

SECOND EDITION

ESSENTIALS

of **Supply
Chain
Management**

- Understand what a supply chain is and how it works
- Utilize the latest technologies to boost efficiency and responsiveness
- Discover new trends and techniques such as RFID and BPM
- Align your supply chain with market demands
- Learn how to develop supply chains for competitive advantage

Michael Hugos

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Table of Contents

[Essentials Series](#)

[Title Page](#)

[Copyright Page](#)

[Dedication](#)

[Preface](#)

[Acknowledgements](#)

[CHAPTER 1 - Key Concepts of Supply Chain Management](#)

[Nothing Entirely New ... Just a Significant Evolution](#)

[How the Supply Chain Works](#)

[The Evolving Structure of Supply Chains](#)

[Participants in the Supply Chain](#)

[Aligning the Supply Chain with Business Strategy](#)

[Chapter Summary](#)

[CHAPTER 2 - Supply Chain Operations: Planning and Sourcing](#)

[A Useful Model of Supply Chain Operations](#)

[Demand Forecasting and Planning \(Plan\)](#)

[Product Pricing \(Plan\)](#)

[Inventory Management \(Plan\)](#)

[Procurement \(Source\)](#)

[Credit and Collections \(Source\)](#)

[Chapter Summary](#)

[CHAPTER 3 - Supply Chain Operations: Making and Delivering](#)

[Product Design \(Make\)](#)
[Production Scheduling \(Make\)](#)
[Facility Management \(Make\)](#)
[Order Management \(Deliver\)](#)
[Delivery Scheduling \(Deliver\)](#)
[Return Processing \(Deliver\)](#)
[Supply Chain Operations Can Be Outsourced](#)
[Chapter Summary](#)

[CHAPTER 4 - Using Information Technology](#)

[Information Systems that Support the Supply Chain](#)
[Data Capture and Data Communications](#)
[Data Storage and Retrieval](#)
[Data Manipulation and Reporting](#)
[New Trends in Supply Chain Technology](#)
[Assessing Technology and System Needs](#)
[E-Business and Supply Chain Integration](#)
[CHAPTER SUMMARY](#)

[CHAPTER 5 - Metrics for Measuring Supply Chain Performance](#)

[A Useful Model of Markets and Their Supply Chains](#)
[Market Performance Categories](#)
[A Framework for Performance Measurement](#)
[Customer Service Metrics](#)
[Internal Efficiency Metrics](#)
[Demand Flexibility Metrics](#)
[Product Development Metrics](#)
[Operations that Enable Supply Chain Performance](#)
[Collecting and Displaying Performance Data](#)
[Three Levels of Detail](#)
[The Data Warehouse](#)
[Spotlighting Problems and Finding Opportunities](#)

[Markets Migrate from One Quadrant to Another](#)
[Sharing Data Across the Supply Chain](#)
[Chapter Summary](#)

[CHAPTER 6 - Supply Chain Coordination](#)

[The “Bullwhip” Effect](#)
[Coordination in the Supply Chain](#)
[Supply Chain Product Data Standards](#)
[Collaborative Planning, Forecasting, and Replenishment](#)
[CPFR in Action](#)
[How to Start Supply Chain Collaboration](#)
[Chapter Summary](#)

[CHAPTER 7 - Defining Supply Chain Opportunities](#)

[The Supply Chain as a Competitive Advantage](#)
[Identify the Business Opportunity and Define the Goal](#)
[Create the Strategy](#)
[Create a Conceptual System Design](#)
[Strategic Guidelines for Designing Systems](#)
[Define Project Objectives](#)
[Create an Initial Project Plan and Budget](#)
[Estimate the Project Budget and ROI](#)
[Define the Specific Costs and Benefits](#)
[Chapter Summary](#)

[CHAPTER 8 - Creating Supply Chains for Competitive Advantage](#)

[Charlie Supply Inc.—The Initial Business Situation](#)
[New Opportunities Emerge—The Follow-On Situation](#)
[Strategic Alliances for Competitive Advantage](#)
[Chapter Summary](#)

