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Introduction to e-Supply Chain Management

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David F. Ross

Introduction to

e- Supply Chain Management

Engaging Technology to
Build Market-Winning
Business Partnerships



St. Lucie Press

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ST. LUCIE PRESS

A CRC Press Company

Boca Raton London New York Washington, D.C.

Library of Congress Cataloging-in-Publication Data

Ross, David Frederick, 1948-

Introduction to e-supply chain management: engaging technology to build market-winning business partnerships / by David F. Ross.

p. cm.

Includes bibliographical references and index.

ISBN 1-57444-324-0 (alk. paper)

1. Business logistics—Data processing. 2. Information technology. 3. Internet. I. Title.

HD38.5 .R6753 2002

658.7'0285—dc21

2002031711

CIP

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International Standard Book Number 1-57444-324-0

Library of Congress Card Number 2002031711

Printed in the United States of America 1 2 3 4 5 6 7 8 9 0

Printed on acid-free paper

Dedication

My loving thanks to my wife Colleen and my son Jonathan, who had to bear, yet again, the burden of lost afternoons and long evenings, but who receive little of the rewards.

Preface

The first years of the twenty-first century have been dramatic ones indeed. The new century began with unprecedented prosperity, record employment, relative security from war, and massive governmental surpluses at all levels. The business and financial communities and, indeed, almost all aspects of life from entertainment to shopping were caught up in the excitement of a computerized tool called the Internet that was cast as the destroyer of the old industrial economy, the harbinger of a whole “new economy,” and the digitization of all forms of human endeavor. By the middle of 2002 the good times had not only soured, but the specter of financial recession, massive layoffs, and corporate scandal had rocked the U.S. economy. The over-hyped e-business revolution fizzled into bankruptcy, ruined stock portfolios, and disillusionment when the dot-com bubble burst. The computer software/hardware industry saw sales plummet as companies looked inward to cost-cutting initiatives and to conserve cash. A vicious and deadly terrorist attack on 11 September, 2001 reminded the country that the world was not rational and peaceful after all, that there was a specter that could with one blow topple what had been considered a rock solid and prosperous economic environment. And, finally, corporate greed, arrogance, abuse of power, and lack of stewardship — the dark side of management that, in the hands of morally weak and intellectually dishonest corporate executives, destroys businesses and human lives — just about applied the knockout blow as the Dow dropped below 8000 and the NASDAQ sank to around 25 percent of its former highs.

While traumatic, the new realities of the economic environment have served to reveal not how over-hyped, although a good deal was indeed just vapor, but how important the effective convergence of technology and the supply chain are to corporate survival. The plummeting economy and the disruptions to the supply chain, while negatively impacting business, have simply accelerated the changes to how companies were internally organized and measured, how they dealt with each other, how assets were to be transacted through the supply pipeline, and what was to be the role of technology, which were already in the works without the intervention of the folks at al-Qaida and WorldCom. The Kmart bankruptcy, for example, illustrated that the company’s inability to master supply chain technology and, consequently, benefit from supply chain efficiencies, could cause disaster to even the largest of companies. Far from causing executives to place *supply chain management* (SCM) and Internet concepts and technologies on the back burner as they rode out the decaying economic times, the tightening of the economy and heavier restrictions and security measures placed on channel flows have rendered access to real-time, accurate supply chain information more critical than ever. Connectivity, messaging, and collaboration have become today’s foremost buzzwords, as companies compete

for survival in an environment where cycle times and permissible margins of error continue to shrink.

According to an Accenture survey (March 2002) on the impact of SCM and the Internet on the worsening economy and restrictions in the supply chain, SCM/Internet initiatives were credited with cost reductions, improved efficiencies, better customer service, more revenue, and greater competitiveness by over 80 percent of the companies responding. Also, more than 70 percent felt that the application of Web-based applications providing end-to-end visibility to the supply chain were the single most important enabler of collaboration with top trading partners. While the survey indicated that the prime reason why companies increasingly were turning toward supply chain partners to outsource functions was to cut costs in the short run, 70 percent of executives saw the long-term creation of partnering agreements as a major strategy in achieving corporate objectives.¹

The mission of this book is to provide a window into the concepts, techniques, and vocabulary of the convergence of SCM and the Internet so that companies can continue to leverage and expand on these exciting business tools to maintain, in these uncertain times, the momentum in supply chain savings and competitive advantage detailed in the Accenture survey. As will be detailed in the pages to follow, what is termed e-SCM provides today's enterprise with the business concepts and technical toolsets to activate supply chain capabilities that will enable executives to architect:

- Process-centered, technology-enabled organizations composed of networks of knowledgeable and highly skilled teams capable of assembling the competencies and resources to be found within the business and outside among trading partners into "virtual organizations" focused on activating strategies designed to continuously pursue total customer satisfaction.
- Collaborative communities of supply chain partners integrated together by concurrent access to databases and information flows that permit them to closely synchronize day-to-day operations and long-term strategies, so that they appear as if they were a single logical enterprise providing seamless, optimized capabilities to the customer.
- Inter-enterprise, Web-based technologies engineered to provide cross-channel teams access to interoperable computerized business components that empower them to interweave common and specialized knowledge to form collaborative supply chain nodes capable of integrating and networking channel processes to achieve optimal productivity.

