

2022

2022 LEARNING SYSTEM
VERSION 5.0

MODULE 8

OPTIMIZATION, SUSTAINABILITY, AND TECHNOLOGY

CSCP

CERTIFIED SUPPLY CHAIN PROFESSIONAL



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APICS Certified Supply Chain Professional (CSCP) Learning System

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Module 8: Optimization, Sustainability, and Technology

The final module in this learning system is all about evaluating and optimizing the supply chain. Because it is so important to ensure that the supply chain strategy aligns with organizational strategy, this module starts with a deeper dive into various organizational strategies. From there it explores how to redesign strategy, supply chain networks, and processes to optimize them.

A key area for supply chain redesign is to embed sustainability into all supply chain processes. We explore the triple bottom line (TBL) as well as United Nations guidelines and Global Reporting Initiative (GRI) standards. Other social, environmental, safety, and quality metrics are explored, and sustainability metrics are discussed.

The final section of this module is about technology. We start with a review of emerging technology trends in supply chain management and then delve into how to succeed at selecting and implementing such technology. Since this often requires project management and change management, these methodologies are addressed here even though they can be applied to any type of project or change. Maintaining technology is also addressed.

Section A: Optimizing Supply Chain Strategy and Tactics

This section is designed to

- Describe the relationship between the business strategy, the organizational strategy, and the supply chain strategy
- Define generic business strategies and describe how they are used
- Understand how a business strategy drives organizational strategy, which in turn drives functional area strategies, including those for supply chain management
- Explain how strategic decisions are made concerning customers and markets, technology, key processes, and sourcing
- Outline the key objectives and elements of supply chain strategy
- Identify specific ways in which supply chain management creates value for all stakeholders
- Address core competencies, cost structure, revenue model, and tax strategy in supply chain strategy
- Identify factors that can cause an organization to have misalignments or gaps in its strategy
- Discuss how to recognize when misalignments or gaps exist and how to resolve them
- Use tools to redesign the supply chain, including network modeling and operations research.

Developing a thorough understanding of organizational strategy is a prerequisite for supply chain managers in developing an aligned supply chain strategy. After addressing some generic strategies and related business models, this section addresses supply chain strategic value and how to optimize the supply chain. Part of this assessment includes financial modeling, network modeling, and operations research.

Topic 1: Business and Supply Chain Strategy

Business strategy and supply chain strategy need to align with and support organizational strategy. The only way to make sure this happens is to develop a good understanding of the organization's strategy. Learning about generic strategies can also help place a particular organization's strategy into context.

Here we start with an overview of business and supply chain strategy, and then we address the business model and strategy (generic strategies), organizational strategy (customer-driven, etc.), the business plan (value proposition and cost/revenue structure to achieve the strategy), and supply chain strategic objectives (including increasing visibility and velocity and reducing variability).

Business and Supply Chain Strategy Road Map

Before working to optimize an organization's supply chain strategy, one must first learn about business strategy and the competitive advantage intended to be provided by a given organizational strategy.

From there, the organization needs to develop or optimize a complementary supply chain strategy. This process needs to be ongoing so that misalignments or gaps are resolved on a regular basis.

Alignment of Strategies

There's a kind of magic in some words, "strategy" and "strategic" being key examples. Place "strategic" in front of the name of any business process, and it acquires an aura of great importance. Strategic objectives cry out to be achieved in a way that simple objectives do not. There's a reason those words have such power. Strategy, originally a military term, is how generals marshal all available resources in pursuit of victory.

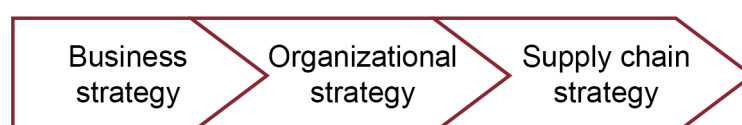
It's really the same in the business world. Each company has a business strategy that paints a broad picture of how it will compete in the marketplace. According to the *APICS Dictionary*, 16th edition, a **strategic plan** describes

how to marshal and determine actions to support the mission, goals, and objectives of an organization. [It] generally includes an organization's explicit mission, goals, and objectives and the specific actions needed to achieve those goals and objectives.

Since business strategy is like military strategy in that it requires the marshaling and organizing of all its resources, then it becomes clear that the business's supply chain can be its most potent strategic resource. Designing and building the right supply chain, one that promotes the business strategies, can give the organization an edge on the competition and help it move faster, deliver more value, and be more flexible in the face of both steady change and surprises. The supply chain strategy is a complex and continually evolving plan to create value for customers and investors.

Exhibit 8-1 shows how the direction of an organization is predicated on its business strategy, which includes its mission and vision statements that give clarity to the organization's purpose.

Exhibit 8-1: Alignment of Strategies



If these strategies are not aligned, the direction and fit will be askew. All three strategies are linked and dependent. The *Dictionary* differentiates between business and organizational strategy (listed as "strategy" in the *Dictionary*) as follows:

Business strategy . A plan for choosing how to compete. Three generic business strategies are (1) least cost, (2) differentiation, and (3) focus.

Strategy [organizational]. For an enterprise, identifies how the company will function in its environment. Specifies how to satisfy customers, how to grow the business, how to

compete in its environment, how to manage the organization and develop capabilities within the business, and how to achieve financial objectives.

Supply chain strategy is then a strategy for how the supply chain will function in its environment to meet the goals of the organization's business and organizational strategies. Competitive advantages are closely related to business strategy because they outline the advantages the organization should realize once it has decided how it will compete. A business model is the organization's business and organizational strategy formalized into a business plan. It specifies the details needed to achieve the strategy.

Processes for developing the supply chain strategy and for designing or redesigning the supply chain follow.

Processes for Developing Supply Chain Strategy

The key processes that supply chain managers need to be able to perform related to developing the supply chain strategy are

- Aligning with the business strategy
- Creating the supply chain strategy.

The following is a general overview of these processes.

Aligning with Business Strategy

The process of aligning with the business strategy involves the following steps:

- Reviewing the organization's business plan, financial statements, and other information and analyses related to business strategy to learn
 - The organization's overall strategic objectives, including its vision, key business policies, and cost and revenue objectives
 - Its value proposition for customers and stakeholders, including its core competencies (and areas it chooses to avoid)
 - How it will differentiate itself in the marketplace to compete and grow in the face of change and uncertainty
- Gathering information on the external environment, including
 - Customer requirements
 - Competitor business and supply chain strategies
 - Competitor supply chain maturity
 - Market size and market share
 - Overall, regional, local, and industry market conditions
 - Global risks and opportunities

- Reviewing current supply chain capacity, resilience, sustainability, and adaptability to understand the current state of the supply chain (actualized strategy)
- Analyzing actual alignment to business strategy and the current environment

Creating Supply Chain Strategy

The process of creating a supply chain strategy that is complementary to the business model and the current environment involves the following steps:

- Defining customer service objectives for business-to-business and/or business-to-consumer
- Selecting a revenue model, including direct and/or indirect and sales channels for each customer segment
- Mapping supply chain objectives to business objectives
- Aligning in-house versus contracted supply chain operating models and cost structure with organizational core competencies and strategy
 - Aligning operating model (e.g., make-to-stock)
 - Aligning cost structure or asset footprint (e.g., property, plant, and equipment and human resources for planning, sourcing, production, and logistics by region)
- Documenting the strategy, including
 - Clarifying the supply chain value proposition
 - Creating a network model
- Presenting and marketing the strategy to gain executive and supply chain partner support and approval
- Accepting feedback and making agreed-upon changes
- Gaining approval for the strategy
- Comparing supply chain strategy to actual supply chain capacity, resilience, sustainability, and adaptability
- Creating action plans to resolve misalignments or gaps between desired and actual supply chain strategy

Note that these action plans often involve supply chain design (or redesign).

Processes for Designing or Redesigning Supply Chain

Supply chain design requirements are based on the types of products and services the organization is selling and how those products and services have been designed. The key here is to develop a sense of customer and business requirements to ensure that the products and services are designed to meet those requirements while also meeting the supply chain's strategic goals, including for efficient and profitable operations. Every good supply chain design also needs to address collaborating with supply chain partners, delivering value using supply chain information systems, and specifying the proper methods of acquiring and managing data.

Once a supply chain has an approved strategy for enabling and complementing the organizational strategy, it is time to get to specifics. Network and process design or redesign is about specifying who, what, where, when, and why for every detail of a supply chain, not only the location and number of facilities but also how products will be designed to facilitate organizational strategy and how information systems will make the network transparent.

The key processes that supply chain managers need to be able to perform related to designing the supply chain are

- Identifying customer and business requirements
- Identifying the current and future states
- Performing a gap analysis between the current and future states
- Developing an action plan to close gaps.

The following is a general overview of these processes.

Identifying Customer and Business Requirements

The process of identifying customer and business requirements has these steps:

- Researching organizational and supply chain strategy for customer and business requirements
- Clarifying what degree of responsiveness and efficiency is required by stakeholders
- Performing market research
- Gathering information on customers' product or service requirements
- Learning how customer and business requirements will change over the product's life cycle
- Understanding when customer and business requirements require development of reverse or specialized supply chains
- Determining when business requirements need to be satisfied through collaboration with supply chain partners
- Determining business requirements for technology, data, and communication channels internally and between partners

Identifying Current and Future States

The process of identifying the current and future states involves the following steps:

- Collecting historical data for several periods up to the present on

- Actual inventory levels per location and in transit
- Inventory ordering methods and communications
- Actual transit times and costs
- Facility costs
- Customer segments
- Efficiency, responsiveness, and other metrics and key performance indicators
- Technology usage, usefulness, and administrative costs
- Mapping process flow for manufacturing and logistics for current products
- Analyzing inventory trends and ordering methods
- Modeling the supply chain in its as-is state using mathematical models, process flowcharts, and descriptive techniques
- Developing a future-state product or service design that will accommodate customer and business requirements and supply chain strategy
- Using supply chain network optimization tools such as network modeling and operations research to design a supply chain that meets strategic goals including responsiveness and efficiency
- Developing a technology model for desired information flows, analytic support, and electronic business
- Communicating the product/service and supply chain designs to stakeholders and gathering feedback
- Getting approval for the finalized designs
- Documenting the finalized designs

Performing Gap Analysis Between Current and Future States

The process of performing a gap analysis between the current and future states involves the following steps:

- Comparing the as-is to the to-be state to determine needed changes to
 - Suppliers
 - Supplier contracts and expectations
 - Collaboration agreements and processes
 - Customer segmentation
 - Facilities (e.g., opened, closed, modified, relocated)
 - Product or service design
 - Production process flows and production lines
 - Processes, policies, and procedures that incorporate continuous improvement and other forms of responsiveness
 - Transportation modes or providers
 - Inventory policy and ordering methods
 - Technologies (adding or retiring)

- Communications policies or procedures
- Metrics to provide incentives to align with strategy
- Estimating the scope of the changes and time and cost involved
- Performing a feasibility study and financial analysis to determine the return on investment
- Preparing a business plan and gaining executive approval for it

Developing Action Plan to Close Gaps

The process of developing an action plan to close gaps involves the following steps:

- Planning how to develop continuous improvement philosophies in ongoing operational processes, policies, and procedures
- Planning how to communicate and manage change initially and over the long term
- Developing project charters for all changes to be implemented as projects
- Gaining approval and funding for each project charter, including the authority to plan projects and expend funds
- Planning each project to define the integration, scope, schedule, budget, quality, and how to manage human resources, communications, risks, procurements, and stakeholders
- Planning the execution, monitoring and controlling, and closing for each project

Note that implementing action plans involve the following steps:

- Communicating and receiving feedback
- Using project management
- Using change management to change the culture and ensure that project results become standard operating procedure

Business Model and Strategy

A **business model** is an organization's plan to generate revenue and turn a profit based on its operations. It shows how the organization will differentiate itself from the competition and how it will function, including the expenses it expects to incur and how its components will work together. A business model is the organization's modus operandi, or way of doing things, and it consists of the following elements:

- Business strategy (what is the generic basis of competition)
- Organizational strategy (what is the specific basis of competition)
- Business plan (how to make the strategy happen)
 - Value proposition
 - Set of core competencies
 - Cost structure
 - Revenue model

Typically, a business strategy will outline how to grow the business, how to distinguish the business from the competition and outperform them, how to achieve superior levels of financial and market performance, and how to create or maintain a sustainable competitive edge.

Generic business strategies include least cost, differentiation, and focus. Least cost relates to a lower cost than the competition for an otherwise equivalent product or service. Differentiation relates to a product or service with more features, options, or models than the competition. Focus relates to whether the product or service is designed for a broad audience or a well-defined market segment or segments. There are many ways that these generic strategies can be combined or made into hybrids, for example:

- **Low cost**—Focuses on delivering no-frills basics with low prices that are hard to match; cost is the basis for competition.
- **Best cost**—Focuses on delivering the best value at a relatively low price; both cost and quality are the bases for competition.
- **Broad differentiation**—Creates product/service attributes that appeal to many buyers looking for variety of goods; customer experience and/or quality are often the basis for competitive differentiation.
- **Focused differentiation**—Develops unique strategies for targeted niche markets to meet unique buyer needs; niche marketing and innovation are important examples of this type of competitive basis.
- **Focused low cost**—Designed to meet well-defined (niche market) buyer needs at a low cost; responsiveness can be the basis for competition.

