is embodied in both operations and the products of organizations.

We are living in an age of *convergence*. That is, we have witnessed the coming together of computing and telecommunications so that many would describe the present as having moved from being systems-centric (mainframe computer), through personal computer-centric, to network-centric, and now to Internet or Web-centric. Some predict that the future (starting around the year 2010) will become more content-centric. Businesses are in a state of evolution that has been both caused and enabled by technology and a technology-based infrastructure.

This is a book about the use and management of telecommunications resources that support the business of the organization, that is, business telecommunications. It provides the information at a level that will be understandable to the student new to telecommunications while still providing essential and in-depth knowledge to satisfy the need for specificity and technological knowledge for the subject. We discuss data and computer communications in some detail as this is where much of the efficiency and effectiveness of business telecommunications take place. We also address that other side of telecommunications, the worldwide telephone system and its impact on local interorganizational human communications. All of the discussion takes place within the management and decision-making environment of running a business that grows in size and telecommunications sophistication.

While information (and data) may be the lifeblood of the organization, telecommunications is the circulation system. Just as the organism cannot exist without its lifeblood, it cannot exist without it being distributed properly. Telecommunications is central to how organizations conduct their business in that it is the conduit for vital organizational information flows. Therefore, a knowledge of telecommunications is essential to students or anyone who will be part of any organization that is decentralized and dispersed, shares resources, and communicates. An understanding of the vocabulary, technology, and use of telecommunications is critical to business/organizational decision makers.

The changed nature of the business environment means that managers can no longer rely on technical specialists to provide them with all telecommunications decisions. Business students must understand how telecommunications in general and telecommunications-intensive information systems in particular are part of the strategic, tactical, and operational decision processes of an organization. The nature of the evolving environment means that a knowledge of telecommunications can mean the difference between achieving competitive advantage and failure. In the 21st century, almost everything will be both global and mobile. Therefore, the organization's telecommunications infrastructure will be vital to its success.

Don't buy technology! Buy resolution to a problem or opportunity! The final determinant is, "What are the *management implications* for choosing a given solution?"

A BOOK FOR BUSINESS STUDENTS

The essentials for a business book on telecommunications, by the global nature of the business market, must be based on management decision making in an environment of competition. The existing texts on telecommunications were generated primarily from an engineering perspective. This text presents the essentials of telecommunications for business decision making around a building-block approach, from the very simple to the global and very complex. Other texts immerse the student in the technology without relating that technology to the business requirements for it. Our approach systematically builds a business and its information and telecommunications systems so that the reader can easily understand relevant issues and be introduced to the technology at a point where the technology makes business sense.

COURSES IN THE CURRICULUM

Courses in telecommunications are now a normal part of Schools of Business curricula. The view that telecommunications is vital to MIS and to business education is widely recognized. This trend will continue as we more fully absorb and integrate the technology of microcomputers, electronic and voice mail, teleconferencing, multimedia, facsimile, distributed processing, the computer integrated enterprise, electronic commerce, wireless and mobile commerce, especially on the Internet's World Wide Web, and communications in general. We believe the need for understanding business telecommunications and courses in business schools will continue to grow at an increasing rate. The growth should be spurred by the radical changes in organizations as the result of reengineering of processes, reliance on teams, and increased dispersion of operations made possible by broad bandwidth, wireless, and mobile technologies.

The objective of this text is to provide the student sufficient vocabulary, technical understanding, and alternatives to be an effective business telecommunications decision maker. In addition the student should become "snowproof," which means to be insulated from being overpowered by vendors and highly technology-based colleagues. Many, if not most, of the students using this text will have limited technological backgrounds, but will be placed in situations to make or support decisions on the use of telecommunications. These students must internalize knowledge and understanding so as to deal effectively with vendors and "techies" who may attempt to overwhelm them with a strange vocabulary and the self-evident merits of telecommunications technology. Students armed with the tools contained in this book will be able to lead the decision process because they understand the technology trade-offs in relation to costs, marketing, customer service, and competition.

The book includes additional material in the chapters and at the end of the chapters that will carry undergraduate students, graduate students, managers, and executives to a deeper and richer understanding of technological concepts. Where some books concentrate only on data communications, we cover both voice and data systems. While others give only broad coverage, we complement breadth with optional depth. While others concentrate on the technology, we support an understanding of technology and the need to manage it. This book provides

several levels of understanding: the technology, the vocabulary, the management issues, and the decision environment.