Today's computer architectures and business applications are truly exciting, and they do portend the coming of a new age of business-to-customer connectivity based on the communication and enrichment of digital information. While the shape of these architectures is still in the process of development, one conclusion, however, is clear: the actual practice of SCM today has moved far beyond its original definition as a technique for optimizing a collection of logistics operations. Today, SCM is a dynamic, evolutionary concept that encompasses not only operational objectives but

also inter-enterprise strategies determining how the whole supply chain will compete in the twenty-first century.

Each chapter in this book attempts to explore and elaborate on the many different components of the combination of SCM and today's Internet technologies. The first chapter focuses on defining Web-enabled SCM and detailing its essential elements. The argument that unfolds is that e-SCM is a management model that conceives of individual enterprises as nodes in a supply chain web, digitally architected and collectively focused on the continuous evolution of new forms of customer value. Among the topics discussed will be the function of Internet-based information in e-SCM, the utilization of supply chain trading partners, and understanding the role of supply chain synchronization.

Chapter 2 is devoted to a detailed discussion of the economic "revolution" driven by the Internet. The analysis begins with a review of the business dynamics of what is being termed the first stage of the "new economy." Among the areas explored are the changes brought about by the Internet to customer management, product cycle management, the basis of information technology, the creation of global businesses, and logistics management. After, the discussion centers on the fundamental principles of e-business: e-collaboration, the rise of new forms of e-business, and the impact of the Internet on human resources. The chapter concludes with a review of the major trends impacting the development of e-business, ranging from the continued migration from vertical to virtually integrated enterprises to the changed role of logistics.

In Chapter 3, the systems foundation of e-SCM will be explored. Discussion begins with an overview of the enterprise systems governing internal computing. Following, the analysis shifts to a review of business-to-business computing, beginning with *electronic data interchange* (EDI) and continuing with a review of the four phases of Internet commerce. Key topics detailed are utilization of the Internet for marketing and sales, Web applications targeted at activating e-commerce possibilities with customers and integrating supplier networks, and the possibilities inherent in e-collaboration and the generation of real-time, agile, and scalable supply chains. The chapter concludes with a brief review of the integrative architectures necessary to assemble into a single framework the mixture of *enterprise resource planning* (ERP) applications, *business-to-business* (B2B) and *business-to-customer* (B2C) point solutions, and business processes and work flows.

Chapter 4 seeks to explore how companies can build effective market-winning business strategies by actualizing the opportunities to be found in SCM and the Internet. Structuring effective business strategies requires companies to closely integrate the physical capabilities, knowledge competencies, and technology connectivity of their supply chain networks alongside company-centric product, service, and infrastructure architectures. Building such a powerful e-SCM strategy requires strategists to carefully craft a comprehensive business vision, assess the depth of current e-SCM trading partner connectivity, and identify and prioritize what initiatives must be undertaken to actualize new value chain partnerships. The chapter concludes with a detailed discussion of a proposed e-SCM strategy development model.

Defining the concepts and computerized toolsets associated with *customer relationship management* (CRM) will be explored in Chapter 5. The chapter begins with

an attempt to define CRM, detail its prominent characteristics, and outline its primary mission. Next, the discussion shifts to outlining a portrait of today's customer. The profile that emerges shows that customers are value driven, that they are looking for strong partnerships with their suppliers, and that they want to be treated as unique individuals. Effectively responding to today's customer requires a customer-centric organization. The middle part of the chapter attempts to detail the steps for creating and nurturing such an organization. The balance of the chapter is then focused on the e-CRM technology applications, such as Internet sales, sales force automation, service, partnership relationship management, electronic billing and payment, and CRM analytics.

Chapter 6 is concerned with exploring the application of e-SCM practices and Web-based tools to the management of manufacturing. The discussion begins by reviewing the role of manufacturing in the "age of e-business." Of particular interest is the availability of an almost bewildering array of technology tools to assist in the management of almost every aspect of manufacturing from transaction control to Internet-enabled B2B exchanges. The chapter discusses one of today's most important drivers of productivity — the ability of manufacturing firms to architect collaborative relationships with business partners to synchronize, through the Internet, all aspects of product design and time-to-market. The chapter concludes with an analysis of today's advanced manufacturing planning functions that seek to apply the latest optimization and Web-based applications to interconnect and make visible the demand and replenishment needs of whole supply network systems.

In Chapter 7, the functions of purchasing and *supplier relationship management* (SRM) will be explored. A critical observation is that the strategic importance of SRM is not to be found in the optimization and automation of purchasing functions, but rather in the nurturing of buy-side partner relationships. The application of Web-based functions have opened an entirely new range of SRM toolsets, enabling companies to dramatically cut costs, automate functions, such as sourcing, *request for quotation* (RFQ), and order generation and monitoring, and optimize supply chain partners to achieve the best products and the best prices from anywhere in the supply network. The chapter concludes with a full discussion of the anatomy of today's e-SRM system followed by an exploration of the e-SRM exchange environment, today's e-marketplace models, and the steps necessary to execute a successful e-SRM implementation.