Competitive advantages mirror the strategies used to create them: A competitive advantage exists when an organization is able to provide the same benefits from a product or service at a lower cost than a competitor (low-cost advantage), deliver benefits that exceed those of a competitor's product or service (differentiation advantage), or create a product or service that is better suited to a given customer segment than the competition can offer (focus advantage). The result of this competitive advantage is superior value creation for the organization and its customers. If this advantage is successfully implemented and marketed, it should result in improved profits and market share.

To see how low-cost-, differentiation-, and focus-based competitive advantages could be interpreted in an organization and its supply chain, we will explore each of these strategies in more detail next.

Low-Cost Advantage Strategies

Strategies consistent with a low-cost approach to competition include a variety of methods to reduce cost in all areas of the supply chain, including resource extraction, transportation, warehousing, and location and design of retail facilities. A powerful nucleus company with a low-cost strategy and a large market share can exert great leverage on its suppliers. Such a company may be able to require

suppliers to cut facility costs, relocate, adopt lean manufacturing (an approach that focuses on waste reduction and quality), change employment practices, and so forth.

A low-cost strategy is adopted in supply chain strategy by emphasizing high operational efficiency, standardized products, and tight supplier inventory control. Supplier quality also needs to be high, or rework and returns will cut deeply into the thin profit margins of this model. Supply chain metrics need to measure efficiency from many perspectives, including asset utilization, inventory turnover, and various direct, indirect, and total cost measures.

A low-cost strategy should not be confused with target cost. **Target costing** is defined in the *APICS Dictionary*, 16th edition, as

the process of designing a product to meet a specific cost objective. Target costing involves setting the planned selling price, subtracting the desired profit as well as marketing and distribution costs, thus leaving the required manufacturing or target cost.

For example, this strategy includes numerous “dollar stores,” where the majority of the products cost only one dollar and the selection is huge.

A variant on a low-cost strategy for multinational corporations is a **global strategy**, defined in the *Dictionary* as

a strategy that focuses on improving worldwide performance through the sales and marketing of common goods and services with minimum product variation by country. Its competitive advantage grows through selecting the best locations for operations in other countries.

In addition to selecting low-cost countries for operations, this strategy benefits from economies of scale by selling products with little variation in all markets. The items themselves may be cheap, expensive, or a varying mix of products, but they can have a lower cost than the competition can offer because of these competitive advantages.

Note that providing a product or service at the lowest price is generally not compatible with either the differentiation or focus (niche marketing) strategy. The lower profit margins provided by this approach are more consistent with mass marketing. However, even low-cost products have to meet some quality standards to remain competitive. Also, price competition can exist within a niche or differentiated market. One luxury automobile may undercut another in price, for example, if it maintains a level of quality and a sterling reputation.

Product or Service Differentiation Advantage Strategies

Determining how to differentiate a product or service begins with a competitive analysis to see what the competition has to offer. According to the *APICS Dictionary*, 16th edition, **competitive analysis** is “an analysis of a competitor that includes its strategies, capabilities, prices, and costs.”

Once a company has analyzed the offerings of competitors, it may differentiate its products and services in a number of ways. This is known as **product differentiation**, “a strategy of making a product distinct from the competition on a nonprice basis such as availability, durability, quality, or reliability” (*Dictionary*).

The following are some types of differentiation:

- High quality—durability, appearance, performance, type of materials, and so on (Quality is often an order qualifier, a necessary prerequisite for a purchase.)
- Diversity of the product line, offering customers many options (The opposite of this approach was Henry Ford’s alleged claim that people could have his cars in any color they wanted as long as they wanted black.)
- Greater reliability (which could be considered a type of quality)
- Special features not available from competing products or services

Taking quality as a differentiation strategy example, the idea is to gain a reputation for reliability and consistency, which requires solid investment in product development and the processes of source, make (especially quality assurance), and return. Quality can be a differentiator for perishable or fragile goods. In this case, transportation and storage are key areas to focus on in the supply chain strategy. For example, Tropicana has not only invested in cutting-edge refrigerated trucks but has also developed a system to ensure that oranges are harvested at peak ripeness.

Supply chain strategies appropriate for product differentiation include the following:

- Modular design combined with postponement. **Postponement** is defined in the *Dictionary* as “a product design or supply chain strategy that deliberately delays final differentiation... until the latest possible time in the process.” Modular design with postponement allows last-minute customization to meet specific consumer demands.
- A base model with numerous options to reduce the risk of obsolescence (e.g., the same base could be used with upgraded subcomponents) while providing a large effective inventory (many configurations) with a small actual inventory.
- Collaboration with suppliers to develop innovative designs, numerous options appealing to different customer tastes, artistic design, and so on.
- Global track and trace technology to reduce the risk of counterfeit items or subcomponents.

Another way to differentiate a product or service is to provide a superior customer experience. When customer experience is the organization’s primary competitive basis, the organization develops a thorough understanding of customer preferences to provide products and services that are just right and are available where and when the customer needs them. This could be as simple as a convenience store that is always open. When customized services are offered, the organization’s

supply chain needs to be sophisticated enough to measure the cost of offering these services to ensure that they remain profitable. From an inventory and logistics perspective, differentiation requires getting goods and services to customers based on their preferences while avoiding the need for expedited production or delivery.

For example, Zappos.com is a shoe, jewelry, and clothing website that places customer service above all other priorities. Their customer service specialists are trained to take as much time as needed to help each customer, even calling them back after tracking down a difficult-to-find pair of shoes, rather than the standard call center philosophy of minimizing customer call time (and thus cost). Since they do not offer above-average pay to call center employees, to ensure that they get only employees who want to provide this high level of personalized service, they offer new employees a one-time cash offer to quit after the first week. This provides an incentive for less-committed employees to self-select out.

In the business-to-business arena, customer experience may mean keeping the customer's operations up and running without interruption. For example, Sandvick Mining provides rock drilling equipment and parts for mining operations. In this industry, keeping the customer's equipment going over all work shifts, day in and day out, is more important than the price of the equipment and spare parts. Providing this reliable customer experience is what the organization differentiates itself on.

Focus Advantage Strategies

Ways to create a focus advantage include

- Niche marketing
- Responsiveness
- Innovation.

Focus: Niche Marketing (Versus Mass Marketing)

Companies can choose to develop products and services for a mass market or for a focused slice of a larger market—a niche market.

As defined in the *APICS Dictionary*, 16th edition, **mass marketing** is “the strategy of sending the same message to all potential customers.” Mass marketing's advantage is the ability to create a simple message and repeat it numerous times using mass media until the message enters the consciousness of consumers. Mass marketing is appropriate for products and services that have broad appeal across many market segments, either because they are staples that everyone needs or because marketing can be used to create an apparent general need or desire. (Bottled water is an example of a product that marketing has developed into an apparent need.) Mass marketing is not just for standardized products. For example, it can be used to sell a customizable product such as a sandwich restaurant that allows customers to specify toppings. The point of mass marketing is to have a single message that can be broadly disseminated, not necessarily to restrict customers to a one-size-fits-all product or service.

Niche marketing is used to design messages to be especially appealing to one or more market segments. It can also use less costly delivery channels because messages can be delivered over just the media the target segments (also known as channels) are likely to use. Internet advertising can even tailor marketing messages to a segment of just one person based on that person's browsing or purchasing history.

Some examples of niche market approaches include

- Catering to high-net-worth customers with products such as luxury automobiles, yachts, large homes, or specialized services such as estate planning, personal training, or expensive cruises
- Designing for a limited age group, such as children or senior citizens with special needs, instead of serving a broader population
- Providing products or services for residents of a particular geographic area, such as growing vegetables for a neighborhood market rather than for packaging and shipping around the nation or world.

Niche marketing shares some characteristics with product/service differentiation. In both cases, the product or service provided to customers has special features. Differentiation by quality, for example, can be the same thing as catering to high-net-worth customers. (Low-net-worth customers, or value shoppers, can also be a niche market.) Some supply chain strategies will work for both approaches. Collaboration to achieve distinctive design is one example. Depending upon the niche, sourcing may focus more on finding special expertise or high-quality materials than on low-cost labor or materials.

An international variant on niche marketing is a **multicountry strategy**. The *Dictionary* defines this as

a strategy in which each country market is self-contained. Customers have unique product expectations that are addressed by local production capabilities.

Focus: Responsiveness

Perhaps the most obvious example of responsiveness is the fast-food industry that grew up in the last half of the 20th century, led by McDonald's. Diners at fine restaurants will happily wait half an hour for their meal, but employees on short lunch breaks become impatient with even a few minutes in line. In the early days of the Toyota Prius automobile—a highly differentiated car—buyers were known to wait for months for a new vehicle. (The same phenomenon occurred when the Volkswagen “Beetle” first came to the United States, where it was both highly differentiated and a low-cost option.) But businesspeople or diplomats on assignment expect a rental car or limousine to be ready immediately when they arrive at the airport. Manufacturers of clothing prosper or go bankrupt by their ability to bring the latest seasonal designs to market rapidly. Perishable products, such as raw food items, must be delivered while fresh. Services may also compete on the basis of speed by cutting time spent waiting on the phone, standing in line, or processing paperwork.

Supply chains designed for responsiveness may rely on substantial supplies of safety stock to avoid outages. Supply chains may have multiple warehouses to place products nearer to users. Another way to develop responsiveness is to invest in supply chain agility, which refers to the ability of sourcing and manufacturing to ramp up or down in production volume quickly without undue costs or hardship. Setting up an agile supply chain can have a large initial cost, but over time it might be more cost-effective than relying on large safety stocks.

Focus: Innovation

A focus on innovation means ensuring that the organization's products and services remain so cutting-edge that they become must-have items for the target market. Apple is a clear example of this competitive model. To succeed at innovation, an organization needs to not only invest heavily in research and development but also address changing customer desires related to functionality and style.

Supply chains enable an innovation strategy by focusing on time to market and time to volume. Time to market creates the differentiation between the organization and its competitors. Products that get to market sooner can capture market share before the competition copies the innovation. Time to volume is critical because demand will peak in the early period of the release and then drop off relatively quickly. Failure to satisfy demand during the early period will severely impact profits. A supply chain that is fully integrated with product design will provide designers with materials and subcomponents that can be quickly and efficiently sourced and produced. This requires close integration of information flows, processes, and physical plants and assets.

Organizations also need to establish defined quality levels for all suppliers so that the right parts arrive on time with no delay. Since compressing design and innovation increases the risk of quality issues, this places more of the quality burden on suppliers, which may result in delays if they come up short. For example, on the verge of its initial release, the Apple Watch had a supply chain issue with a defective subcomponent. A part that made a gentle tapping sensation on the wrist was found to be defective. Since quality control found this issue before the watches were shipped to customers, rework but not recall was needed, and one of the two suppliers of this subcomponent needed to be abandoned. The remaining supplier needed extra time to ramp up to the increased demand. This created a bottleneck on time to volume at a critical time for the innovative technology.

Choosing Business Strategy

It is important to focus primarily on one competitive strategy, at least within a given business unit. Most strategies have tradeoffs that make it difficult or impossible to pursue more than one at once. For example, providing high service at the lowest price is a challenge. The marketing messages will also become confusing. However, not all the strategies are mutually exclusive; for example, product differentiation and niche marketing fit well together.

That being said, trying to be all things will dilute the competitive advantage organizations gain from specialization. While a company that focuses on innovation needs to keep costs competitive and a low-cost strategy company still needs to pay attention to quality, these lower-priority considerations should not be allowed to drive strategic decisions. For example, Spirit Airlines has decided to be the “dollar store” of airlines. Since it is an airline, it obviously needs safe airplanes, but strategic decisions are based on the budget travel model. The number of seats per plane needs to be maximized even if this impacts customer comfort, so their seats don’t recline. They also charge for water and all other items and put advertisements all over the plane. Customer complaints are high with this airline, but they get many repeat customers—even many complaining customers—because the price of the flight is the driving factor behind their actual purchase decisions.

Once an organization has decided on a business strategy, it uses these choices to drive the organizational strategy and eventually the supply chain strategy.

Organizational Strategy

Where do you start when building an organization’s strategy? Part of the *APICS Dictionary*, 16th edition, definition of **organizational strategy** is that it “identifies how the organization will function in its environment.” The best place to start is to envision what the future should look like, or to begin with the end in mind. Setting clear goals will drive other decisions.

After looking at the goals of organizational strategy, we will cover four examples of organizational strategy in detail: customer focus and alignment, the forecast-driven enterprise, the demand-driven enterprise, and product-type-driven supply chains.

Goals of Organizational Strategy and Impact on Supply Chain Strategy

The goals of organizational strategy are provided in its definition. Goals are related to how the organization will satisfy customers; grow its vertical/horizontal footprint; thrive in its competitive environment and increase market share; identify, develop, and maintain core competencies; manage operations and partner relations; learn and grow; innovate; and make a profit.

Whatever strategy the corporation adopts to satisfy customers, grow, compete, organize itself, and make money, the supply chain has to operate in a manner that furthers those goals. To give a simple example, if customers are demanding deeply discounted prices on durable, high-volume goods with stable demand, a supply chain strategy that focuses on low-cost sourcing and/or capital expenditure with justified return on investment (ROI) would be on target to accomplish that goal. In the case of equipment investments, ROI would need to come in the form of lower labor costs, greater throughput, or increased economies of scale.

Horizontal supply chains will contain a number of independent organizations, each with its own goals, processes, operations, technology, and strategy. So, when we refer to the necessity of aligning supply

chain strategy with organizational strategy, we are referring to the strategies of a channel master or nucleus firm. Traditionally, that's the manufacturer of a product—the company that sits right at the center of the supply chain (or network), with suppliers in tiers on one side and customers on the other.