Bringing technology to bear on a process yields richer dividends if one is willing to consider reengineering the process.

Part of our thrust is to use real and created cases to demonstrate the concepts of the chapters and to show the decision process that is occurring. We provide problems that allow the students to demonstrate understanding of the decision processes, such as when to consider bypass; the economics of a VAN or organizational networks; use of real and virtual networks; the lingering implications of the AT&T divestiture, telecommunications regulation, telecommunications deregulation, and privatization; twisted-wire versus fiber optic cable versus wireless; telecommunications as an investment rather than a cost; and the economic value of truly managing the organization's voice and data systems.

Students in a two-year program other than an associate degree in telecommunications will probably take the course in the second year. Those in a telecommunications program will likely use the book the first year. Students in a four-year college will take the course their junior or senior year regardless of their program. The students will most likely be MIS/CIS or computer science majors, although we believe the book should have appeal to engineering management curricula. The students may include this as an elective course, taking it to strengthen their technical backgrounds. Most students will realize that taking a business telecommunications course was one of their better decisions when they are faced with a myriad of telecommunications choices in the organizational environment.

From a management perspective, the primary focus is on the *level of quality* and the *level of service* rather than on the technology itself.

ENGINEERING OR BUSINESS

We focus on business applications and provide examples that are relevant to business rather than concentrating primarily on the technology as do most of the books on networking and data communications. Our aim is to provide the essential information that will enable students to make a smooth transition to managerial roles. Engineering students should find that this book will provide needed managerial topics and issues that many of them will encounter as they transition to project leadership and supervisory positions in their organizations. We attempt to make the subject real and referent to everyday life so it becomes something students will want to know about.

Major telecommunications companies have found this book useful in bringing new managers up to speed quickly, especially if they come from a nontechnology background. The book reads easily for managers from other disciplines and allows them to learn at a quick pace.

Many students from a nontechnical curriculum who take a traditional telecommunications course will rapidly encounter what may appear to be high-level electrical engineering material. To avoid this, we introduce the technology within the more comfortable context of the business needs for communications. The book has a strong management tone and decision thrust; therefore the instructor must be aware that the technology itself may not be self-evident. To aid this process, we explain technical subjects through analogous comparison to familiar subjects.

We have applied this method to teaching with considerable success. When students discover that technology can be learned, they have fun with many of the analogies. The students' success rate will depend on the expectations and proper presentation sequencing of the instructor. Business students should learn an appropriate level of the material and achieve success levels comparable with those attained in average business courses.

This book is designed for a pragmatic, nontheoretical approach to telecommunications. The *management and use of* telecommunications systems and equipment involve large expenditures and require understanding of the dimensions of the relevant decisions. The vocabulary is elementary, the technical content is understandable, the methods are applied, and the subject is comprehensive.

The value of any telecommunications technology is measured in its contribution to the firm's business objectives.

AIDS TO LEARNING

To aid in the learning process, we use a developing, although contrived, business case throughout the book. By addressing technology within the environment of business needs, the reader develops an appreciation for the *business need* for the technology. The continuing case threaded throughout the chapters accentuates the concepts and provides a building-block approach that integrates each new facet and tenet of telecommunications into a coherent business application.

A computer-based graphing tool, netViz[®], is optionally packaged with each text to aid the student in visualizing network problems and solutions. Finally, there are cases and papers as well as recommended readings at the end of most chapters that further discuss relevant topics.

INTRODUCTION TO THE CONTINUING CASE

Johnson Enterprises, Inc.

We begin each chapter with a portion of a continuing case in which we describe the evolution and development of a small business. **Johnson Enterprises, Inc.**, the organization in question, is a successful business now headed by Carlton Johnson. His father, Michael, started the company in 1951 that is today **JEI**. What was a one-person operation in a small building on East Oak Street in Denver, Colorado, has grown into a multidivision and multinational corporation with several manufacturing sites and many customers.

Johnson Lighting Company, like the majority of companies started each year, began life as an idea. Resources, other than a motivated owner, were scarce. Michael opened business with an office and a telephone. He had the capital to carry him through the first two years of business, during which time he established a reputation as a reliable

firm with which to do business. He relied on his suppliers to warehouse his inventory, selling his services out of a group of catalogs. He also relied on these suppliers to provide him short-term credit. He demonstrated his value to his suppliers by a willingness to do quality work and paying his bills on time.