Chapter 8 is concerned with detailing the elements of logistics management in the Internet Age. The discussion begins with a review of the function of logistics and its evolution to what can be called *logistics resource management* (LRM). After a detailed definition of the structure and key capabilities of LRM, the chapter proceeds to describe the different categories of LRM available today and the array of possible Web-based toolsets driving logistics performance measurement and warehouse and transportation management. Afterwards, strategies for the use of third-party logistics services are reviewed. The different types of logistics service providers, the growth of Internet-enabled providers, and the challenges of choosing a logistics partner that matches, if not facilitates, overall company business strategies are explored in depth.

Grappling with the content and selection decisions surrounding today's Web-enabled technologies is the subject of the last chapter. Discussion opens with a review of the internal, interorganizational, and technology architecture requirements for implementing e-SCM. Converging SCM and the Internet will require companies to make the transition from company-centric to supply chain process-centric organizations that are customer-focused, flexible, and capable of metamorphosing to be more responsive to the needs of trading partners and customers, and that they are driven by an empowered cross-functional, cross-enterprise work force. The analysis next moves to the construction of inter-enterprise architecture. The argument voiced is that internal organizational reengineering is insufficient, and that the only way in today's business environment to build sustainable competitive advantage is to architect a collaborative community of trading partners collectively driven to deliver the highest level of customer service possible. The discussion of the third area, technology architecture, attempts to describe the hardware and software frameworks necessary to ensure the interoperability and integration of the business applications found at each trading partner node in the supply channel. The chapter ends with a review of the future of e-SCM, new technology developments, and the steps necessary to transform the organization to the e-SCM environment.

ENDNOTES

1. "SCM is Key to Improvement, Accenture Poll Finds," *Global Logistics and Supply Chain Strategies*, 6, 3, 2002, 16.

Acknowledgments

Writing a book on today's business environment is like trying to hold quicksilver. Today's technology and business environment is changing so quickly that concepts and applications at the forefront of thought are often passé or even obsolete when the book hits the general marketplace. Doubtlessly, many of the ideas and the relevancy of the resources used to create this book are destined, with alarming quickness, to be out-of-date as the book moves past its publication date. Still, to begin with, I would sincerely like to express my sincere thanks to the many students, professionals, and companies that I have worked with over the past several years, who have contributed their ideas and experience. I would also like to thank my colleagues and friends at Intentia, whose expert knowledge on today's suite of collaborate business software contributed significantly regarding the many technical aspects of the book.

The author would especially like to thank the executive and editorial staff at CRC Press for so eagerly welcoming the project. I would like to thank Ms. Pat Roberson for her kind help in processing the manuscript through to completion. The author would also like to thank the entire staff at the University of Chicago Library for their help. Finally, I would like to express my thanks to my wife Colleen and my son Jonathan for their support, encouragement, and understanding during the many months this book was written.

About the Author

A distinguished educator and consultant, **David F. Ross**, Ph.D., CFPIM, has spent over 25 years in the fields of production and distribution management. During his 13 years as a practitioner, he held several line and staff positions. For the past 15 years, Dr. Ross has been involved in ERP and e-Business education and consulting for several software companies. Currently, he is Education Business Group Manager for Intentia–Americas and is located in the corporate offices in Schaumburg, IL (e-mail: david.ross@intentia.com). He has taught operations management at Eastern Illinois University and Oakton Community College. He is also an instructor in the APICS practitioner education program.

Introduction to e-Supply Chain Management is Dr. Ross's third book in the field of distribution and supply chain management. His first book, *Distribution: Planning and Control* (Kluwer, 1996), has been used as a standard logistics management text by several universities and is on the required reading list for the APICS's "Detailed Planning and Scheduling" CPIM exam. His second book, *Competing Through Supply Chain Management* (Kluwer, 1998), was one of the first texts on the science of supply chain management and it also has been on the reading lists at several universities for courses in logistics management.

Acronyms

3PL	Third Party Logistics
4PL	Fourth Party Logistics
ABC	Activity-Based Costing
ABCM	Activity-Based Cost Management
ABM	Activity-Based Management
ACM	Advanced Customer Management
AEI	Automatic Equipment Identification
AIDC	Automatic Identification and Data Collection
AIM	Automatic Identification Manufacturing
ALM	Asset Lifecycle Management
AMHS	Automated Material Handling Systems
ANSI	American National Standards Institute
ANX	Automotive Network Exchange
APICS	American Production and Inventory Control Society
APS	Advanced Planning and Scheduling
ASN	Advanced Shipping Notice
ASP	Application Service Provider
ATP	Available to Promise
B2B	Business-to-Business
B2C	Business-to-Customer
BI	Business Intelligence
BOM	Bill of Materials
BPM	Business Process Management
CAD	Computer Aided Design
CAM	Computer Aided Manufacture
CAM	Collaborative Asset Management
CBCs	Collaborative Business Communities
CIC	Customer Interaction Center
CLM	Council of Logistics Management
CMC	Collaborative Manufacturing Commerce
CMS	Customer Management Strategies
CMMS	Computerized Maintenance Management System
CORBA	Common Object Request Broker Architecture
CPC	Collaborative Product Commerce
CPFR	Collaborative Planning, Forecasting, and Replenishment
CPD	Collaborative Product Development
CPG	Consumer Packaged Goods
CRM	Customer Relationship Management
CRP	Continuous Replenishment Programs