However, if a supply chain has a dominant company with a dominating strategy (one that is dictating its requirements to others), for example, a large retailer, then supplier and manufacturer strategies and goals must align with that retailer's organizational and supply chain strategies. The suppliers of suppliers also have strategies to be brought into alignment. Finally, the strategies, once aligned, have to meet two broad goals: to serve the end customers' needs and to be profitable for the supply chain as a whole and each company individually.

Strategy: Customer Focus and Alignment

Organizations with a customer focus and alignment prioritize what's good for the customer—not what's good for the nucleus company or even what seems to be good for the supply chain itself. The matching supply chain strategy therefore needs to be focused on giving the final customer the right product at the right time and place for the right price. It isn't necessarily about the most advanced product or service, nor is it always about the lowest price, the fastest time, or the most convenient place. It's about the balance of quality, price, and availability (timing and place) that's just right for the customer.

How does one determine what is the right amount of each of these factors? Here are some basic premises that will help supply chain managers get started in determining the appropriate balance to enable this strategy:

- Serving the end-user customer is the primary driver of supply chain decisions.
- Organizations in the supply chain have to make a profit and stay in business to serve the customer.

Functional teams in the organization will provide their input and research on the optimal balance for the supply chain to meet customer needs. Design engineers—or, better yet, design teams from across the network—design products that are right for the end customer and can be sold profitably. Market research looks for the true, and not always obvious, needs in potential consumers that the supply chain can be engineered to satisfy profitably. Logistics strategy begins with data about customer demands for availability—of materials, components, service, or finished products, depending upon the customer—and then it looks for ways to move products in a cost-effective way with acceptable risk. That is, decisions are not just about product features or price or speedy delivery. They are about the right features at the right price on the right schedule.

The term “customer” can be a complex concept in relation to supply chains because there may be multiple customers with different stakes in the process. When we talk about customer focus, we mean the end user, the consumer of the product. But perhaps only the retailer actually sees the end user and has a direct relationship with that person or entity. Everyone else in the supply chain has a more immediate customer just downstream before one gets to this ultimate customer. If the supply chain is

completely aligned in its focus on the end customer, then, at least in theory, serving the customer just to an organization's downstream side would automatically serve the end user and also be in the supplying organization's best interest as well as the interest of investors.

Within each supply chain partner there are internal "customers" whose needs also must be aligned with corporate and supply chain strategies. Each manager must understand his or her role in making the supply chain profitable, and staff, too, must be rewarded, motivated, and trained in alignment with the needs of the supply chain's end customer.

Consider sustainable supply chain management, which is basically a supply chain that works to maximize the positive long-term social and environmental impact of its actions while remaining profitable. Successfully managing for sustainability requires a strategic mindset, involving numerous personnel and financial resources and a commitment from suppliers in multiple tiers as well as consumers further up the supply chain. Departments must cooperate with other departments in their organization (e.g., purchasing and environmental or design departments) and with their counterparts at suppliers. This type of collaboration between supply chain partners necessitates breaking down cultural barriers and building a culture of trust to ensure that the focus is on end-to-end supply chain activities.

Strategy: Forecast-Driven Enterprise

Another example of an organizational strategy is the forecast-driven enterprise. Simply put, this strategy is one in which the nucleus company, usually the manufacturer, uses a forecast, an estimate of future demand, as the basis of its organizational strategy.

When a supply chain works in response to forecasts, it's called a **push system**, and it entails the following (as described in the *APICS Dictionary*, 16th edition):

- 1) In production, the production of items at required times based on a given schedule planned in advance.
- 2) In material control, the issuing of material according to a given schedule or issuing material to a job order at its start time.
- 3) In distribution, a system for replenishing field warehouse inventories where replenishment decision making is centralized, usually at the manufacturing site or central supply facility.

Everything in a push system is pushed downstream from one point to the next according to schedules based on the forecasts. The supplier delivers components in the amounts determined by the schedule to inventory, where they await use in manufacturing. The plant turns them into finished products and pushes the products to the distribution center or the retailer, where they await an order from downstream.

Here is the complicating factor: It is difficult to know what customer requirements will be from day to day, month to month, quarter to quarter, and so on. If a manufacturer knew its customers were going to need 1,000 SKUs (stock keeping units) every Wednesday afternoon, then getting those products to customers at the right time and place would be a matter of simple calculation based upon lead times for

production and delivery. The manufacturer would look at the bill of material, determine the lead time for each item listed, and submit schedules to its suppliers.

Unfortunately, it's difficult to predict even the most stable demand—say, for a product like diapers. There is some variability in demand for diapers, even though they aren't subject to seasonal changes and are in demand in all economic cycles. However, they are subject to the bullwhip effect. That's why Procter & Gamble provides vendor-managed inventory (VMI) to Walmart to plan for demand and replenishment of diapers.

In situations outside this kind of partnership, forecasting along the supply chain may work like this:

- The retailer forecasts demand from parents who purchase diapers.
- The wholesaler forecasts demand from all its retailers.
- The manufacturer forecasts demand from the wholesale distributors.
- The component suppliers forecast demand from manufacturers.
- The raw materials suppliers forecast demand from the component manufacturers.

How effective is this strategy? Here's how forecasting error and the bullwhip effect can make this push strategy less effective:

- Parents vary their diaper-buying patterns in fairly small increments due to factors nobody fully understands. They may go to different stores for a change, shop on Tuesday instead of Wednesday, or buy two or three weeks' worth at one time because the diapers are on sale. So, actual demand never quite meets the forecast.
- Meanwhile the retailer's order includes a little extra safety stock. Or maybe the retailer runs a promotion that is not communicated to the distributor, thus resulting in needing a larger order than was previously forecasted. These fluctuations impact forecasting for the distributor.
- The wholesale distributor had forecasted demand based on past orders from its retailers. But now those demand patterns have wider variability than the demand pattern at the retailer's checkout counters due to that safety stock or uncommunicated promotion. Sometimes inventory accumulates because demand is less than the forecast, and this means that the retailer's next order shrinks because it has a glut of diapers, so it becomes feast or famine up the chain.
- Up the supply chain, the manufacturer looks at the distributor's order demand pattern and makes its own forecasts showing an even wider swing in variability.
- And this variability goes up the supply chain with ever-wider swings.

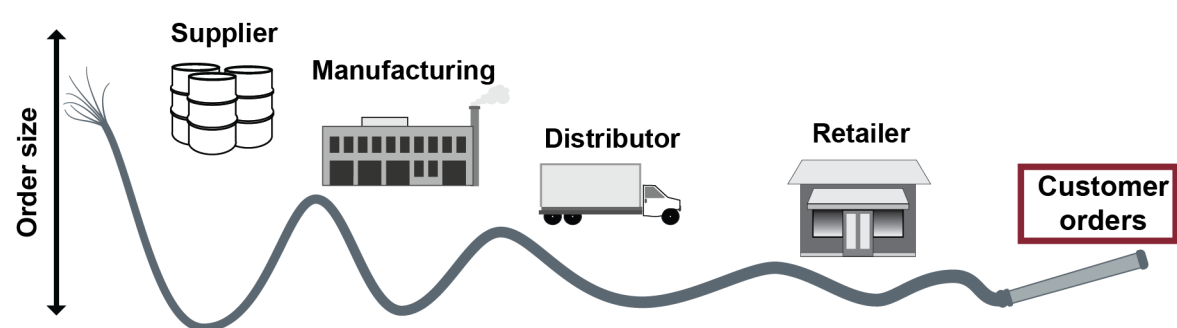
This is the **bullwhip effect**, which the *Dictionary* defines as

An extreme change in the supply position upstream in a supply chain generated by a small change in demand downstream in the supply chain. Inventory can quickly move

from being backordered to being excess. This is caused by the serial nature of communicating orders up the chain with the inherent transportation delays of moving product down the chain. The bullwhip effect can be eliminated by synchronizing the supply chain.

The bullwhip effect is shown in Exhibit 8-2. It affects all manner of supply chains that are based on serial forecasting by each independent division or company that touches the product as it travels from raw material to finished good. Communication of little more than orders (failure to communicate actual demand) plus over-reliance on forecasts are root causes of the bullwhip effect. One solution to the bullwhip effect then is better visibility in both directions but especially of promotions, orders to replenish safety stock, and other information on actual demand. Another solution is to rely less on forecasting, which is the purpose of the next strategy discussed.

Exhibit 8-2: Bullwhip Effect



Strategy: Demand-Driven Enterprise

Since the bullwhip effect is driven by demand forecasts, a solution is to replace the forecasts with actual demand information to the degree this is feasible. This isn't necessarily a simple matter, but supply chain professionals have developed demand-driven techniques for letting actual orders (not forecasts) drive production and distribution while maintaining strategic buffers of inventory in key locations rather than spreading inventory throughout the system. Demand-driven planning (DDP) and its key ordering method, **demand-driven material requirements planning (DDMRP)**, are central elements of many of these models. DDMRP is defined as "a method for planning material needs that enables a company to build more closely to actual market requirements" (*APICS Dictionary*, 16th edition). DDP and DDMRP are discussed more elsewhere.

The **demand-driven supply network** is defined in the *Dictionary* as "a situation in which a customer purchase initiates real-time information flows through the supply chain that consequently cause movement of product through the network." It is type of **pull system**, which the *Dictionary* defines as follows:

- 1) In production, the production of items only as demanded for use or to replace those taken for use.
- 2) In material control, the withdrawal of inventory as demanded by the using operations. Material is not issued until a signal comes from the user.
- 3) In

distribution, a system for replenishing field warehouse inventories where replenishment decisions are made at the field warehouse itself, not at the central warehouse or plant.

In the demand-driven supply chain, supply management is focused on customer demand. Instead of manufacturers planning their operations based on factory capacity and asset utilization, the demand-driven supply model uses a customer-centric approach that allows demand to drive supply chain planning and execution—moving the “push-pull frontier,” as it’s called, back up the supply chain at least to the factory but often to first-tier suppliers too. Instead of producing to the forecast and sending finished products to inventory, the production process is based on actual demand information. There is, in other words, no fixed production schedule in a strictly demand-driven supply chain. Product is turned out only in response to actual orders, “on demand,” in other words. This often leads to a decrease in lead times due to the ability to better anticipate incoming orders from the retailer. Even deliveries of raw material are determined using actual demand information. (Note, however, that suppliers may still need to rely on forecasts to determine their production. The art of forecasting remains crucial, even in a demand-driven supply chain.)

The challenge in changing from forecast-driven (push) systems to demand-driven (pull) systems is in reducing inventory without also lowering customer satisfaction. When a demand-driven system is set up and managed properly, it can actually enhance customer service while reducing costs. But stockouts are a risk.

- In the forecast-push process, the risk is related to the build-up of inventory all along the supply chain. Not only does inventory cost money while it sits in a retail stockroom, distribution center, or preproduction storage area; it runs the risk of becoming obsolete or irrelevant for a number of reasons. In a world of rapid innovation, inventory obsolescence is a real threat. Season close-out sales and discount resellers are ways of clearing out overstock. Magazine distributors destroy huge quantities of monthly magazines when they come back from retail outlets. (Since magazines are inexpensive to produce and destroy compared to their retail price, the distributors would rather destroy ten copies than miss one sale.) Those are the results of producing to forecasts that no one trusts and purposely overstocking in case of unexpectedly high demand.
- In the demand-pull, make-to-order model, on the other hand, the risk is that orders will begin to come in above capacity and all along the supply chain there will be expensive activity to run the plant overtime, expedite more and faster transportation, or convince customers to wait or accept a substitute product. (Running short of stock is also a risk in the forecast-driven supply chain. Forecasts can be wrong in either direction.)

Demand-driven enterprises therefore establish strategic inventory buffers and monitor the size of those buffers so that throughput can be kept high enough to satisfy most demand while keeping aggregate levels of inventory very low. They also rely more on make-to-order or assemble-to-order whenever feasible.

In reality, most organizations pursue a push-pull strategy, and the point where push moves to pull is the key strategic decision. Once that decision has been made, building a demand-driven enterprise can require significant changes in all supply chain processes.

The following are some major steps:

- **Provide access to real demand data along the supply chain for greater visibility of the end customer.** The first requirement is to replace the forecasts with real data. The only supply chain partner with access to these data firsthand is the retailer, and retailers in the past have been no more willing to share business data than any other company. The other partners lack “visibility”—one of the main supply chain principles promoted by APICS. They simply cannot see what’s going on with the end customer. But visibility is required in a pull system. With point-of-sale scanning or radio frequency identification (RFID), a retailer can transfer customer activity data to its suppliers continuously. Instead of producing to a forecast, manufacturers with immediate signals from the front lines can plan one day’s production runs at the end of the prior day. They produce just enough to replace the sold items.
- **Establish trust and promote collaboration among supply chain partners.** Collaboration is implied in the sharing of information. But more is at stake than simply sharing sales information. Partners may have to invest in new technology and develop new systems to be able to use the real-time data. With orders going out without a schedule, all processes will have to be altered—warehousing (less storage needed), packaging, shipping, and planning will all be handled differently in the new system. In return for the real-time data and subsequent reduction of inventory, suppliers and distributors have to agree to change their processes in whatever way necessary to make the new system function at the desired level of customer service.
- **Increase agility of trade partners.** Because the inventory buffers will be much reduced in this demand-driven supply chain, the trade partners need to develop agility—the ability to respond to the variability in the flow of orders based on sales. The plant, for example, may have to undergo considerable change if it has to produce several different kinds of products under the new circumstances. When making-to-forecast, a plant can run a larger volume of each product to send to inventory; when making-to-order, the plant may have to produce several different types of products in a day. There will be no room for long changeover times between runs of different products; therefore, equipment, processes, work center layouts, staffing, or siting—or all these things—may have to change to create the capacity required to handle the new system.