As we follow the daily adventures of **Johnson Lighting Company**, we will introduce business decision opportunities, some brought about because of telecommunications technology and some that would require new capabilities. In each case, we will show that the use of the technology is to solve a business problem or capitalize on an opportunity. Additionally, you should be aware that this company, like many in the world today, often stumbles into opportunities, and it is only astute awareness or luck that prevents future problems.

Look here for questions and answers that help you learn.

To enforce and reinforce topics, we use *marginal notes* on many pages, as a way to highlight items in the margins. Within the body of the text, and even in the case, we use *information windows* and *technology notes* to bring more lengthy items to the forefront. Finally, we include articles about how companies are using the technology under discussion in *real-world windows*. The use of real-world examples throughout sets this book apart from those that focus primarily on technology.

INFORMATION WINDOW, TECHNOLOGY NOTE, OR REAL WORLD

For example, as we discuss the evolution of Johnson Lighting, we introduce various technologies. Some of this technology requires explanation because it is new, or because it is old and no longer in use. The point of these *technology notes* is to bring the explanation of the technology close to its introduction in the text. The purpose of describing antiquated technology is to show the roots of what we use today. While you may not be as interested in this old stuff as some new hot technology, remember that this is what many people with whom you will work grew up with. This is also where the vocabulary we use today comes from. This is all a point of reference and a reminder of just how far we have come in a short time.

CHAPTER SUMMARIES

The book is composed of 16 chapters divided into seven topic areas. A brief description of each follows.

Part I—Communications Basics

This opening section discusses the analog part of our world, that is, the basic communications model, voice systems, and media. This sets the environment for the digital portion that follows in Part II.

Chapter 1—What Is Technology? What Is Telecommunications?

Telecommunications is a special form of technology. This chapter reminds the reader that s/he is familiar and comfortable with much technology in the home and office, paying special attention to the telecommunications-based technology. This is followed with the basic model of communication and telecommunications. The chapter includes a brief overview of the major types of information systems.

Chapter 2—Where Did the Telephone Come From and How Does It Work?

This chapter reviews the analog and voice world. It begins by describing the plain old telephone system (POTS) that was in place before data communications. While this is historical, it's where we came from and provides a valuable frame of reference to explain the evolution to the present environment. We concentrate on voice telephone communications, and such concepts therein as analog wave forms, telephone channels, switch and instrument capabilities, and private branch exchanges.

Chapter 3—What Technologies and Media Do We Use for Voice and Data Systems?

Channels are paths over which signals travel; media are the physical circuits on which channels reside. This chapter reviews wired and wireless media. Although wired media, in general, have greater bandwidth, the wireless domain is growing rapidly because it frees us to be more productive and competitive. Wireless covers the spectrum of radio, microwave, satellite; GPS and infrared (IR); IEEE 802.11b and *Bluetooth*; fixed, movable, and moving.

Part II—Data Communications and Networks

This section takes the reader through the basics of digital data communications, beginning with codes and modems. This is followed by digital-to-analog (D/A) conversion, modulation, multiplexing, topology, protocols, and network equipment. This covers complex material, but is broken into five chapters for ease of learning.

Chapter 4—Data Communications: The Basics

Beginning with the telegraph, we introduce the reader to the digital world and its coding schemes, and serial and parallel circuits. Next are discussions of modems, compression, and attenuation. The chapter ends with error detection and correction.

Chapter 5—Data Communications: Conversion, Modulation, and Multiplexing

For data communications, we want to work in a digital environment. We cover the analog-to-digital conversion and how to put multiple signals on a single circuit, that is, modulation and multiplexing. It ends with our first look at ISDN and expands on compression standards. In the end, we are looking for as much bandwidth as we can muster, which takes into account the native bandwidth of the channel, noise, and compression.

Chapter 6—Networks by Topology and Protocols

This is a discussion of possible shapes and layouts of networks, for example, topologies, and their merits plus the protocols that accompany the topologies. The chapter ends with a discussion of the ports of a computer through which we communicate with the outside world.

Chapter 7—Telecommunications Architectural Models

Architectural models provide frameworks for understanding telecommunications systems interconnectivity. This brings us to the Open Systems Interconnect (OSI) seven-layer model established so that equipment will interoperate.