CSM	Customer Service Management, or Component and Supplier Management
CTP	Capable to Promise
CTX	Consortium Trading Exchange
DCS	Design Collaboration Software
e-BPO	Electronic Business Optimization
e-SCM	Electronic Supply Chain Management
EA	Enterprise Application
EAI	Enterprise Application Integration
EAM	Enterprise Asset Management
EBO	Equipment Brand Owner
EBPP	Electronic Bill Presentment and Payment
EBS	Enterprise Business System
ECM	Enterprise Commerce Management
ECR	Efficient Customer Response
EDI	Electronic Data Interchange
EMA	Enterprise Marketing Automation
EMS	Enterprise Management Strategies
EPM	Enterprise Performance Measurement
EPS	Earnings Per Share
ERP	Enterprise Resource Planning
EVA	Economic Value Added
FGI	Finished Goods Inventory
FMS	Freight Management System
GLS	Global Logistics System
GUI	Graphical User Interface
HCM	Human Capital Management
HRMS	Human Resources Management System
HSC	Hosted Supply Chain Services
IBPP	Internet Bill Presentment and Payment
ICO	Inventory Chain Optimization
ICT	Information and Communications Technology
IES	Inter-Enterprise Solutions
ISO	International Standards Organization
ISP	Internet Service Supplier
IT	Information Technology
ITE	Internet Trading Association
ITX	Independent Trading Exchange
JIT	Just-In-Time Manufacturing and Distribution
KPI	Key Performance Indicator
LAN	Local Area Network
LLP	Lead Logistics Provider
LLS	Lead Logistics Supplier
LP	Linear Programming
LSP	Logistics Service Providers
LTL	Less Than Truckload

MRO	Maintenance, Repair, and Operations Supplies
MRP	Material Requirements Planning
NAPM	National Association of Purchasing Management
NPV	Net Present Value
OEM	Original Equipment Manufacturers
OLAP	Online Analytical Processing
ORM	Operational Resource Management
OSB	Order, Shipping, and Billing
P2P	Peer-to-Peer
PDM	Product Data Management
PIM	Product Information Management
PLM	Product Lifecycle Management
PMI	Performance Measurement and Improvement
POD	Bill of Lading and Delivery Receipt
POS	Point-Of-Sale
PPE	Plant, Property, and Equipment
PRM	Partner Relationship Management
PSO	Professional Services Organization
PTX	Private Trading Exchange
QFD	Quality Functional Deployment
QR	Quick Response
RFID	Radio Frequency Identification
RFQ	Request for Quotation
ROA	Return on Asset
ROACE	Return On Average Capital Employed
ROI	Return on Investment
ROIC	Return On Invested Capital
ROLAP	Relational Online Analytical Programming
SCCI	Supply Chain Council International
SCE	Supply Chain Execution
SCEM	Supply Chain Event Management
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference model
SCP	Supply Chain Planning
SCS	Supply Chain Synchronization
SCVA	Supply Chain Value Assessment
SEM	Strategic Enterprise Management
SFA	Sales Force Automation
SKU	Stock Keeping Unit
SMEs	Small and Medium Size Enterprises
SPA	Specialty Apparel Business
SPC	Statistical Process Control
SRM	Supplier Relationship Management
SSM	Strategic e-Sourcing Management
T&A	Time and Attendance
T&E	Time and Expense

TCM	Total Cost Management
TCO	Total Cost of Ownership
TOC	Theory Of Constraints
TL	Truck Load
TMS	Transportation Management System
VAN	Value-Added Network
VMI	Vendor Managed Inventory
VPN	Virtual Private Networks
VSP	Vertical Service Provider
WAN	Wide Area Network
WERC	Warehousing Education and Research Council
WIP	Work-in-Process
WMS	Warehouse Management System
WRM	Workforce Relationship Management
XML	Extensible Markup Language

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1 The Advent of Supply Chain Management: Architecting the Supply Chain for Competitive Advantage

Over the past decade, companies spanning a wide spectrum of industries have been focusing their competitive strategies on leveraging the competencies and innovative capabilities to be found in the clusters of customers and suppliers constituting their business supply chains. While it is true that during the same period much effort had been invested in quality management models, the application of information technologies, and process and organizational reengineering, today's best enterprises have increasingly looked toward *supply chain management* (SCM) to provide fresh vistas for new sources of competitive advantage.

This is not to say that in the past companies were unmindful of the importance of the relationships that existed between themselves and their trading partners. Businesses had always looked to their channel partners for opportunities to apply organizational techniques and technologies that could accelerate transaction and information transfer speed and cement channel loyalties. Today academics, consultants, and practitioners alike have come to understand that the capacity of companies to continuously reinvent competitive advantage depends on the ability to look *outward* to their supply chains in the search for resources to engineer the right blend of competencies that will resonate with their own organizations and core product and process strategies. In fact, perhaps the *ultimate* core competency an enterprise may possess today is not to be found in a temporary advantage it may hold, for example, in an area of product design or market brand, but rather in the ability to continuously assemble and implement market-winning capabilities arising from collaborative alliances with supply chain partners. Competitive advantage in tomorrow's environment will go to those enterprises that can consistently anticipate and implement customer-winning supply chain competencies, while discarding those that have become commodities or easily copied by the competition.