Gartner’s annual supply chain report (“The AMR Supply Chain Top 25 for 2021”) ranks the top 25 demand-driven supply chains, thereby underscoring the importance of this and other cutting-edge supply chain strategies. A link to this report is provided in the online Resource Center.

Strategy: Product-Type-Driven

The last organizational strategy we'll cover is based on a company having more than one supply chain, depending upon the types of products that are passing along the chain and other variables. For a product with a complex bill of material (many parts that combine into many components to make the final product), a manufacturer may be bringing in materials from many suppliers. And these materials might range from low-priced commodities to fragile or sophisticated materials that require special shipping and handling. Suppliers might range from small specialized organizations to raw materials giants larger than the manufacturer. Some are key accounts; some might be occasional buyers. The finished products may be sold through several different channels—e-commerce, printed catalogs, commercial, retail. These variables may combine in different ways, each suggesting its own type of supply chain strategy.

In “What Is the Right Supply Chain for Your Product?” Marshall L. Fisher distinguished two types of products, functional versus innovative, that require different supply chain strategies.

Functional products “are mature products that tend to have a low profit margin and a predictable demand” (*APICS Dictionary*, 16th edition). Functional products change little from year to year and have longer life cycles, relatively low contribution margins, and little variety. Because demand for them is stable, they are fairly easy to forecast, with a low margin of forecasting error (perhaps around 10 percent), very few stockouts, and no end-of-season markdowns. The appropriate supply chain for these products should emphasize predictability and low cost with performance indicators such as

- High average utilization rate in manufacturing
- Minimal inventory with high inventory turns
- Short lead time (consistent with low cost)
- Suppliers chosen for cost and quality
- Product design that strives for maximum performance and minimal cost.

However, make-to-order functional products, such as replacement parts for customized equipment, usually have long lead times (six months to a year).

Innovative products have unpredictable demand, relatively short life cycles (three months for seasonal clothing), many variants in each category, and high contribution margins of 20 to 60 percent. They have average stockout rates from 10 to 40 percent, end-of-season markdowns in the range of 10 to 25 percent of regular price, and a margin of error on forecasts of 40 to 100 percent. However, the lead time to make them to order may be as low as one day and generally is no more than two weeks. Maintaining fast lead times may require fast and more expensive modes of transportation.

The supply chain for innovative products should emphasize market responsiveness rather than physical efficiency, with performance indicators such as

- Excess buffer capacity and significant safety stock of parts or finished items
- Aggressive reduction of lead times

- Suppliers chosen for agility: speed, volume and production run flexibility, and quality (rather than cost)
- Modular design that postpones differentiation as long as possible.

Innovative products, with their high margins and unpredictable demand, justify the extra expense for holding costs. (Fisher also proposes, however, that manufacturers of innovative products can look for other solutions to the problem of unpredictable demand, such as aggressively reducing lead times and producing products to order rather than for inventory.)

What happens when a product can fall into either category? Fisher says that some products can be either innovative or functional. Automobiles fit that description, with a low-priced, no-frills car like a base model Chevrolet Spark representing the functional end of the spectrum and a Porsche representing the other end. Similarly, coffee can be functional or come from a high-end coffee shop, with the customer experience and the quality of the product being differentiators.

Writing in Harvard Business School's *Working Knowledge*, Jonathan Byrnes, a professor at MIT, asserts that one supply chain is not enough; two, three, or more would be preferable. "One size fits all" supply chains may have been sufficient in the past, he believes, when that was the competitive norm, but advancements in information technology make it possible to have multiple, dynamic supply chains that can accommodate different product and information flows.

Byrnes breaks products into three categories: staples, seasonal products, and fashion products.

- **Staples** (which are much like Fisher's functional products) have steady, year-round demand and low margins. White underwear is an example. Byrnes advises stocking staples only in retail outlets in small quantities and transporting them in truckload quantities. A full truckload is more cost-effective for the shipper than a partially loaded vehicle.
- **Seasonal products** could include outdoor patio furniture, holiday décor, etc., for which the demand is more predictable since it is tied to the holiday or season.
- **Fashion products** are like Fisher's innovative items, with unpredictable demand. Zara, the Spanish clothing brand, has two supply chains, one for staples and the other for fashion clothing. To get the fastest response time, Zara uses European suppliers for the fashion items. But for the more predictable demand items, it uses eastern European suppliers that are known to have poor response times (not a concern) and lower cost.

In addition to varying the supply chain by product type, Fisher recommends several other variables to consider—store type, seasonality, and product life cycle. Demand varies considerably over the life cycle of many products. The same item might have infrequent demand at first, more stable demand in its maturity phase, and falling demand at the end of its life cycle. With more than one supply chain, the

nucleus company can move its products from one chain to the other in response to changing variables, such as type of channel, seasonal needs, or life cycle stage.

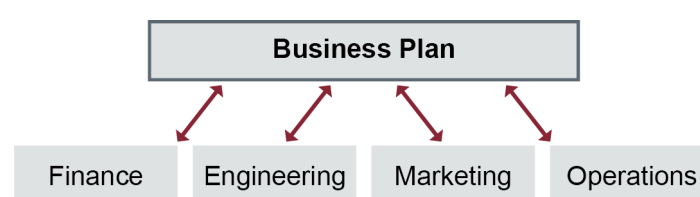
Business Plan

Business and organizational strategies are formalized and clearly specified within an organization's business plan. A business plan is a written document that describes the overall direction of the company and what it wants to become in the future. The *APICS Dictionary*, 16th edition, defines a **business plan** in part as follows:

A statement of long-range strategy and revenue, cost, and profit objectives usually accompanied by budgets, a projected balance sheet, and a cash flow (source and application of funds) statement. A business plan is usually stated in terms of dollars and grouped by product family. The business plan is then translated into synchronized tactical functional plans through the production planning process (or the sales and operations planning process). Although frequently stated in different terms (dollars versus units), these tactical plans should agree with each other and with the business plan.

The business plan provides general direction regarding how the company plans on achieving its long-term objectives. Key functions such as finance, engineering, marketing, and operations typically have input into the plan. As illustrated in Exhibit 8-3, the overall business plan cascades down to those same functions.

Exhibit 8-3: Impact of Business Plan



The finance function manages and tracks the sources of funds, amounts available for use, cash flows, budgets, profits, product profit margins, and return on investment. Engineering is responsible for research and development and the design and redesign of products to meet requirements. Marketing's focus is on analysis of the marketplace and how the company positions itself and its products. The goal of operations is to meet the demands of the marketplace via the organization's products. Operations also manages the manufacturing facilities, machinery, equipment, labor, materials, and procurement as efficiently as possible. These functional roles collectively support the success of the supply chain.

The business plan is based on and aligned with the business strategy and with market requirements. It provides a framework for the organization's performance objectives that are tied to strategic goals. Formation of and changes to the business plan come from top management's modifications to the business and organizational strategy. However, just because an organization invests time in developing

and documenting a strategy, the selected strategy may or may not be the best fit for an organization's actual capabilities and actual business environment.

One way to determine how well a strategy fits an organization is to use Porter's five fundamental elements. After that the various components of the business plan are discussed: value proposition, core competencies, cost structure, and revenue model.

Porter's Five Fundamental Elements

Michael Porter, in his influential work on business strategy, *Competitive Advantage*, argued that an organization's "fitness" for a given competitive strategy relied on choices related to five fundamental elements of any business. (Note that these are not Porter's famous "five forces" but rather areas that need to be aligned to support a given strategy.)

- **Customer service.** The accuracy, flexibility, and speed of responses and deliveries.
- **Sales channels.** The allowed methods of placing an order for goods or services.
- **Value system.** The value-added activities that the organization—and the supply chain partners—will provide. This requires specifying the core competencies the organization will pursue and that other supply chain partners will pursue to add value.
- **Operating model.** The way plan, make, source, deliver, and return operations are arranged to meet working capital and cost objectives at the proper level of customer service. Make-to-stock, make-to-order, assemble-to-order, and engineer-to-order are types of operating models.
- **Asset footprint.** The scope and location of owned and leased property, plant, and equipment; information systems and infrastructure; cost, distribution, and skill levels of human resources; and access to capital.

The idea here is to put the proper emphasis on each element. Rather than isolating the decisions regarding each element, which could lead to suboptimization and conflicting goals, planning for all of these business elements should be integrated to develop a cohesive strategy.

Value Proposition

The organization's value proposition is the set of activities considered valuable by the organization's customers. The value proposition may also explicitly discuss the value provided by supply chain partners.

The *APICS Dictionary*, 16th edition, defines **value** broadly as "the worth of an item, good, or service." While this merely shifts the discussion from the meaning of value to the meaning of worth, note how value includes both goods and services. A related concept that is fundamental to supply chain

management is value added. Adding value to a good or service is the responsibility of each entity and process in the supply chain. The *Dictionary* defines **value added** in manufacturing terms as

the actual increase of utility from the viewpoint of the customer as a part is transformed from raw material to finished inventory; the contribution made by an operation or a plant to the final usefulness and value of a product, as seen by the customer. The objective is to eliminate all non-value-added activities in producing and providing a good or service.

The value proposition shows how the organization plans to emphasize each of Porter's five fundamental elements and thus provide the added value as defined by the customer in terms of customer service, quality, increase in utility for the price, and so on. The value proposition is a relative assessment of what is value-added. An operation or process adds value if it does so better, faster, and/or at a lower cost than the available alternatives. Thus it is benchmarked against competitors and third-party service providers. This analysis can help the organization validate its core competencies and the value of the products or services rendered by others.

Core Competencies

An organization's core competencies can be analyzed best by breaking the necessary functions and activities down into categories. (The subcategories shown leverage SCOR® processes.)

- Decision-making activities
 - Planning
 - Enabling
- Execution activities
 - Sourcing
 - Making
 - Delivering
 - Returning

Some organizations choose to retain the decision-making activities and outsource some or all of the execution activities to organizations that can leverage lower-paid workers or other competitive advantages. Other organizations retain certain portions of execution activities to meet quality objectives. For example, an organization could do its own purchasing and get bulk discounts while controlling quality levels but then outsource the final assembly of the product to a third party who is responsible for final quality and lead time at a lower manufacturing cost.

Core competencies generally fall within one or more areas of competitive advantage:

- Economy-of-scale advantages allow high utilization of assets at a low per-unit cost. This can involve bulk purchasing, high-capacity production with long runs, large-quantity shipping, or a large customer base.

- Geographic expertise or capacity advantages take the form of regional networking, business associations, language and culture expertise, or regional economies of scale.
- Technology advantages include proprietary technologies that would be cost-prohibitive to develop or license.
- Resource advantages include currently available labor, expertise, materials, or financing that would take time and effort to develop.

Cost Structure

An organization's cost structure will be influenced by its operating model, asset footprint, capacity, customer service levels, technology investments, market labor prices, and so on. Of these, the operating model and the asset footprint most strongly influence cost structure.

The cost structure of various operating models differs significantly:

- Make-to-stock has low production costs but high inventory carrying costs. This model is best for standardized, high-volume products.
- Assemble-to-order (modules are made to stock but the final customer order is assembled only after being ordered) has moderate production costs and low inventory carrying and planning costs. This model is for moderate- to high-demand items with many options, such as computers.
- Make-to-order has high production costs but low inventory carrying costs and low planning costs. This model is for items that have sporadic demand patterns or that come in a wide variety of configurations or options.
- Configure-to-order (mass-producing items that can be configured after being ordered) is a short lead time extension of make-to-order that has moderate production and inventory carrying costs. It is used when it would take longer to assemble the item than the customer is willing to wait. Delivery times can be reduced and customer experiences tailored.
- Engineer-to-order (e.g., construction of a building) has production and inventory costs that can be initiated after payment is agreed upon.

The asset footprint is the number, location, and size of the organization's property, plant, and equipment (PP&E) and the regions or countries in which the organization operates. While minimizing such assets is good for an organization's balance sheet, the footprint needs to be large enough and capable enough to handle the required capacity of each type of activity in the supply chain. In addition to these physical assets, a supply chain asset footprint can also refer to soft assets, such as the location of various functional areas or teams such as a purchasing team. The goal of footprint optimization is to determine how much of each type of asset is needed in total and then to decide where to locate them to enable targeted customer service levels. There are several models for how these costs can be configured.

- With a global asset footprint, all production for a good or service takes place at one set of locations for distribution globally. This model increases economies of scale and minimizes unit production costs. It is best for items that require highly specialized expertise and are capital-intensive. There will also be a cost to address business interruption risk.
- With a regional asset footprint, production and sales are localized by region. This cost model is best when transportation costs or time are a significant part of the decision. Products can also be produced to meet regional requirements. Different types of products can be made in different regions for some cross-swapping of products.
- With a country-specific asset footprint, production and sales are localized by country. This model is best when transportation costs or time requirements are prohibitively high relative to the sale price/weight of the good. Avoidance of duties and tariffs or compliance with a country's local sourcing regulations can be other reasons for using this model.

The decisions regarding what to own and what to source through contracts will have a large impact on the organization's cost structure. In addition, some areas have tax incentives to attract business while others have higher taxes. Tax optimization is an area for specialists who can provide valuable input to related cost discussions.