Chapter 8—LANs, WANs, Enterprise Networks, and Network Equipment

Networks are composed of components to enable connectivity from small, local area to large, even global, networks. This chapter begins with a discussion of networks as to geography and security, from LANs to WANs and VPNs. It

ends with equipment from the simplest repeater and goes through routers to gateways.

Part III—Uses of Networks

This section discusses uses of connectivity, starting with the Internet and moving to business applications, such as teleconferencing, telecommuting, and other ways to support dispersed operations.

Chapter 9—The Internet Connects to the World; the Intranet Connects the Organization

The Internet is about connectivity. This chapter discusses this ultimate WAN and its primary applications that are based on the Internet browser and the World Wide Web. This is where the reader will likely be in sync with the material relating to eCommerce and eBusiness. Concepts of net storage and B2B/B2C are discussed. A major example of national connectivity is provided by JANET, which covers most of the United Kingdom. Finally, the intranet, Internet technologies inside the organization, is discussed.

Chapter 10—Business Applications of Telecommunications

There are thousands of applications for telecommunications. We chose to consolidate them here as opposed to placing them within chapters. Now that the reader is familiar with voice and data systems, s/he can appreciate these and other applications that may produce competitive advantage. These applications range from the familiar ATM to teleconferencing, telecommuting, EDI, and military uses of telecommunications.

Part IV—Legislation and Global Issues

This part concentrates on the legal and regulatory sides of telecommunications. The world's telecommunications industry has been shaped by laws, regulations, and deregulation.

Chapter 11—How Do Legislation and Regulation Affect Telecommunications?

Telecommunications in the United States of America has developed in an environment of laws, rules, and regulations. We discuss the major legislative acts and their implications to the telecommunications industry and the managers who must work within it. The Telecommunications Act of 1996 updates the Telecommunications Act of 1934. While these events seem particular to this one nation, all countries must deal with regulation, deregulation, privatization, and control and the U.S. experience can serve as an example to be followed or avoided. This is followed by a discussion of the special telecommunications needs for those needing accommodation.

Part V—Managing Telecommunications

Here we stress the area of the management of telecommunications, how we organize to make it all work, and how we control projects. Probably one of the most

important issues for the telecommunications managers today is the area of security, which is expanded upon here.

Chapter 12—Management of Voice and Data Systems in Organizations

The management of telecommunications involves the management of groups of people and their tasks. We develop an understanding of the organization and supervision of people required: (1) the group who creates, installs, and maintains the systems; (2) the oversight issues such as performance and configuration management; (3) security and privacy; and (4) quality-of-service (QoS) strategies.

Chapter 13—How Do You Manage Telecommunications Projects? SDLC for Telecommunications

All organizations will need to install, update, and add capabilities to the telecommunications infrastructure. We take a systems development life cycle approach to the projects that will effect these changes. It is vital for anyone involved in projects to understand the phases of the project and how they and the component resources can be managed to create the needed telecommunications capabilities.

Part VI—The Need for Bandwidth

This final section discusses high speed, broadband needs, and capabilities. First we contend that one can do a lot with a little bandwidth. Then we review the possibilities of technology to use in those cases where you need a lot of bandwidth. This is addressed for both the office and the home.

Chapter 14—Bandwidth for the Office

Once we have determined that wide bandwidth is required, we discuss some of the alternatives, in this chapter and the next. The more bandwidth we have, the greater are the growth possibilities and the greater the flexibility. This all, however, comes with an attendant cost. This chapter introduces the lower- and high-bandwidth technologies appropriate for the office.

Chapter 15—Bandwidth for the Home

The home and SOHO generally have differing bandwidth than does the traditional office. This chapter discusses the possibilities, ranging from ISDN to DSL and cable modems. It ends with a discussion of various wireless technologies.

Part VII—The Future

We close the book with a look to the future. As the reader should now appreciate, the technology changes almost daily.

Chapter 16—Epilogue

We discuss those forces that will drive the adoption of technology and what will cause it to be constrained. One way is to ask people what they can envision in the presence of free computing, global connectivity, and unlimited, low-cost bandwidth.

DISTINGUISHING FEATURES AND BENEFITS

Our book provides students with the following features and benefits:

Telecommunications is placed in the context and environment of the business.

- Communications is at the heart of business transactions.
- Voice and data communications support business.
- Most business functions depend on telecommunications.
- Most information systems are telecommunications-intensive information systems.
- The historical review of voice and data communications is thorough and understandable.
- Relevant legislation and regulation are covered.
- Coverage of business applications directly relates learning to the future activities of the student.