This opening chapter is focused on defining SCM and exploring the competitive challenges and marketplace opportunities that have shaped and continue to drive its development. The chapter begins with an examination of why SCM has risen to be perhaps today's most critical business strategic paradigm. Next, a short description

of the evolution of Internet-enabled SCM will be explored. Once the broad contours of SCM and its merger with e-business are detailed, a concise definition of *e-SCM* will be offered. The argument that unfolds is that e-SCM is a management model that conceives of individual enterprises as nodes in a supply chain web, digitally architected and collectively focused on the continuous evolution of new forms of customer value. Once a working definition of e-SCM has been established, the balance of the chapter will detail the characteristics of the e-SCM concept. Among topics discussed will be the function of Internet-based information in e-SCM, the utilization of supply chain trading partners, and understanding the role of supply chain synchronization.

I. THE RISE OF SUPPLY CHAIN MANAGEMENT

In today's business environment, no enterprise can expect to build a successful product, process, or service advantage without integrating their strategies with those of the supply chain systems in which they are inextricably entwined. In the past, what occurred outside of the four walls of the business was of secondary importance in comparison to the execution of strategies designed to effectively manage internal engineering, manufacturing, marketing, sales, and finance activities. In contrast, a company's ability to look *outward* to its channel alliances to gain access to sources of unique competencies, physical resources, and marketplace value is now the measure of success. Once a backwater of business management, creating "chains" of business partners has become one of a successful company's most powerful competitive strategies.

What has caused this awareness of the "interconnectiveness" of once isolated and often adversarial businesses occupying the same supply chain? What forces have obsoleted long-practiced methods of ensuring corporate governance, structuring businesses, and developing strategies? What will be the long-term impact on the fabric of business ecosystems of an increasing dependence on channel partnerships? What are the possible opportunities as well as the liabilities of channel alliances? How should information technology tools like the Internet be integrated into supply chain management, and what new sources of market winning product and service value will be identified?

The supply chain focus of today's enterprise has arisen in response to several critical business requirements.¹ To begin with, companies have begun to extend the tools of modern enterprise management to their supplier and customer channels in the search for additional sources of cost reduction and process improvement. Over the past decade, businesses have been assiduously applying to internal functions computerized techniques and management methods, such as *Enterprise Resource Planning* (ERP), *total quality management* (TQM), and *business process reengineering* (BRP), in an effort to optimize organizations and activate highly agile, lean manufacturing and distribution functions capable of superlative quality and service. As this movement toward *internal* cost reduction and process optimization has moved to its ultimate conclusion, today's best companies have sought to apply the same management and technology paradigms *outward* to their supply chains. The goal is to relentlessly eradicate all forms of waste where supply chain entities touch,

such as logistics, inventory, procurement, customer management, product development, and financial functions.

Second, over the past several years, companies have all but abandoned strategies based on the vertical integration of resources. On the one side, businesses have continued to divest themselves of functions that were either not profitable or for which they had weak competencies. On the other side, today's market-leading enterprises have found that, by closely collaborating with their supply chain partners in developing such cross-channel functions as product development, forecasting, inventory management, and logistics, new avenues for competitive advantage can be uncovered. Achieving these advantages can only occur when entire supply chains work seamlessly to leverage complementary capabilities. Collaboration can take the form of outsourcing operations functions to permit channel specialists to leverage their core competencies to supplement an internal functional weakness. Channel partnering can also take the form of strategic collaboration regarding product development, sourcing, marketing, production and capacity management, information technology, and distribution and delivery.

Third, the explosion in global trade has opened up new markets and new forms of competition virtually inaccessible just a few years ago. Leveraging the interactive power of today's Internet technologies and breakthroughs in international logistics, companies are no longer limited to selling and sourcing within their own national boundaries. Recently, global enterprises, fostered by international bodies and regional trade agreements, have been on a frantic search for business partners that will provide them not only with cost reductions but also access to resources and markets previously beyond their reach. Finally, e-business technologies have enabled even the smallest of companies to assemble closely networked global supply chains, empowering them with the capability to implement competitive business models previously possessed by only the largest of corporations.

Fourth, today's marketplace requirement that companies be agile as well as efficient, in order to meet consumer demand for shorter time frames in terms of services, product mixes, and volume and variety changes, has spawned the engineering of virtual organizations and interoperable processes impossible without supply chain collaboration. The conventional business paradigms assumed that each company was an island and that collaboration with other organizations, even direct customers and suppliers, was self-defeating. In contrast, market-leading enterprises depend on the creation of panchannel integrated processes that require the generation of organizational structures capable of merging similar capabilities, designing teams for the joint development of new products, productive processes, and information technologies, and structuring radically new forms of vertical integration. Today's most successful and revolutionary companies, such as Wal-Mart, Amazon.com, Intel, W.W. Granger, and others, know that continued market dominance will go to those who know how to harness the evolutionary processes taking place within their supply chains.