[CHAPTER 9 - The Promise of the Real-Time Supply Chain](#)

[The Start of Something Big](#)

[The Profit Potential of the Self-Adjusting Feedback Loop](#)

[Harnessing the Feedback Loop to the Supply Chain](#)

[Playing the Game of Supply Chain Management](#)

[Strengthening Supply Chain Alliances](#)

[Emergent Behavior in Supply Chains](#)

[Adaptive Networks and Economic Cycles](#)

[Chapter Summary](#)

[Index](#)

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ESSENTIALS **of Supply Chain** **Management**

SECOND EDITION

Michael Hugos



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To my wife, Venetia

Preface

I am a practicing business executive with more than 20 years of hands-on experience in deploying information technology and improving operating procedures to meet business challenges. One of the greatest challenges and one of the greatest opportunities that organizations face today is the use of supply chains to enable their continued growth and success. Since the year 2000 we have seen supply chain management rise in importance and prominence within organizations of all types—businesses, governments, the military, and aid and relief organizations.

In this second edition of the book I made changes and additions based on feedback from readers and based on the continuing impact of technology on the way we manage our supply chains. I devote an entire chapter to information technology (IT). Technologies such as radio frequency identification (RFID), business process management (BPM), and simulation modeling have the potential to move supply chain performance to a whole new level of responsiveness and efficiency

There is an expanded chapter on supply chain coordination. The new levels of supply chain performance we are all looking for will be the result of improved coordination between the different parties in the supply chain. I explore the EPC Global Network and the Global Data Synchronization Network (GDSN) and how they combine with RFID to empower coordination between companies. I also offer a real world case study showing how I used simple technology to deliver a supply chain visibility and coordination system for a Fortune 100 company. The first version of the system was rolled out in 90 days and it

quickly yielded significant benefits for this company and the distributors and manufacturers that were its supply chain partners.

Finally, there is an entirely new chapter on creating supply chains for competitive advantage. Readers have asked for more specific examples of how to use supply chain capabilities to support a company's business strategy. To this end, I present two business situations and show how a company in those situations can develop supply chain capabilities to best support its strategic goals. These examples are based on my own personal experience as well as my observations of other companies and what they have done or not done to use their supply chains effectively. If you wish to discuss your responses to the exercises or debate the merits of my solutions, I invite you to contact me at mhugos@yahoo.com.

It is my intent in this book to provide a clear framework for understanding the essential concepts of supply chain management. Then I build on this understanding and show how to develop and deploy supply chains to achieve success in the fast-paced, global economy we all live in. Chapters 1 through 3 provide an executive overview of the basic principles and the business operations that drive supply chain performance. Chapters 4 through 6 discuss techniques, technologies, and metrics for use in coordinating your operations with those of your supply chain partners. In Chapters 7 and 8 I present a pragmatic approach and case study examples for defining supply chain opportunities and designing and building systems to effectively respond to those opportunities. The last chapter, Chapter 9, outlines the profit potential now available to companies that learn to harness the power of the real-time supply chain. This is the promise of the agile and adaptive supply chain.

The book is written for three groups of readers: for business executives who must decide what kind of supply chain their organizations need and how much to spend to get them; for managers and staff who are now or soon will be responsible for building and operating some part of the supply chains in their companies; and for people who need to come up to speed quickly and participate in intelligent conversations about supply chain challenges and opportunities. The concepts and techniques presented here serve as a common vocabulary and frame of reference that everyone can use when communicating about supply chain management issues.

Acknowledgments

I would like to thank my colleagues and coworkers in companies such as Anixter International, Georgia-Pacific, Network Services Company, Starbucks, and Whole Foods Market for the opportunity to work with them in developing supply chains that are opening up whole new possibilities.

I am indebted (more than I even know) to my wife Venetia. She patiently supported me while I wrote this book. She became a weekend widow as I secluded myself in my study to write these pages. She read chapters, kept me from going off on tangents, and provided sound advice.