Technology is explained, but in relation to management decision making.

- The value and merit of technology is not self-evident.
- The creation of telecommunications capabilities requires trade-offs.
- The use of technology like telecommunications may be a cost or an investment.
- Differences between analog and digital cellular are covered.
- Both wired and wireless systems are covered.

The management of telecommunications is a part of business strategy.

- Telecommunications, properly utilized, can give a competitive advantage.
- Telecommunications, like MIS, is vital to the conduct of business.
- Telecommunications allows decentralization of the decision process.
- Coverage is provided on management of telecommunications projects.

INSTRUCTOR SUPPORT MATERIALS

A comprehensive instructor support package will be available to adopters of the text.

- ***Instructor's Manual*** includes solutions to end-of-chapter questions, teaching suggestions, lecture outlines, and suggestions for using the PowerPoint classroom presentation software.
- ***Testbank and computerized testbank***, prepared by Gerald Canfield of the University of Maryland, contains true-false, multiple choice, and other test questions. Also available in computerized form.

- *PowerPoint Classroom Presentation Software* contains lecture presentation slides of key topics and graphics from each chapter as well as lecture outlines and other teaching tips.

Caveat

Technology in general and telecommunications technology in particular are evolving so rapidly that you will likely become aware of capabilities that are not covered in this text. In our chapter on telecommunications in the future we may well be talking about your present. By the time this book is published, the future may have arrived. We have, however, covered the important facts and features of telecommunications that allow you to work effectively in the industry, even one that is evolving so rapidly. Though you may be using higher-speed, greater-bandwidth channels; more powerful switches; better computers; and even media unheard of in the 1990s, the tenets of telecommunications management remain unchanged. These are that business managers, not technicians or engineers, must make the decisions about technology that provide a business solution to a problem, opportunity, or threat from the environment. This book was developed and dedicated to allow you to do this, with an awareness that the technology and the environment are rapidly evolving.

ACKNOWLEDGMENTS

We would like to express our gratitude to the reviewers of this project who gave us their suggestions for improving the final text:

Kemal Altinkemer
Purdue University

Ralph Annina
Keller Graduate School of Management

Robert Burnside
DeVry Institute of Technology

Gerald C. Canfield
University of Maryland–Baltimore County

Robert P. Cervený
Florida Atlantic University

James S. Cross
Michigan Technological University

Art Dearing
Tarleton State University

Omar A. El Sawy
*University of Southern California–
Los Angeles*

K. Dale Foster
Memorial University of Newfoundland

Varun Grover
University of South Carolina

Michael Henson
BellSouth Telecommunications

Bhushan L. Kapoor
California State University–Fullerton

George D. Kraft
Illinois Institute of Technology

Kuber Maharjan
Purdue University School of Technology

Denise J. McManus
Wake Forest University

Sabyasachi Mitra
Georgia Institute of Technology

Marianne Murphy
Northeastern University

J. David Naumann
University of Minnesota

Ram Pakath
University of Kentucky

Roger Alan Pick
University of Missouri–Kansas City

Hasan Pirkul
The Ohio State University

Jim Quan
Florida Atlantic University

Chetan Sankar
Auburn University

Neal G. Shaw
University of Texas at Arlington

Siva Viswanathan
University of Maryland–College Park

Michael E. Whitman
Kennesaw State University

We wish to acknowledge the contributions of others in compiling this book: **Dr. Denise J. McManus** of Wake Forest University for her help with the Glossary and risk management; **Justin Williams** for his help with TCP/IP; **Dafni Greene** for her help with network hardware; **James Ryan** for his help on Quality of Service; **Steve Guendert** for his aid with SAN and NAS systems; **Ken Liang** for his help with customer relationship management; **Heath Campbell** for general help in moving from 1/e to 2/e; **Stephen Kirkemeir**, Sr. Vice President of *BellSouth* for his guidance and encouragement in this endeavor; and to our many colleagues who added their talent by way of cases at the end of chapters.

Our thanks also go out to the book team at McGraw-Hill/Irwin: Rick Williamson, Kelly Delso, Pat Frederickson, Jennifer McQueen, along with many others who contributed their ideas and hard work to the project.

Houston H. Carr

Charles A. Snyder

URL for the book: <http://telecom.business.auburn.edu/jei>

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