Finally, the application of breakthrough information technology tools centered on the Internet has enabled companies to look at their supply chains as a revolutionary source of competitive advantage. Before the Internet, businesses used their supply chain partners to realize tactical advantages, such as passing documents

through *electronic data interchange* (EDI) and integrating logistics functions. With the advent of e-commerce, these tactical advantages have been dramatically enhanced with the addition of strategic capabilities that enable whole supply chains to create radically new regions of marketplace value virtually impossible in the past. Enterprises are recognizing that the transfer of all functions of SCM to the Web will provide for the true integration of the customer value-enhancing capacities found among allied channel partners. As companies implement Internet technologies that connect all channel information, transactions, and decisions, whole channel systems will be able to continuously generate radically new sources of competitive advantage through cyber-collaboration, enabling joint product innovation, on-line buying markets, networked planning and operations management, and customer fulfillment.

For over a decade, market leading companies have been learning how to leverage the competitive strengths to be found in their business supply chains. Enterprises, such as Sun Microsystems, Microsoft, Siemens, Amazon.com, and Barnes & Noble.com, have been able to tap into the tremendous enabling power of SCM to tear down internal functional boundaries, leverage channel-wide human and technological capacities, and engineer “virtual” organizations capable of responding to new marketplace opportunities. With the application of e-business to SCM, these and other visionary companies are now generating the agile, scalable organizations capable of delivering to their customers revolutionary levels of convenience, delivery reliability, speed to market, and product/service customization impossible without the Internet. Without a doubt, the merger of the SCM management concept and the enabling power of the Internet are providing the basis for a profound transformation of the marketplace and the way business will be conducted in the twenty-first century.

II. EVOLUTION OF SUPPLY CHAIN MANAGEMENT

Although the concept of SCM has only just appeared, its development can be traced back to the rise of modern logistics. In fact, SCM is closely connected with and in many ways is the product of the significant changes that have occurred in logistics management. Over the past 30 years logistics has progressed from a purely operational function to a key strategic component. As logistics has evolved through time, the basic features of SCM can also be identified. Logistics has always been about managing the synchronization of the needs of individual companies for product and service acquisition with the resources available from suppliers, on the one side, and distribution functions to meet the demands of the customer, on the other. The SCM concept, enhanced by the power of Internet technology, is the maturation of these basic value-added functions. This section seeks to explore briefly the origins of SCM and sets the stage for a full definition of e-SCM value chains to follow.

A. HISTORICAL BEGINNINGS

For centuries, enterprises have been faced with the fundamental problem that demand for goods and services often extended far beyond the location where products were

made. It had always been the role of the *logistics* functions within the company to fill this gap in the marketing, distribution, and procurement systems by providing for the efficient and speedy movement of goods and services from the point of manufacture to the point of need. The critical dynamics of this process consist of time to delivery, cost, and ease of exchange. Companies that have been able to effectively leverage the supply channels linking them with their customers and suppliers are able to more profitably operate and focus their productive functions, while extending their reach to capture marketplaces and generate demand beyond the compass of their physical locations. When viewed from this perspective, the supply chain system concept can be described as a network of interdependent partners, who not only supply the necessary products and services to the channel system, but who also stimulate demand and facilitate the synchronization of the competencies and resources of the entire supply chain network to produce capabilities enabling a level of operational excellence and marketplace leadership unattainable by each business operating on its own.

B. STAGES OF SUPPLY CHAIN MANAGEMENT DEVELOPMENT

Historically, synchronizing the supply chain has always occupied a central position in the management of the enterprise, linking business marketing and sales strategies with manufacturing, inventory, and service execution. As far back as the beginning of the twentieth century, economists considered the activities associated with effectively managing business channels to be the crucial mechanism by which goods and services were exchanged through the economic system. However, despite its importance, this concept, first termed *logistics*, was slow to develop. Most business executives considered the channel management function to be of only tactical importance and, because of the scope and lack of integration among supply network nodes, virtually impossible to manage as an integrated function. In fact, it was not until the late 1960s, when cost pressures and the availability of computerized information tools enabled forward-looking companies to begin to dramatically revamp the nature and function of the supply chain, that the strategic opportunities afforded by logistics began to emerge.

The SCM concept could be said to consist of five distinct management stages. The first can be described as the era of internal logistics departmentalism. In the second stage, logistics began the migration from organizational decentralization to centralization of core functions driven by new attitudes associated with cost optimization and customer service. Stage three witnessed the dramatic expansion of logistics beyond a narrow concern with internal warehousing and transportation to embrace new concepts calling for the linkage of internal operations with analogous functions performed by channel trading partners. As the concept of channel relationships grew, the old logistics concept gave way, in stage-four, to full supply chain management. Today, with the application of Internet technology to the SCM concept, we can describe SCM as entering into stage five, e-SCM. These stages are portrayed in Table 1.1. A short discussion of each stage is as follows.