Revenue Model

A revenue model is the organization's plan for how it will earn more revenue than its expenses and thus earn a profit. A revenue model considers the sales channels that the organization will employ to sell the good or service. Channels can be direct or indirect, that is, from a dedicated sales force or web page or through intermediaries such as distributors or retailers. Each sales channel will have different profit margins, depending on the cost of setting up and maintaining that channel and the amount of profit that each supply chain partner retains. Customer segmentation and customer profitability are the primary decision points regarding which channels to maintain and promote for which customers. Other decisions related to the revenue model include who receives goods or services when demand outstrips supply and whether to offer channels that directly compete with one another, such as a self-service vending machine or website versus a retail store.

Supply Chain Strategic Objectives

With supply chain management, the functions of planning, buying, manufacturing, delivering products, and being paid have evolved from control of discrete business functions to an emphasis on business process excellence and the management of a network of relationships tied together by complex information flows. Achieving the benefits of supply chain management requires strategic planning to master the connected processes.

The objectives of planning and implementing a sound strategy for supply chain management practices, systems, and technologies include

- Improving market knowledge
- Implementing the three Vs—increased velocity, increased visibility, and reduced variability in the flows of goods and services, funds, and information
- Streamlining operations
- Improving risk management
- Increasing sustainability.

Improving Market Knowledge

With supply chain management strategies in place, partners in the supply chain begin to share their knowledge about the marketplace and customers. It may take some time for the organizations to build trust before they share their account information. After the initial setup expense, data shared between partners can be an inexpensive and invaluable source of information on customer demand.

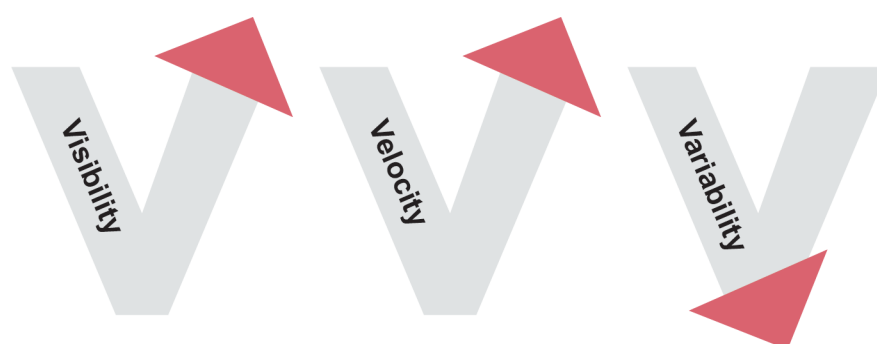
There are myriad sources and documents containing valuable customer information that can be shared between supply chain partners, including transaction records, customer survey results, sales and service representative knowledge, and information from distribution points such as retailers, internet sites, or kiosks.

If this kind of market information is not forthcoming from a supply chain partner, another option is to purchase data from survey companies and database marketing companies. Service or finance bureaus can provide broad information about the customer pool. As opposed to data from partners, such data do not necessarily paint a picture of a business's own customers. Purchased data may be more useful in acquiring new customers than in managing relationships with existing customers.

Implementing Three Vs

Often called the three Vs of supply chain management, visibility, velocity, and variability are key elements of successful supply chain strategy. No matter what the competitive priority, the goal of supply chain management is to increase visibility and velocity while reducing variability, as seen in Exhibit 8-4. The future of supply chain management lies in continued pursuit of that goal.

Exhibit 8-4: Three Vs



Increased Visibility

According to the *APICS Dictionary*, 16th edition, **visibility** is

the ability to view important information throughout a facility or supply chain no matter where in the facility or supply chain the information is located.

Increased visibility along the supply chain is a benefit for supply chain partners and the end customer. With better visibility, a supply chain manager or employee can see the results of activities occurring in the chain and is made aware of minor, incremental changes via technological processes. For example, point-of-sale data may be “visible” to computers in warehouses, the manufacturing plant, and suppliers’ facilities. Data about a sale can instantaneously trigger appropriate actions in all those places automatically. Shipments are scheduled from the warehouse to replenish the retailer’s shelves, manufacturing produces another unit, and suppliers release parts to the manufacturer. With all these actions prompted automatically and instantaneously by technology, the supply chain partners can realize savings in cost and time. Better visibility has resulted in greater velocity.

Increased Velocity

The flows of physical materials and services, cash, information, and returns (or the reverse flow) of products for repairs, recycling, or disposal benefit from being increased in speed and efficiency. Supply chain management impacts the velocity of these four flows in a positive manner. According to the *Dictionary*, **velocity** is

a term used to indicate the relative speed of all transactions, collectively, within a supply chain community. A maximum velocity is most desirable because it indicates a higher asset turnover for stockholders and faster order-to-delivery response for customers.

Velocity, like visibility, is enhanced by good supply chain management. Methods of increasing the velocity of transactions along the supply chain include

- Relying on more rapid modes of transportation (if there is a net benefit after the increase in transportation costs)
- Reducing the time in which inventory is not moving (idle, queue, wait time, etc.) such as by using Just-in-Time delivery and lean manufacturing (The less time inventory spends at rest, the less likely it is to suffer damage or spoilage. Increased velocity reduces the expenses involved in warehousing inventory.)
- Eliminating activities that don’t add value, thus reducing the time required to accomplish supply chain activities
- Speeding up the flow of demand and cash as well as the velocity of inventory. (The more rapidly payments are received from customers, the sooner the money can be put to work in the business or invested. Information about demand changes is crucial when the competitive strategy is responsiveness.)

Reduced Variability

Variability is the natural tendency of the results of all business activities to fluctuate above and below an average value, such as fluctuations around the average time to completion, the average number of defects, average daily sales, or average production yields.

Supply chain management works to reduce variability in both supply and demand as much as possible. The traditional offset against variability is safety stock. If greater visibility along the chain results in greater velocity, supply chain managers should also be able to reduce the amounts of safety stock required to match supply to spikes in demand. As the demand signal speeds more rapidly up the supply chain, distribution and production can get off to a faster start to meet the demand.

Demand variability has many causes, but a primary cause that can be minimized is the bullwhip effect (an extreme change in the supply position upstream that is generated by a small change in demand downstream in the supply chain). Inventory can quickly move from being backordered to being in excess due to the serial nature of communicating orders up the supply chain with the inherent transportation delays of moving product down the supply chain.

Supply variability typically increases in waves down the chain, starting with small amounts at the resource extraction sites and culminating in the largest amounts at the retail end of the chain. For example, any variability in the supply of a raw material, such as an agricultural product that is dependent upon fluctuating growing conditions, can result in even more widely fluctuating purchase orders for that raw material from buyers down the supply chain. A shortage in supply during one period may result in overpurchasing in the next period, with the excess accumulating in warehouses as safety stock. Buyers depending upon the supply will increase or decrease their purchase orders to reflect the variability of materials, parts, and products available to them, while variability increases at each point in the chain. The accumulating excesses can in turn trigger underpurchasing. Supply chain managers use visibility, velocity, and other supply chain tools such as strategic buffers to manage supply variability.

Additional Vs

Supply chain managers should attend to some other Vs, including vocalization, variety, and volume.

Vocalization refers to the need to have good communications between supply chain partners as a vital way to prevent the bullwhip effect rather than just assuming that current orders will form a reliable pattern.

Variety refers to the mix of products and services in a portfolio that must alter to meet changes in customer demand. Too much or too little variety can both be bad.

Volume is the amount of product being produced in a given time. A supply chain must be flexible enough to expand and contract volume to meet changes in demand for mass-customized products and services.

Streamlining Operations

Achieving the benefits of supply chain management requires mastery of connected processes. As supply chains evolve, their ability to streamline key operational processes and flows also increases.

With good supply chain management, the day-to-day functioning of the organization is smoother, with fewer process-related operational issues, because the organization is adept at

- Identifying each partner and step in the supply chain
- Identifying bottlenecks or problem areas in the supply chain
- Identifying and removing or simplifying unnecessary steps or those that do not add value for customers or partners
- Knowing who is responsible for each substep or task within a larger process and how it impacts the supply chain's performance and output
- Identifying processes that are interdependent and knowing how a change in one will affect another.

The benefits of streamlined operations are felt enterprisewide and across functions in the form of increased velocity of cash, information, and physical materials and services in the supply chain.

Improving Risk Management

With supply chain management, the organization develops a risk management strategy and plan in advance that describe how it will address supply chain vulnerabilities by avoiding, accepting, transferring, or mitigating risk. Managing risk proactively gives an organization an edge over its competition in a number of ways:

- It helps keep the supply chain flexible so that it can continue functioning despite disruptive events, which in turn helps balance the costs of contingency planning against the potential economic, facility, resources, and inventory losses.
- Risks are shared among supply chain partners who will be prepared to work in concert and play their parts responsibly.
- Risk planning arms employees and supply chain partners with valuable, actionable information and confidence to handle most situations with a well-thought-out strategy driven by the risk data.

With a risk strategy and plan in place, supply chains typically improve their chance of keeping material, information, and payments flowing through the network and arriving in the right number, time, and condition even if a risk event occurs.

Increasing Sustainability

Sustainability goals can create corporate obligations that go beyond the traditional emphasis on bottom-line profits. Sustainability can include social and environmental goals, but all solutions also need to meet economic goals such as by being cost-effective.

For a social example, improving working conditions and promoting a healthier working environment will help make the workforce more sustainable. Investments in this area can reduce related risks and costs, such as those from absenteeism.

For an environmental example, organizational (and consumer) practices rely upon energy derived from fossil fuels that cannot be sustained beyond the availability of such energy resources. Supply chain management incorporates sustainability efforts such as replacement of resources as they are used (as in the planting of seedlings as part of forest management), upgrade of assets to more efficient versions, and increased reliance on wind and solar energy to power manufacturing processes.

Topic 2: Supply Chain Strategic Value and Optimization

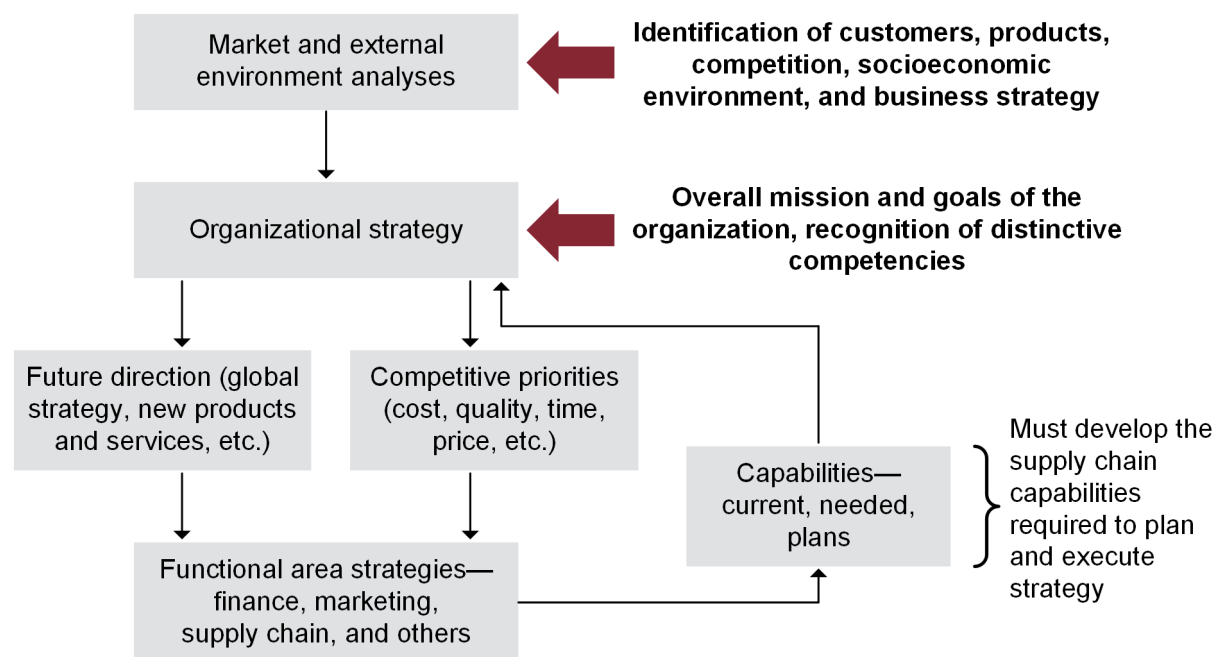
Following a predetermined strategy-setting process can help ensure that the supply chain strategy aligns well with the organizational strategy. Creating a stakeholder value proposition is a critical way to set supply chain objectives. It can involve analysis of value chains and value stream mapping as well as analysis of different types of stakeholders to see what they value. Given clear objectives, the next steps are to assess the current state of the supply chain in terms of value propositions and core competencies and then set a complementary cost structure, revenue model, and tax strategy. To keep a supply chain strategy relevant, it is important to regularly identify and remove misalignments or gaps, so this is discussed last.

Alignment of Organization and Supply Chain Strategies

A supply chain's overarching goals are to provide customers with goods and services when and where they want them, at a competitive price, to remain consistent with the strategies of the organization and the extended supply chain, and to ensure that the supply chain is globally competitive. Time, distance, and collaboration are the basic elements in modern supply chains that impact the chain's ability to respond to competitive changes in the global marketplace.

Exhibit 8-5 shows the strategic decision-making process flow that goes into aligning organizational and supply chain strategies.