I want to thank my friend Percy for all his input and assistance during the research and writing of this book. Also thank you to my friend Kelly David—his CD, *Broken Voyage*, often provided the music I needed to find my way through to the end of this project.

CHAPTER 1

Key Concepts of Supply Chain Management



After reading this chapter you will be able to

- Appreciate what a supply chain is and what it does
- Understand where your company fits in the supply chains it participates in and the role it plays in those supply chains
- Discuss ways to align your supply chain with your business strategy
- Start an intelligent conversation about the supply chain management issues in your company

This book is organized to give you a solid grounding in the “nuts and bolts” of supply chain management. The book explains the essential concepts and practices and then shows examples of how to put them to use. When you finish you will have a solid foundation in supply chain management to work from.

The first three chapters give you a working understanding of the key principles and business operations that drive any

supply chain. The next three chapters present the techniques, technologies, and metrics to use to improve your internal operations and coordinate more effectively with your customers and suppliers in the supply chains your company is a part of.

The last three chapters show you how to find supply chain opportunities and respond effectively to best capitalize on these opportunities. Case studies are used to illustrate supply chain challenges and to present solutions for those challenges. These case studies and their solutions bring together the material presented in the rest of the book and show how it applies to real world business situations.

Supply chains encompass the companies and the business activities needed to design, make, deliver, and use a product or service. Businesses depend on their supply chains to provide them with what they need to survive and thrive. Every business fits into one or more supply chains and has a role to play in each of them.

The pace of change and the uncertainty about how markets will evolve has made it increasingly important for companies to be aware of the supply chains they participate in and to understand the roles that they play. Those companies that learn how to build and participate in strong supply chains will have a substantial competitive advantage in their markets.

Nothing Entirely New ... Just a Significant Evolution

The practice of supply chain management is guided by some basic underlying concepts that have not changed much over the centuries. Several hundred years ago, Napoleon made the remark, "An army marches on its

stomach.” Napoleon was a master strategist and a skillful general and this remark shows that he clearly understood the importance of what we would now call an efficient supply chain. Unless the soldiers are fed, the army cannot move.

Along these same lines, there is another saying that goes, “Amateurs talk strategy and professionals talk logistics.” People can discuss all sorts of grand strategies and dashing maneuvers but none of that will be possible without first figuring out how to meet the day-to-day demands of providing an army with fuel, spare parts, food, shelter, and ammunition. It is the seemingly mundane activities of the quartermaster and the supply sergeants that often determine an army’s success. This has many analogies in business.

The term “supply chain management” arose in the late 1980s and came into widespread use in the 1990s. Prior to that time, businesses used terms such as “logistics” and “operations management” instead. Here are some definitions of a supply chain:

- “A supply chain is the alignment of firms that bring products or services to market.”—from Lambert, Stock, and Ellram (Lambert, Douglas M., James R. Stock, and Lisa M. Ellram, 1998, *Fundamentals of Logistics Management*, Boston, MA: Irwin/McGraw-Hill, Chapter 14).
- “A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves ...” —from Chopra and Meindl (Chopra, Sunil, and Peter Meindl, 2003, *Supply Chain, Second Edition*, Upper Saddle River, NJ: Prentice-Hall, Inc., Chapter 1).

- “A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers.”—from Ganeshan and Harrison (Ganeshan, Ram, and Terry P. Harrison, 1995, “An Introduction to Supply Chain Management,” Department of Management Sciences and Information Systems, 303 Beam Business Building, Penn State University, University Park, PA).

If this is what a supply chain is then we can define supply chain management as the things we do to influence the behavior of the supply chain and get the results we want. Some definitions of supply chain management are:

- “The systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole.”—from Mentzer, DeWitt, Keebler, Min, Nix, Smith, and Zacharia (Mentzer, John T., William DeWitt, James S. Keebler, Soonhong Min, Nancy W. Nix, Carlo D. Smith, and Zach G. Zacharia, 2001, “Defining Supply Chain Management,” *Journal of Business Logistics*, Vol. 22, No. 2, p. 18).
- “Supply chain management is the coordination of production, inventory, location, and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served.”—my own words.