TABLE 1.1
SCM Management Stages

SCM Stage	Management Focus	Organizational Design
Stage 1 to 1960s		
Warehousing and Transportation	Operations performance	Decentralized logistics functions
	Support for sales/marketing	Weak internal linkages between logistics functions
	Warehousing	Little logistics management authority
	Inventory control	
	Transportation efficiencies	
Stage 2 to 1980		
Total Cost Management	Logistics centralization	Centralized logistics functions
	Total cost management	Growing power of logistics management authority
	Optimizing operations	Application of computer
	Customer service	
	Logistics as a competitive advantage	
Stage 3 to 1990		
Integrated Logistics Management	Logistics planning	Expansion of logistics functions
	Supply chain strategies	Supply chain planning
	Integration with enterprise functions	Support for TQM
	Integration with channel operations functions	Expansion of logistics management functions
Stage 4 to 2000		
Supply Chain Management	Strategic view of supply chain	Trading partner networking
	Use of extranet technologies	Virtual organization
	Growth of coevolutionary channel alliances	Market coevolution
	Collaboration to leverage channel competencies	Benchmarking and reengineering
		Supply chain TQM metrics
Stage 5 2000+		
e-Supply Chain Management	Application of the Internet to the SCM concept	Networked, multi-enterprise supply chain
	Low-cost instantaneous sharing of all databases	.coms, e-tailers, and market exchanges
	e-Information	Organizational agility and
	SCM synchronization	scaleability

1. First Stage — Logistics Decentralization

Historically, the first stage of SCM occurred in the period extending from the late 19th century to the early 1960s. During this era logistics was not perceived as a source of significant competitive advantage. Viewed essentially as an intermediary function concerned with inventory management and delivery, it was felt that logistics could not make much of a contribution to profitability and, therefore, was not worthy

of much capital investment. It was accorded little management status, and assigned less qualified staff. For the most part, companies segmented logistics activities, dividing them among operations functions, such as sales, production, and accounting. Not only were activities that were naturally supportive, such as procurement management, inbound transportation, and inventory management, separated from one another, but narrow departmental performance measurements also pitted logistics functions against each other. The result was a rather disjointed, relatively uncoordinated, and costly management of logistics activities.

In an era when process and delivery cycle times were long, global competition practically non-existent, and the marketplace driven by mass production and mass distribution, logistics decentralization was a minor problem for most companies. By the early 1960s, however, changes in the business climate were forcing executives to rethink their logistics strategies. To begin with, expanding product lines, demand for shorter cycle times, and growing competition had begun to expose the dramatic wastes and inefficiencies of logistics decentralization. Second, executives were finding themselves handcuffed by the lack of a unified logistics planning and execution strategy. Logistics responsibilities were scattered throughout the organization, and no single manager was responsible for integrating channel management activities with the rest of the business. Finally, logistics decentralization had made it impossible to pursue effective cost trade-off strategies. Logistics performance was often caught in a performance measurement paradox. For example, transportation might seek to reduce costs by requiring a higher payload-to-cost ratio, even if the decision resulted in higher inventories.

By the mid-1960s it was clear that the existing structure and purpose of logistics and channel management functions were in need of serious revision. As late as 1969, Donald Bowersox, the dean of modern logistics management, lamented that the management science of logistics was still in its infancy. There was no standardization of terms or a commonly accepted vocabulary. No one was quite sure what form a revamped logistics function should look like. Should it be attached to the firm's marketing function? Should it be attached to manufacturing? Should it be a department on its own? What would be the impact on logistics of the growth of computerized technology?²

2. Second Stage — Total Cost Management

The second stage in the evolution of SCM can be said to revolve around two critical focal points. The first can be described as the concerted effort made by companies to centralize logistics functions into a single management system. By merging what previously had been a series of fragmented functions into a single department, it would be possible to decrease individual costs associated with transportation, inventory, and physical distribution, while simultaneously increasing the productivity of the logistics system as a whole. Second, it was hoped that centralization would facilitate the application of the *total cost concept* to logistics. The objective of this strategy is to strive to minimize the total cost of logistics, rather than focus on reducing the costs of one or two specific logistics functions, such as transportation or warehousing. A much larger assumption was that, because logistics costs and

customer service were reciprocal, it would be easy to calculate the cost trade-offs necessary to balance total logistics costs with marketing and sales objectives.

The movement toward logistics centralization was driven by three converging factors. To begin with, as the economic and energy crises of the mid-1970s dramatically drove up inventory carrying costs, the marketplace began to demand smaller order quantities and more frequent deliveries from their supply partners. Second, explosions in product lines during the period required everyone in the supply channel to deliver products on time, avert obsolescence, and prevent channel inventory imbalances. Finally, new concepts of marketing, pricing, and promotion facilitated by the computer necessitated a thorough change in the cumbersome, fragmented methods of traditional channel management.

In addition to the operational demands driving reinvention of the logistics, a number of new ideas regarding the strategic place of logistics in the enterprise were emerging simultaneously. The first was the growing realization that, instead of a disconnected series of functions, logistics should rather be considered as a single integrated supply system. Complementary to this new idea of logistics was the application of new computerized technologies and management methods. During this period, computers became much more sophisticated, less costly, and more accessible. Also, new management methods centering on *just-in-time* (JIT), zero inventories, and quality management permitted companies to be more flexible and responsive, further eroding the old logistics model. Finally, logistics centralization was further accentuated by the realization that effective execution of logistics functions was critical to expanding customer service. As the era of mass production and mass distribution faded, companies found themselves looking to logistics capabilities to assist in gaining and sustaining competitive advantage through the coordination of channel resources.