Exhibit 8-5: Aligning Organizational and Supply Chain Strategies



This flowchart shows that

- The organization's market and external environment analyses identify relevant customers, products, competition, and socioeconomic environment issues.
- Management uses these analyses to derive the organization's mission and overall goals to support those factors. The organization needs to identify and leverage its core competencies and note areas where it lacks expertise, since those capabilities might be outsourced.
- Organizational strategy drives the organization's future direction and competitive priorities.
- These in turn drive functional area strategies, including those for the supply chain.
- Supply chain strategies drive the supply chain capabilities of the present, the immediate future, and the long term.
- These supply chain capabilities feed into a continuous loop and help the organization determine how to continuously adjust its competitive priorities of cost, quality, time, and price to support its dynamic organizational strategy.

Once the supply chain strategy exists and there is confirmation that it is properly aligned with organizational strategy, the organization will monitor and control the strategy to ensure that it is still appropriate. Being flexible and changing the supply chain strategy when circumstances warrant taking a new direction keeps the strategy alive.

Supply chain strategies need the same elements as an organization's business model, and these are explored in this general content area: value proposition, core competencies, cost structure, and revenue model.

Supply Chain Value Proposition

Like the organization's overall value proposition, a supply chain strategy needs to show how it will create value for the organization. Supply chain management, like any other type of business

management, aims to create value through financial benefits and provide value to customers and other stakeholders by upholding the ethics of customers, stakeholders, and community.

The goal is to add value at each step regardless of whether this is a service-oriented or manufacturing-oriented supply chain. This value can take the form of utility versus price, but other factors like availability or attractiveness also matter.

A key way to determine what is and is not value-added is to use value chains and value stream mapping. After discussing these concepts, we address how different types of stakeholders have different types of things they value.

Value Chains and Value Stream Mapping

Although many would assume that a supply chain is, in fact, a value chain—at least if well managed—others may draw a distinction between the two. According to the *APICS Dictionary*, 16th edition, the **value chain** is made up of “the functions within a company that add value to the goods or services that the organization sells to customers and for which it receives payment.” A supply chain then strings the value chains of each entity together to satisfy market demands for specific products or services.

Value chains integrate a variety of supply chain activities throughout the product/service life cycle, from determination of customer needs through product/service development, operations, and distribution. The intent of a value chain is to increase the value of a product or service as it passes through stages of development and distribution before reaching the end user.

Not all value chain activities are technically part of the supply chain, and persons engaged in these activities may not understand their role in supporting the supply chain. Those activities might include engineering, marketing, finance, accounting, information technology, human resources, and legal. Managers from outside the supply chain often don’t understand the requirements of supply chain management, can’t distinguish a value chain from a supply chain, and consequently don’t provide the supply chain management support required from their areas.

Two closely related terms are value stream and value stream mapping.

As defined in the *Dictionary*, a **value stream** is

the processes of creating, producing, and delivering a good or service to the market. For a good, the value stream encompasses the raw material supplier, the manufacture and assembly of the good, and the distribution network. For a service, the value stream consists of suppliers, support personnel and technology, the service “producer,” and the distribution channel. The value stream may be controlled by a single business or a network of several businesses.

A value stream encompasses all the primary actions required to bring a product or service from concept to placing it in the hands of the end user. It also includes timing. Mapping the stream aids in process

improvement.

Value stream mapping is defined in the *Dictionary* as

a lean production tool to visually understand the flow of materials from supplier to customer that includes the current process and flow as well as the value-added and non-value-added time of all the process steps. [It is] used to lead to reduction of waste, decrease flow time, and make the process flow more efficient and effective.

Exhibit 8-6 shows a basic process flowchart for a supply chain used to show the as-is state of a process, and Exhibit 8-7 shows how an organization can apply value stream mapping to find the most effective production flow for that supply chain process in a to-be state for the process.

Exhibit 8-6: As-Is Process Flowchart Example

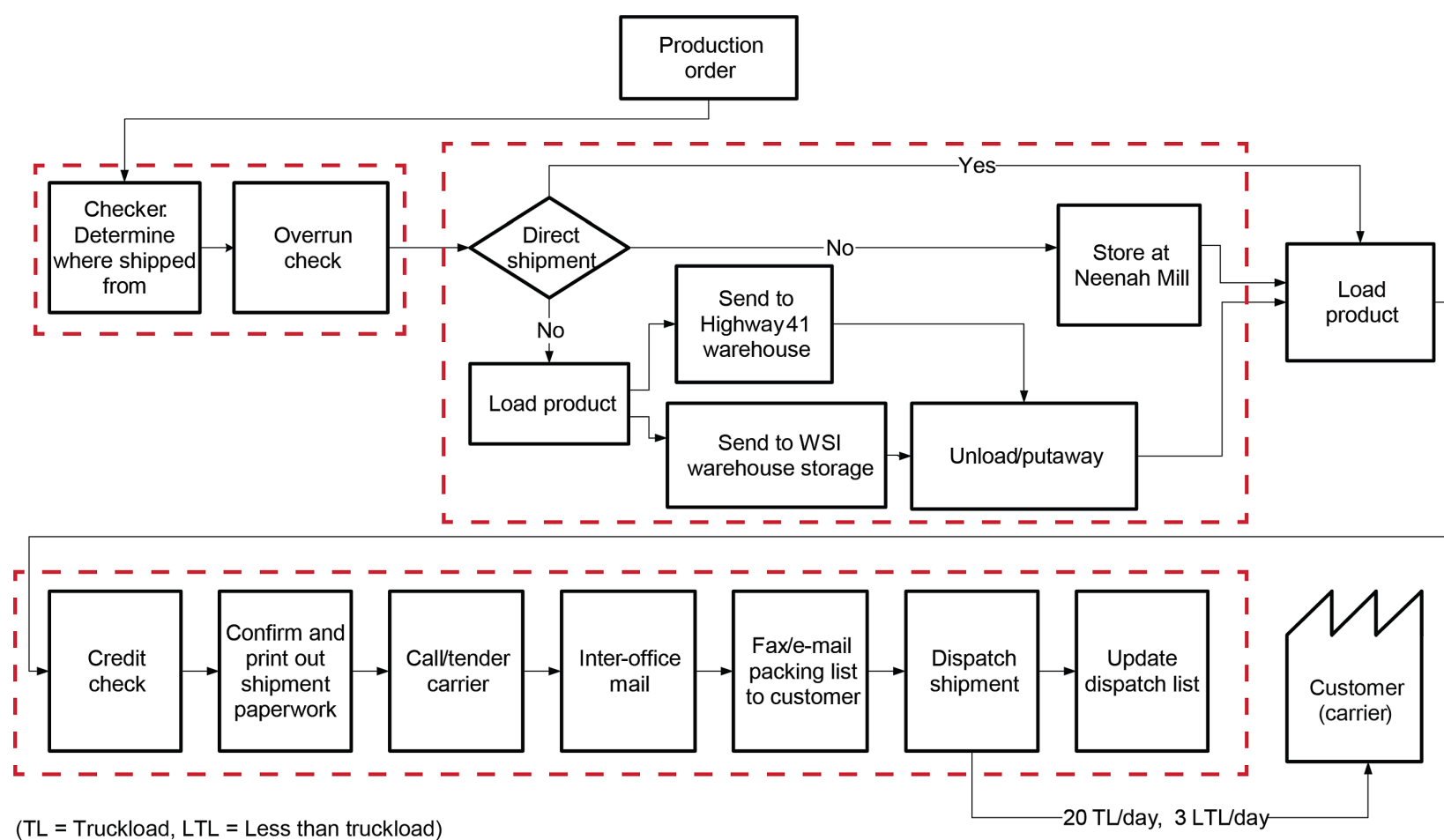
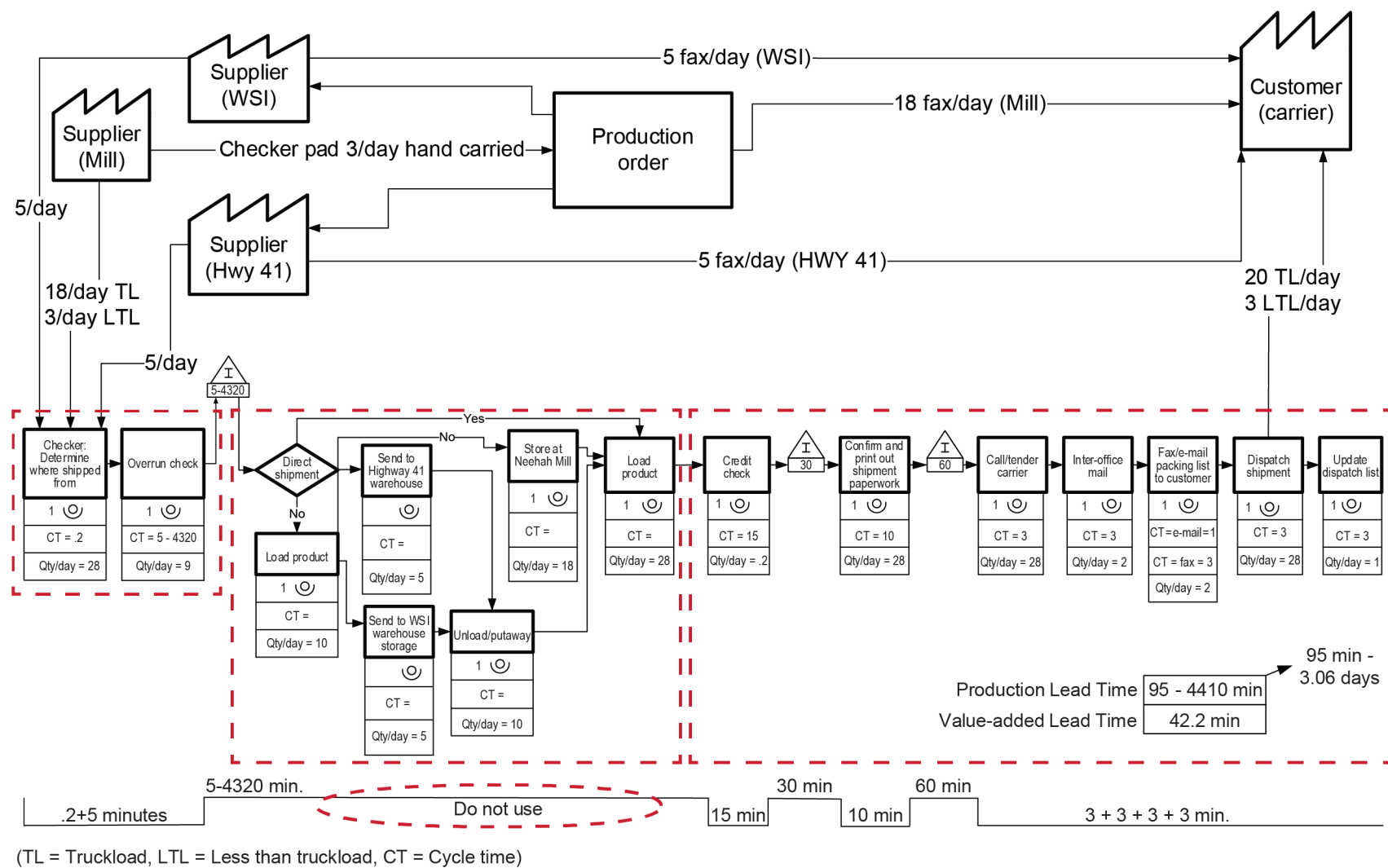


Exhibit 8-7: Value Stream Mapping Example: To-Be State



Stakeholders and Value

When planning any new supply chain activity or monitoring continuing practices, it is important to identify all the stakeholder groups and determine the impact the activity will have on each one.

The primary stakeholder in any business activity is the organization itself. It must be profitable to survive and create value for any other stakeholder group.

Customers are also significant stakeholders in supply chains. In addition to the consumer of the ultimate good or service, each downstream organization is a customer, who must create value for itself and its customers. Each intermediate customer has their own view of the potential value of any particular activity, though the ultimate customer is the true decider. For example, a supplier may decide to increase profits by raising the price of goods sold to its downstream supply chain partners. If this drives up the ultimate price to the consumer, a reduction in sales volume may reduce overall profit despite the higher profit margin. The end result of each partner's activities must optimize value for the supply chain as a whole.

There are also stakeholders that are external to the supply chain's business partners and end customers. These include investors, lenders, communities, and governments.

To investors and lenders, supply chain value may be defined as capital growth, dividend income, or interest payments and eventual return of invested capital. Investors expect returns to be equal to or greater than those that could be earned from a market investment of similar risk.

Communities and local governments may also feel the impact of supply chain operations because they affect community members and their environment. The location of a retail outlet, warehouse, or other supply chain facility will impact the community where it is built and maintained. The community, and its political leadership, may judge this impact to be a positive value (e.g., jobs) or a detriment (e.g., pollution or noise).

Stakeholders usually have different views of what value a supply chain should create, and supply chain activities that are beneficial to one stakeholder group can be harmful to another. So managing a supply chain successfully sometimes requires balancing increases in value for one stakeholder with decreases for another. Everyone must be satisfied enough to continue participating. Customers have to keep buying, investors have to keep investing, workers have to keep showing up and giving their best, communities must be satisfied with each supply chain partner’s impact on social and environmental values, and so on.

Exhibit 8-8 lists typical supply chain stakeholders and the types of things each typically values.