There is a difference between the concept of supply chain management and the traditional concept of logistics.

Logistics typically refers to activities that occur within the boundaries of a single organization and supply chains refer to networks of companies that work together and coordinate their actions to deliver a product to market. Also, traditional logistics focuses its attention on activities such as procurement, distribution, maintenance, and inventory management. Supply chain management acknowledges all of traditional logistics and also includes activities such as marketing, new product development, finance, and customer service.

In the wider view of supply chain thinking, these additional activities are now seen as part of the work needed to fulfill customer requests. Supply chain management views the supply chain and the organizations in it as a single entity. It brings a systems approach to understanding and managing the different activities needed to coordinate the flow of products and services to best serve the ultimate customer. This systems approach provides the framework in which to best respond to business requirements that otherwise would seem to be in conflict with each other.

Taken individually, different supply chain requirements often have conflicting needs. For instance, the requirement of maintaining high levels of customer service calls for maintaining high levels of inventory, but then the requirement to operate efficiently calls for reducing inventory levels. It is only when these requirements are seen together as parts of a larger picture that ways can be found to effectively balance their different demands.

Effective supply chain management requires simultaneous improvements in both customer service levels and the internal operating efficiencies of the companies in the supply chain. Customer service at its most basic level means consistently high order fill rates, high on-time

delivery rates, and a very low rate of products returned by customers for whatever reason. Internal efficiency for organizations in a supply chain means that these organizations get an attractive rate of return on their investments in inventory and other assets and that they find ways to lower their operating and sales expenses.

There is a basic pattern to the practice of supply chain management. Each supply chain has its own unique set of market demands and operating challenges and yet the issues remain essentially the same in every case. Companies in any supply chain must make decisions individually and collectively regarding their actions in five areas:

1. *Production*—What products does the market want? How much of which products should be produced and by when? This activity includes the creation of master production schedules that take into account plant capacities, workload balancing, quality control, and equipment maintenance.
2. *Inventory*—What inventory should be stocked at each stage in a supply chain? How much inventory should be held as raw materials, semifinished, or finished goods? The primary purpose of inventory is to act as a buffer against uncertainty in the supply chain. However, holding inventory can be expensive, so what are the optimal inventory levels and reorder points?
3. *Location*—Where should facilities for production and inventory storage be located? Where are the most cost efficient locations for production and for storage of inventory? Should existing facilities be used or new ones built? Once these decisions are made they determine the possible paths available for product to flow through for delivery to the final consumer.
4. *Transportation*—How should inventory be moved from one supply chain location to another? Air freight and

truck delivery are generally fast and reliable but they are expensive. Shipping by sea or rail is much less expensive but usually involves longer transit times and more uncertainty. This uncertainty must be compensated for by stocking higher levels of inventory. When is it better to use which mode of transportation?

5. *Information*—How much data should be collected and how much information should be shared? Timely and accurate information holds the promise of better coordination and better decision making. With good information, people can make effective decisions about what to produce and how much, about where to locate inventory and how best to transport it.

The sum of these decisions will define the capabilities and effectiveness of a company's supply chain. The things a company can do and the ways that it can compete in its markets are all very much dependent on the effectiveness of its supply chain. If a company's strategy is to serve a mass market and compete on the basis of price, it had better have a supply chain that is optimized for low cost. If a company's strategy is to serve a market segment and compete on the basis of customer service and convenience, it had better have a supply chain optimized for responsiveness. Who a company is and what it can do is shaped by its supply chain and by the markets it serves.