3. Third Stage — Integrated Functions

During the 1980s, enterprise executives became increasingly aware that focusing solely on the total cost of logistics represented a passive approach to channel management. This awareness was driven by the radical changes occurring in what was rapidly becoming a global marketplace. If the decade could be compressed into two quintessential catchwords, they would be *competition* and *quality management*. Competition came in the form of tremendous pressure from global companies, often deploying radically new management philosophies and organizational structures that realized unheard-of levels of productivity, quality, and profitability. The threat also came from a new view of the place of quality and how it could be implemented to capture marketplace advantage. Management concepts, driven by JIT and *total quality management* (TQM) philosophies, were providing competitors with tools to compress time out of development cycles, engineer more flexible and “lean” processes, tap into the creative powers of the workforce, and generate entirely new forms of competitive advantage.

Businesses responded to these challenges by focusing, first of all, on revamping their organizations, either through corporate restructuring or by searching for

methods to achieve cost reductions, work-force retraining, the application of technology to improve productivities, more careful use of fixed and variable assets, strategic outsourcing, and identification of customers, products, and markets providing the greatest potential for competitive advantage. Second, companies began to understand that logistics and other channel management functions could be leveraged as a dynamic force capable of winning customers beyond the execution of traditional marketing objectives. Competitive values, such as speed of delivery, value-added services, development time to market, materials acquisition, and product availability, could be realized when the entire organization worked together, both internally and in close collaboration with supply chain trading partners.

One of the most significant results of the challenges of the 1980s was the recognition that logistics itself constituted a significant competitive weapon. Up to this period, most executives had viewed logistics as playing a tactical role, with little impact on corporate strategic planning. By the mid-1980s, however, companies began to understand that, by enabling organizations to pursue both cost/operational and service/value advantages through continuous process improvement and closer integration with channel partners, logistics could provide enormous strategic value. By enabling trading partners not only to integrate their logistics functions but also to converge supporting efforts occurring in marketing, product development, inventory and manufacturing capacity planning, and quality management, companies could tap into reservoirs of “virtual” resources and competencies unattainable by even the largest of corporations acting independently. The realization of this opportunity is the subject matter of stage-four SCM.

4. Fourth Stage — Supply Chain Management

During the mid-1990s, companies began to expand the concepts of integrated logistics and supply channel management to embrace the new realities of the marketplace. The acceleration of globalization, the increasing power of the customer demanding ever higher levels of service and supplier agility, organizational reengineering, third-party outsourcing, and the growing pervasiveness of information technologies had forced businesses to look beyond the integrated logistics paradigm in the search for new strategic models. The pressure of responding to these new challenges compelled organizations to implement what only can be called a dramatic paradigm shift from stage-three logistics to SCM. As discussed above, the fundamental feature of the integrated logistics model was the merger of channel management functions with those of trading partners targeted at improving customer service and total cost reduction across whole channels. In contrast, at the core of phase four organizations is a distinct recognition that competitive advantage can only be built by optimizing and synchronizing the productive competencies of each channel trading partner to realize entirely new levels of customer value.

Using the *supply chain operations reference* (SCOR) model as a benchmark, the differences between stage-three logistics and stage-four SCM can be clearly illustrated.

- *Plan.* In stage-three logistics, most business functions were still inward looking. Firms focused their energies on internal company scenario planning, business modeling, and corporate resource allocation management. ERP systems and sequential process management tools assisted managers to execute channel-level inventory flows, transportation, and customer fulfillment. In contrast, stage-four SCM companies began to perceive themselves and the supply networks to which they belonged as “value chains.” Knowing the total cost to all network partners and optimizing the customer-winning velocity of collective supply channel competencies became the central focus. Companies began to deploy channel optimization software and communications enabling tools like EDI to network their ERP systems, in order to provide visibility to requirements needs across the entire network.
- *Source.* Companies with stage-three sourcing functions utilize the integrated logistics concept to merge their procurement needs with the capabilities of their channel suppliers. The goal is to reduce costs and lead times, share critical planning data, assure quality and delivery reliability, and develop win-win partnerships. In contrast, stage-four SCM sourcing functions perceive their suppliers as extensions of a single supply chain system. Besides achieving the benefits of integrated logistics, a critical goal of SCM-driven companies is to utilize channel data to execute volume purchasing to benefit all network trading partners. When possible, computerized extranet technologies are used to assemble channel collaborative relationships pointing toward consortia buying. Transportation and warehousing costs are reduced by the joint utilization of outsourcing opportunities, thereby reducing the overall assets invested in channel inventories.
- *Make.* Stage-three organizations resist sharing product design and process technologies. Normally, collaboration in this area is undertaken in response to quality management certification or when it is found to be more economical to outsource manufacturing. There is minimal networking between trading partners when it comes to *computer aided design* (CAD) and ERP manufacturing databases. Stage-four companies, on the other hand, seek to make collaborative design planning and scheduling with their supply chains a fundamental issue. When possible, they seek to closely integrate their ERP systems to eliminate time and cost up and down the supply channel. SCM firms also understand that speedy product design-to-market occurs when they seek to leverage the competencies and resources of channel partners to generate “virtual” manufacturing environments that are capable of being as agile and scaleable as necessary to take advantage of every marketplace opportunity.
- *Deliver.* Customer management in stage-three companies is squarely focused on making internal sales functions more efficient. A heavy priority is placed on basic available-to-promise functionality, finished goods management, and determining the proper timing of distribution channel differentiation. While there is some limited sharing of specific information on market segments and customers, databases are considered proprietary,