Exhibit 8-8: Supply Chain Stakeholder Values

Supply Chain Stakeholders	Stakeholder Values
Companies in supply chain	Profit margin, market share, revenues, expenses, image and reputation
End customers	Affordable, safe, attractive, useful products; affordable, timely, secure, easy, pleasant services; sustainable manufacturing practices
Investors	Return on investment (capital growth, dividend income), comprehensive and comprehensible communications
Lenders	Risk commensurate with reward, long-term stability, interest and return of principal
Communities/ environment	Tax base enhancement, sustainable manufacturing practices, environmental impact (safety, aesthetics, convenience, natural resources), attractive jobs
Governments	Legality, regulation, overall impact on community members and environment
Employees	Job security, wages and benefits, opportunity, good working conditions, sustainable and safe manufacturing processes

Types of Value

Supply chains should create three types of value—financial, customer, and social—regardless of whether they are functioning within for-profit companies; nonprofit, charitable, or governmental organizations; or branches of the military.

Financial Value

Adding value that customers desire promotes increased sales, which can lead to an improved bottom line and more stable cash flows.

One method of increasing financial value is to reduce costs. Take these considerations into account when looking for opportunities to cut costs in a supply chain:

- **Cut costs to yield net gains at the bottom line.** One danger in pursuing cost reductions is the possibility that spending less in one area of the business will simply mean spending more elsewhere or even possibly creating a net loss. In the early stages of supply chain maturity, this sort of suboptimization happens often. The warehouse manager might, for example, eliminate one or more storage facilities to save warehousing costs without consulting with the traffic manager about the need for compensating changes in transportation.

A more evolved supply chain management function (possibly outsourced) analyzes relevant data, including data on demand and transportation cost, to derive the appropriate size, location, and number of warehouses using inventory optimization software. (The *APICS Dictionary*, 16th edition, defines **inventory optimization software** as “a computer application having the capability of finding optimal inventory strategies and policies related to customer service and return on investment over several echelons of a supply chain.”)

Changes at any one point in the system will create changes elsewhere; therefore, change has to be viewed holistically. Supply chain management necessitates cross-functional teamwork for the internal change and cross-entity teamwork for the lateral chain. The guiding principle always has to be creation of value at the customer’s end of the chain. If a leaner supply chain can deliver the same customer satisfaction with a greater profit, then cost cutting is justified.

- **It takes money to make money.** Many of the improvements in supply chain performance require investments of money up front to realize greater revenues, profits, or both down the line—or simply to remain competitive on a global playing field. As always, the end result has to be a net gain. If an improvement in the supply chain brings in more revenue than the cost of the investment, then it’s justified. Purchasing automated machinery to improve warehousing, upgrading hardware and software, training managers in team building, and other investments may be necessary to build and maintain a competitive supply chain.

Measures of financial success include **return on investment (ROI)** and **return on assets (ROA)** . ROI is defined in the *Dictionary* as “a relative measure of financial performance that provides a means for comparing various investments by calculating the profits returned during a specified time period.” ROA is defined as “net income for the previous 12 months divided by total assets.”

- **Gains should be equitably distributed.** Be careful when pursuing increases in supply chain efficiency or effectiveness that are unevenly distributed to stakeholders. If cost cutting is used to cut prices for the consumer and the result is enough extra volume to more than compensate for the lower price per unit, then overall profits increase for the organization, other supply chain partners, and their investors. However, one can go too far in this regard. While most of these cost savings should be

passed on when selling price-sensitive products and services in a market that has other low-cost competitors, even in this case, some of the savings should be shared with partners and/or reinvested in future supply chain improvements.

Perhaps the most challenging task of all in a supply chain is agreeing on productive sharing of any financial gains. For instance, a powerful nucleus firm can rake in the benefits of an alteration in the location of inventory (or any other process change) at the expense of its suppliers. This can be self-defeating if it drives away quality suppliers. Teamwork among supply chain entities can create improved value for customers for a net financial gain that is equitably shared by all stakeholders.

Maintenance and upgrades to the supply chain's infrastructure require continuous reinvestment. Equipment and technology need to be acquired and maintained. Employees have to be compensated at a competitive rate, trained in new processes and products, and recognized for their contributions. Research and development need support in identifying market needs and creating products and services to satisfy them.

Customer Value

In a competitive economy, making money depends upon responding to customers' needs. The ultimate goal of market-driven supply chain management, therefore, must always be to deliver products and services that the customer values—and, of course, will pay for.

Depending upon the market being served, a supply chain may be managed so that it delivers one or more of these values to its end customers:

- **Quality of product or service.** Quality applies to all products and services, from the production of a product like a bed mattress to the reliability and speed of cellular network services. Decisions all along the supply chain have to be coordinated to achieve the appropriate level of quality through the right design, the right production, the right personnel, and the right materials.
- **Affordability.** Almost all products and services have an appropriate price level, one to which the market will react favorably. The supply chain has to invest in the processes, people, and technology conducive to creating a product at the right price. If a company's marketing strategy is to provide the best everyday low price, this demands complete efficiency in the supply chain. Supply chain managers who are operating with those types of goals must develop collaborative design processes so that products are inexpensive to source, easy to ship, and have few quality issues.
- **Availability.** For some products or customers, availability is of paramount value and the supply chain has to be designed to deliver products and services right on time. This may affect not only the placement of inventories but also the selection of transportation modes (overnight delivery, refrigerated containers, etc.).

- **Service.** Product and service are inseparable. For example, the process of delivering a vehicle to a customer is intertwined with related services—transportation, financing, dealer preparation, sales, warranty agreements, and repair and replacement services at the dealership. Collaborative design will include input from marketing, manufacturing, logistics, and supply to determine a product's service requirements so it will be easy to maintain and can facilitate planned services. At the same time the team will implement an efficient reverse chain that takes products back for repair, replacement, or recycling.
- **Sustainability.** Consumers and customers are a driving force behind environmental and social supply chain innovation. For some individual consumer segments, sustainability is important enough that they will pay a premium for that good or service. (Estimating this premium can be difficult, however.) Opinions for or against a company's environmental practices may be shaped by the media, community groups, environmental organizations, lobbyists, and others who exert social pressures. Boycotts or negative social media campaigns are examples of related reputation risks.

There is no logic in making customers pay for a feature or service they don't value or that isn't required. If, for example, availability is a key value to customers, such as for critical maintenance parts, emphasis in the planning stage might be placed on fast and reliable delivery services, even if that requires cutting back elsewhere to stay within budget. Similarly, some perishable goods require special handling by high-end carriers to reduce spoilage risk. However, if the customer doesn't value immediate availability and the product doesn't require it, then putting money into rapid delivery is not a rational supply chain decision.

An international fashion clothing brand such as Zara succeeds by focusing its attention on its customers' values—creativity, quality design, and rapid turnaround—to capture and quickly deliver the latest trends in taste for each new season. All their decisions about suppliers and distribution must serve those goals.

Social Value

Supply chains are also judged on their contribution to society.

- **Delivering socially desirable and useful products or services.** Supply chains deliver products and services that are embedded in a social and cultural environment. Businesses produce what society demands. Bullet trains in Asia and Europe exist because those societies value speedy public transportation. Supply chains also affect society in terms of the jobs and tax revenues they create.
- **Avoiding or reducing negative environmental side effects from extraction, processing, and construction.** The impact of business on the natural environment applies to supply chain activities all the way from extraction of raw materials through manufacturing processes, logistics, and distribution. Through laws and regulations, society requires businesses to contribute to a healthy environment. Conformance to these regulations has become an increasingly significant part of supply

chain management, including accepting back sensitive materials at end of their life cycles using a reverse supply chain.

- **Integrating sustainability into the supply chain.** Investment analysts often reward forward-looking environmental and social policies and supply chain practices.

Existing Network and Process Evaluation

Information gathered about organizational strategy and about the supply chain's value proposition are inputs into the next step in generating a supply chain strategy: evaluation of the existing network and its processes. You need to know where you are and what you are actually good at before determining what needs to be improved. We'll look at the general capabilities needed in a supply chain and at supply chain core competencies.

General Capabilities

A supply chain strategy needs to specify how it will arrange and prioritize its various capabilities. Every supply chain is made up of organizations, people, processes, and information. Each supply chain's capabilities are based on its

- Organizational design
- Processes
- Systems and technology
- Human resources
- Metrics (measurement techniques).

Evaluating the existing network and processes in these areas involves determining how much priority the supply chain currently places on each of these elements and how mature each area is relative to internal goals or external benchmarks.

Organizational Design

According to the *APICS Dictionary*, 16th edition, **organizational design** refers to

the creation of an organizational structure to support the strategic business plans and goals of an enterprise (e.g., for-profit and not-for-profit companies). Given the mission and business strategy, the organizational structure design provides the framework within which the business operational and management activities will be performed.

Organizational design also encompasses how the organization communicates internally and externally, the chains of authority and responsibility, financial management, and job hierarchy and descriptions. The key question to ask is the degree to which the organizational structure enables or hinders supply chain management.

Supply Chain Processes

Supply chain management covers a series of linked processes. Although management of any one activity or link in the chain may be straightforward, effective supply chain management requires mastery of these connected processes. It is important to assess the maturity level of these interconnections since they are hard to form and keep.

Systems and Technology

Being able to integrate, implement, and manage sophisticated software that can automate complex and numerous transactions involved in supply chain management is a critical capability. Information systems may enable organizations or supply chains to integrate operations at various levels: integrating one plant, partial or full cross-company functionality, or multiple supply chain partner integration.

Many organizations use an enterprise resources planning (ERP) system to provide transactional support for multiple business processes. It is important to assess whether the ERP system enables critical links between strategy and operations and supports the specific supply chain capabilities that a company desires.

When assessing existing levels of partner integration, explore what technologies the organization is using to transfer data between parties, how much automatic identification and data capture technologies are being used to automate the process, and whether the information is being put to use, such as for marketing analysis to gain insight into customer behavior. When making these assessments, review information on each supplier category related to how much you need them and how much they need you to place the current level of integration into context. Some suppliers may need better integration than they currently have.

Making technological advances has challenges, however. Hurdles may include incompatibility of programming languages and different software applications and network protocols. There are also human and organizational barriers that can prevent taking full advantage of available technology. Despite the steady moderation of price and increase in user-friendly electronic linkages, some departments or users may question the usefulness and related costs of technology. New users of this technology have to be trained, and, in some cases, they also have to be converted from a skeptical to an accepting attitude toward new technologies. Change management is therefore critical in implementing technology design.

The most significant assessment to make with partners is to determine the degree to which you trust them and vice versa. Lack of trust among companies along the supply chain and even across functional areas or teams within organizations can undermine integration goals. Trust is built in small increments, so assess what steps each party has taken or plans to take to build trust. Steps that prove effective with one party might be used with other parties.

Human Resources

An organization is significantly impacted by the manner in which it creates and organizes its functions and how the people within the departments manage the business operations and key processes.

Horizontally organized supply chains typically have no unified ownership or management structures (unlike vertically integrated supply chains), but more mature chains may develop cross-functional planning and implementation teams that have executive sponsorship from each organization.

It is also important to assess how much the supply chain management mindset has been embraced at the organization and at partner organizations. Development of supply chain strategy and the control of supply chain processes depend entirely on having the right people in place—people educated in supply chain thinking rather than functional silo thinking. Of necessity, supply chain management sometimes draws upon personnel attached to multiple functions, yet they may be available only part-time to the supply chain team. These functions also need to understand the benefits of supply chain and functional area integration.

The hiring and training programs of the organization and supply chain partner organizations should be assessed to see whether the organizations are acquiring and developing properly skilled, process-oriented, and knowledgeable supply chain specialists to design and monitor supply chain processes. An assessment should also be made as to whether other functions receive some basic level of training on supply chains to sell them on the benefits of supply chain management. Change management may also be needed.

Unlike specialists in traditional functions—production, logistics, procurement, etc.—an organization needs supply chain personnel with expertise that extends beyond deep knowledge of one area or functional discipline. These personnel need to be broadly knowledgeable about the enterprise as a whole and trained in the art of inspiring people to work harmoniously in pursuit of a common goal. People on supply chain teams may represent every function, from procurement to marketing. On occasion, the supply chain manager may need to work as a diplomatic go-between when mistrust and misunderstanding prevent team members from cooperating with one another.

In addition to the multidisciplinary, communication-savvy, holistically oriented supply chain manager, the organization and the supply chain need people with specialized skills to contribute to the success of supply chain initiatives. For instance, a team member with cost accounting or technology expertise comes in handy when planning an initiative. With so much pressure to keep costs low, upgrade initiatives must be skillfully managed to keep costs in line and avoid driving up product prices. Modeling the process in advance with data from supply chain partners can help prove feasibility and speed later implementation.

Finding and developing the level of talent required to manage supply chains requires skilled and knowledgeable human resources management staff. The degree to which human resources policies

support and enable or hinder the integration efforts required of a supply chain need to be assessed. In large organizations with complex bureaucratic structures, the key to improving such policies is to find an executive-level champion.

Supply chain professionals should be able to do the following:

- See the supply chain as one continuous entity made up of linked processes.
- Manage relationships among and between teams to coordinate different temperaments and visions.
- Understand the business model and its alignment with the supply chain.
- Manage costs skillfully for the chain as a whole. (Understand net value.)
- Identify technology requirements such as to provide the entire supply chain with visibility at the required level of velocity (e.g., real-time updates).

Supply Chain Metrics

An organization should have the right set of metrics in place and be capable of measuring these key performance indicators efficiently.

To answer questions such as “How well is the supply chain performing?” or “Is our supply chain helping or hurting corporate objectives?” the answer should include a data-driven component. Here are some ways to benchmark an organization’s past performance:

- Desired performance (to show how close or distant from goals)
- Competitor performance
- Industry average performance (“We’re better than average!”)
- World-class, or best-in-class, performance from any industry for the same activity or process you’re assessing

Quantitative data generally provide the most convincing evidence. When discussing your cash-to-cash cycle, for instance, you might say “We’ve got it down from 50 days to 20, and that’s better than the industry average.”