How the Supply Chain Works

Two influential source books that define principles and practices of supply chain management are *The Goal* (Goldratt, Eliyahu M., 1984, The Goal, Great Barrington, MA: The North River Press Publishing Corporation); and *Supply Chain Management, Second Edition* by Sunil Chopra and

Peter Meindl. *The Goal* explores the issues and provides answers to the problem of optimizing operations in any business system whether it be manufacturing, mortgage loan processing, or supply chain management. *Supply Chain Management, Second Edition* is an in-depth presentation of the concepts and techniques of the profession. Much of the material presented in this chapter and in the next two chapters can be found in greater detail in these two books.



IN THE REAL WORLD

Alexander the Great based his strategies and campaigns on his army's unique capabilities and these were made possible by effective supply chain management.

In the spirit of the saying, "Amateurs talk strategy and professionals talk logistics," let's look at the campaigns of Alexander the Great. For those who think that his greatness was only due to his ability to dream up bold moves and cut a dashing figure in the saddle, think again. Alexander was a master of supply chain management and he could not have succeeded otherwise. The authors from Greek and Roman times who recorded his deeds had little to say about something so apparently unglamorous as how he secured supplies for his army. Yet, from these same

sources, many little details can be pieced together to show the overall supply chain picture and how Alexander managed it. A modern historian, Donald Engels, has investigated this topic in his book *Alexander the Great and the Logistics of the Macedonian Army* (Engels, Donald W., 1978, *Alexander the Great and the Logistics of the Macedonian Army*, Los Angeles, CA: University of California Press).

He begins by pointing out that given the conditions and the technology that existed in Alexander's time, his strategy and tactics had to be very closely tied to his ability to get supplies and to run a lean, efficient organization. The only way to transport large amounts of material over long distances was by oceangoing ships or by barges on rivers and canals. Once away from rivers and sea coasts, an army had to be able to live off the land over which it traveled. Diminishing returns set in quickly when using pack animals and carts to haul supplies because the animals themselves had to eat and would soon consume all the food and water they were hauling unless they could graze along the way.

Alexander's army was able to achieve its brilliant successes because it managed its supply chain so well. The army had a logistics structure that was fundamentally different from other armies of the time. In other armies the number of support people and camp followers was often as large as the number of actual fighting soldiers because armies traveled with huge numbers of carts and pack animals to carry their equipment and provisions, as well as the people

needed to tend them. In the Macedonian army the use of carts was severely restricted. Soldiers were trained to carry their own equipment and provisions. Other contemporary armies did not require their soldiers to carry such heavy burdens but they paid for this because the resulting baggage trains reduced their speed and mobility.

The result of the Macedonian army's logistics structure was that it became the fastest, lightest, and most mobile army of its time. It was capable of making lightning strikes against an opponent often before they were even aware of what was happening. Because the army was able to move quickly and suddenly, Alexander could use this capability to devise strategies and employ tactics that allowed him to surprise and overwhelm enemies that were numerically much larger.

The picture that emerges of how Alexander managed his supply chain is an interesting one. For instance, time and again the historical sources mention that before he entered a new territory, he would receive the surrender of its ruler and arrange in advance with local officials for the supplies his army would need. If a region did not surrender to him in advance, Alexander would not commit his entire army to a campaign in that land. He would not risk putting his army in a situation where it could be crippled or destroyed by a lack of provisions. Instead, he would gather intelligence about the routes, the resources, and the climate of the region and then set off with a small, light force to surprise his opponent. The main army

would remain behind at a well-stocked base until Alexander secured adequate supplies for it to follow.

Whenever the army set up a new base it looked for an area that provided easy access to a navigable river or a seaport. Then ships would arrive from other parts of Alexander's empire bringing in large amounts of supplies. The army always stayed in its winter camp until the first spring harvest of the new year so that food supplies would be available. When it marched, it avoided dry or uninhabited areas and moved through river valleys and populated regions whenever possible so the horses could graze and the army could requisition supplies along the route.

Alexander had a deep understanding of the capabilities and limitations of his supply chain. He learned well how to formulate strategies and use tactics that built upon the unique strengths that his logistics and supply chain capabilities gave him and he wisely took measures to compensate for the limitations of his supply chain. His opponents often outnumbered him and were usually fighting on their own home territory. Yet their advantages were undermined by clumsy and inefficient supply chains that restricted their ability to act and limited their options for opposing Alexander's moves.

The goal or mission of supply chain management can be defined using Mr. Goldratt's words as "Increase throughput while simultaneously reducing both inventory and operating expense." In this definition throughput refers to the rate at which sales to the end customer occur. Depending on the market being served, sales or throughput occurs for

different reasons. In some markets customers value and will pay for high levels of service. In other markets customers seek simply the lowest price for an item.

As we saw in the previous section, there are five areas where companies can make decisions that will define their supply chain capabilities: Production; Inventory; Location; Transportation; and Information. Chopra and Meindl define these areas as performance drivers that can be managed to produce the capabilities needed for a given supply chain.

Effective supply chain management calls first for an understanding of each driver and how it operates. Each driver has the ability to directly affect the supply chain and enable certain capabilities. The next step is to develop an appreciation for the results that can be obtained by mixing different combinations of these drivers. Let's start by looking at the drivers individually.

Production

Production refers to the capacity of a supply chain to make and store products. The facilities of production are factories and warehouses. The fundamental decision that managers face when making production decisions is how to resolve the trade-off between responsiveness and efficiency. If factories and warehouses are built with a lot of excess capacity, they can be very flexible and respond quickly to wide swings in product demand. Facilities where all or almost all capacity is being used are not capable of responding easily to fluctuations in demand. On the other hand, capacity costs money and excess capacity is idle capacity not in use and not generating revenue. So the more excess capacity that exists, the less efficient the operation becomes.

Factories can be built to accommodate one of two approaches to manufacturing:

1. *Product Focus*—A factory that takes a product focus performs the range of different operations required to make a given product line from fabrication of different product parts to assembly of these parts.
2. *Functional Focus*—A functional approach concentrates on performing just a few operations such as only making a select group of parts or only doing assembly. These functions can be applied to making many different kinds of products.

A product approach tends to result in developing expertise about a given set of products at the expense of expertise about any particular function. A functional approach results in expertise about particular functions instead of expertise in a given product. Companies need to decide which approach or what mix of these two approaches will give them the capability and expertise they need to best respond to customer demands.

As with factories, warehouses too can be built to accommodate different approaches. There are three main approaches to use in warehousing:

1. *Stock Keeping Unit (SKU) Storage*—In this traditional approach, all of a given type of product is stored together. This is an efficient and easy to understand way to store products.
2. *Job Lot Storage*—In this approach, all the different products related to the needs of a certain type of customer or related to the needs of a particular job are stored together. This allows for an efficient picking and packing operation but usually requires more storage space than the traditional SKU storage approach.
3. *Crossdocking*—An approach that was pioneered by Wal-Mart in its drive to increase efficiencies in its

supply chain. In this approach, product is not actually warehoused in the facility. Instead the facility is used to house a process where trucks from suppliers arrive and unload large quantities of different products. These large lots are then broken down into smaller lots. Smaller lots of different products are recombined according to the needs of the day and quickly loaded onto outbound trucks that deliver the products to their final destination.

Inventory

Inventory is spread throughout the supply chain and includes everything from raw material to work in process to finished goods that are held by the manufacturers, distributors, and retailers in a supply chain. Again, managers must decide where they want to position themselves in the trade-off between responsiveness and efficiency. Holding large amounts of inventory allows a company or an entire supply chain to be very responsive to fluctuations in customer demand. However, the creation and storage of inventory is a cost and to achieve high levels of efficiency, the cost of inventory should be kept as low as possible.

There are three basic decisions to make regarding the creation and holding of inventory:

1. *Cycle Inventory*—This is the amount of inventory needed to satisfy demand for the product in the period between purchases of the product. Companies tend to produce and to purchase in large lots in order to gain the advantages that economies of scale can bring. However, with large lots also comes increased carrying costs. Carrying costs come from the cost to store, handle, and insure the inventory. Managers face