Organizations can also use a checklist to measure performance. This could include certain activities, types of equipment, technologies, etc. One example is the Oliver Wight supply chain excellence checklist. (Refer to the Resource Center for more information.)

Summing Up

Taken together, the elements just discussed determine the capabilities of organizations within a supply chain. The assessment of existing networks and processes should look for

- Integrated organizational design with a process orientation
- Key supply chain processes in place and functioning at competitive velocity
- Systems and technology sufficiently advanced to tie all processes together and allow the supply network to operate from the same, simultaneously available data

- Educated and skilled employees who have a process focus, can see the end-to-end supply chain as a single entity, and manage accordingly
- Metrics that are in place to assess performance against a relevant standard and locate areas for improvement.

All of these supply chain capabilities should be aligned with one another and with the supply chain strategy.

One major international petroleum company, for example, instituted advanced information technology to convert from a forecast-driven to a demand-driven enterprise. Demand data from filling stations and large industrial customers became available throughout the supply and distribution networks for use in marketing, logistics, planning, and refining. These shared demand data fed into virtually every decision made along the supply chain, from spot-market purchases to scheduling of refill runs. When all supply chain processes operated from the same base of data, the partners functioned as seamlessly as a “virtual network” (as if they were one company).

Supply Chain Core Competencies

An organization’s supply chain management function may excel in certain areas, and these may be core competencies if the function does them better than the competition or third parties could do them. By contrast, things that are not core competencies are things that others can do better, faster, or more efficiently. Core competencies can include tangible elements, such as having a fleet of trucks of the right size plus great truck-routing software, and intangible elements, such as excellent management skills or a high-service supply chain brand image. Determining core competencies involves considering how an organization’s internal capabilities differentiate it from its competition in each of the following key items:

- Adding value to products, such as shorter time to market
- Improving market access, such as providing new market channels
- Building financial strength through increased income and shared costs
- Adding technological strength if there is internal expertise in the use of more advanced software and systems
- Strengthening operations by lowering system costs and cycle times
- Enhancing strategic growth to break through barriers to new industries and opportunities
- Improving organizational skills that facilitate shared learning and insights among management and employees (internally and/or among other partners)

Assessing the current state of what the organization considers to be core competencies can reveal gaps that can be the focus of change initiatives, or research might reveal that more major changes are needed, such as if new service providers now exist who can outmatch the organization’s capabilities.

Organizations leverage their and others' core competencies in order to achieve defined goals and objectives. The following supply chain management objectives are key areas to assess when implementing a business strategy and determining where to invest:

- Excellence in customer service
- Effective and efficient use of systemwide resources
- Effective and efficient leveraging of partner core competencies

Excellence in Customer Service

Customer service, according to the *APICS Dictionary*, 16th edition, is “the ability of a company to address the needs, inquiries, and requests from customers.” It can also be explained as a “measure of the delivery of a product to the customer at the time the customer specified.”

Organizations with a customer service core competency will develop and use their customer service strategy to identify and prioritize all activities required to fulfill customers' logistical requirements at least as well, or better, than the competition does. The strategy should address the fundamental attributes of basic customer service: availability, operational performance, and customer satisfaction. The organization may consider one or more of these areas to be a core competency. The organization may also target the measures that are weak if it wants the overall customer service area to be a core competency. Let's take a closer look at each of these attributes.

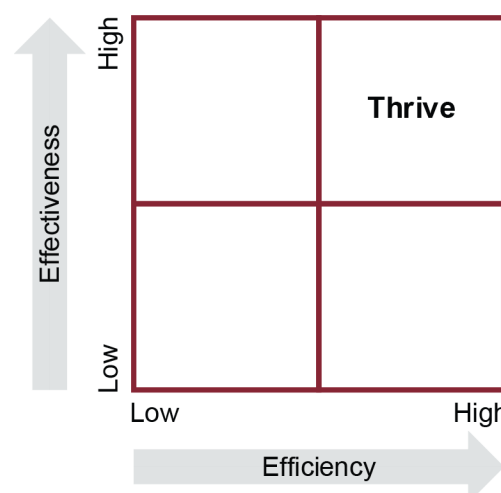
- **Availability** is having the product where and when it is wanted by a customer. Great supply chain management organizations can achieve high levels of availability while keeping investment in inventory and facilities to a minimum. Such an organization is less likely to have products out of stock over time and is more able to ship complete orders. (If a customer order is missing only one item out of several, the order is considered incomplete.) Measures tied to availability include stockout frequency, fill rate, and orders shipped complete.
- **Operational performance** deals with the time needed to deliver a customer order. Great supply chain management reduces the elapsed time from when the customer places an order until the product is delivered and ready for use. Well-designed supply chain management systems might focus on facilitating speedy and reliable delivery at a higher costs; facilitating slow, steady, and inexpensive delivery; or maintaining both as competencies by having multiple supply chains. Another operational performance competency to assess is whether the supply chain is flexible enough to accommodate unexpected or unusual customer requests or shifts in demand. It should also be determined whether there is a sound system for responding to service failures and whether there are contingency plans in place for disruptions.
- **Customer satisfaction** takes into account customer perceptions, expectations, and opinions based on the customer's experience and knowledge. Mature processes include discussing and clarifying customer expectations for an order in terms of quality, price, and delivery. Increases in customer

satisfaction can be evidenced by seeing how many successful long-term customer relationships exist.

Effective and Efficient Use of Systemwide Resources

Effectiveness is doing the right things, and efficiency is doing the things right. Both are needed for an organization or supply chain to have a core competency in its use of resources, and both need to be balanced for the organization to thrive, as illustrated in .

Exhibit 8-9: Balancing Effectiveness with Efficiency



Use of supply chain resources is effective when it helps the organization achieve its business objectives. Resources can be in the form of workers, raw materials, equipment, etc. Being effective means that the supply chain gets the right product and the right amount to the right customer at the right time and price. Effectiveness is measured against the customer's needs and wants—while still meeting cost objectives. For instance, if a supplier encounters a glitch in its normal mode of over-the-road transport of the car parts that it makes for an auto manufacturer, it could still get the order to the customer on time if it sends the parts via air. Air is far more costly, but it contributes to the company's effectiveness in meeting its customer needs, in this case, for a plant that doesn't need to shut down due to lack of parts.

Companies use a variety of tools and metrics to measure effectiveness, such as benchmarking and comparing the company's actual performance against its organizational strategies for growth, increased sales, increased customer satisfaction ratings, or improvements in the metrics of the SCOR framework. Supply chain management enables an organization to be more effective in reaching these types of strategic goals.

Efficiency is defined in the *Dictionary* as

a measurement (usually expressed as a percentage) of the actual output to the standard output expected. [It] measures how well something is performing relative to existing standards.

Efficiency is inward-focused, in that an organization or its extended supply chain looks to its internal processes to determine how the processes can be done less expensively, in less time, and with fewer resources without missing customer service targets.

Efficiency is one of the measures of capacity in a supply chain. Capacity is all about what can be accomplished by employing all the resources in the supply chain network. That includes work centers, storage sites, people, and equipment. An efficient system will have greater capacity than the same system would have with poor efficiency. According to the *Dictionary*, **capacity** has two meanings:

- 1) The capability of a system to perform its expected function.
- 2) The capability of a worker, machine, work center, plant, or organization to produce output per time period.

Supply chain management can increase the efficiency of any mix of manufacturers (or service providers), suppliers, and customers in a supply chain. When a supply chain is operating at high efficiency, it means that it's using its resources well to produce the level of output in a production plan within the time allowed. If it does so while meeting customer service objectives and other key performance indicators, then it is also effective.

Effective and Efficient Leveraging of Partner Core Competencies

If the organization is able to recognize when another organization is stronger in certain core competencies, at least in certain specialized areas or regions of the world, then it will be in a position to leverage these competitive advantages.

If the organization and its partners can achieve more together than they could have individually, then mutual strengths are being effectively leveraged. The selection of the "right" partners means that their corporate cultures, operating styles, and business practices are similar enough for the benefits of an alliance to outweigh the negatives. Well-chosen partners will benefit from a high level of mutual trust, respect of each other's expertise and contributions, and a shared common vision.

In order to leverage a partner's strengths, the organization must identify the partner's core strengths or competencies and reassess them over time. Supply chain management technologies and practices can help a company select the appropriate partners and support them by

- Providing and receiving timely and accurate information
- Helping them deal successfully with channel customers and marketing
- Aiding them in leveraging their strengths, such as innovation, speed, high quality, low cost, etc.

Cost Structure, Revenue Model, and Tax Strategy

A supply chain strategy needs to build off of its value proposition and core competencies to show how it will add financial value. Here we look at how supply chain strategy needs to specify a cost structure, a

revenue model, and tax strategy.

Cost Structure

A supply chain's cost structure (or at least one organization's portion of it) consists of spending priorities for customer service, sales channels, value system, operating model, and asset footprint. Note that what you own or lease will carry a different cost structure from what you contract out, but both methods have related costs. Outsourcing or partnering costs include supervision costs and a reduced share of total revenues as benefits are shared with more partners and service providers.

Like other areas of supply chain strategy, a supply chain's cost structure needs to support the organization's overall cost structure. For example, if the organization chooses low cost as its basis of competition, then the supply chain strategy will tend toward efficiency as its cost structure. An efficient supply chain will have economies of scale, will use third parties whenever the total cost is the lowest, and will minimize more expensive forms of customer service such as expensive sales channels. Even in a make-to-stock operating model, inventory levels will be minimized. This model will not be able to emphasize responsiveness, such as ensuring delivery during an emergency, as high levels of responsiveness come at a high cost.

On the other hand, if the organization has innovation or customer experience as a basis of competition, its supply chain will likely pursue this focus or differentiation competitive basis by investing in responsiveness, so that it can respond quickly to changes in market conditions, transformative technologies, the need to increase capacity (i.e., agility), new competitors, or the incorporation of newly acquired organizations. In this case, the cost structure will not be able to also maximize efficiency in all areas, as some redundancy and scalable capacity may be needed.

Regardless of the strategy, costs will need to be tracked and controlled so that they can be minimized to the extent possible given the strategic goals. Depending upon the type of industry, supply chain costs can be as high as 50 percent of a company's revenues. According to research done by A. T. Kearney, a global consulting firm, inefficiencies in the supply chain can total 25 percent of a company's operating costs, so there is often significant room for improvement.

Spend management is one tool that organizations employ to ensure that outgoing funds are appropriate and authorized. The *APICS Dictionary*, 16th edition, defines **spend management** as

managing the outflow of funds in order to buy goods and services. The term is intended to encompass such processes as outsourcing, procurement, e-procurement, and supply chain management.

Spend management often deals with consolidating internal demand across business functions, divisions, or extended partners and/or consolidating suppliers in a given category to find areas for purchasing and transportation quantity rate discounts. Relative to financial performance, spend

management involves managing the outflow of funds in order to buy goods and services. Spend management may also need to coordinate closely with accounts payable, because payment timing is vital to spend management execution.

If supply chain management can reduce the amount spent on inventory or increase the speed with which inventory is converted into cash without reducing customer service or revenue, then it contributes directly to the company's financial performance. Saving money will always be a priority; organizations realize a more direct gain when costs go down than when revenues go up. This is because when revenues go up all variable expenses also go up. When sales increase, variable costs, such as direct material and labor costs, increase along with the revenue increases. However, cutting, say, one dollar per unit from a cost increases the profit margin by one dollar per unit, so the entire gain is leveraged.

Revenue Model

A supply chain's revenue model will parallel its organizational equivalent. However, a supply chain doesn't directly produce revenue unless the sales channels are included in what is defined as the supply chain. Supply chain strategy can include establishment of sales channels (e.g., warehouses, transportation networks, network partnerships) that do generate revenue. In the past, a supply chain was perceived as a cost center. This mentality led to cost-cutting measures that often compromised value. More modern supply chain revenue models consider the supply chain as a value-added service that earns the organization a share of the revenue it is producing. Supply chain managers need to play a role in justifying supply chain management by promoting it with executives as a value-added function.

Tax Strategy

Supply chain management strategies have an impact on tax planning because multinational organizations often work to reduce the global tax liability of the extended enterprise. Paying less in taxes around the world translates into increased earnings per share.

Organizations that operate internationally can design their supply chains to take advantage of tax regulations in various regions that are designed to lure business to a specific country, region, or local area. This will be just one factor in the decision to move some part of operations to a given area, so the goal will be to find areas with the minimum total supply chain cost. As taxes increase, these advantages tend to play a greater role in the decision. In many cases, the headquarters of an organization may move to one location to minimize income taxes while other supply chain operations move elsewhere to take advantage of operational tax advantages. A tax-aligned supply chain (TASC) is one that weighs taxation among other supply chain costs and challenges.

By aligning tax planning with supply chain efficiency initiatives, an organization might find a location that increases both efficiency and tax savings. This strategy applies for the most part to large, multinational organizations that are in the midst of modifying their supply chains, giving them the opportunity to locate assets and operations in low-tax countries. The World Bank's "Doing Business 2020" includes an

indicator for tax policies by country. A link to this index has been included in the online Resource Center.

Types of Taxes

Various types of taxes might be used as incentives, including property, income, and value-added taxes (VAT). The taxes might be lowered for an area for an indefinite period through a change in tax policy. For example, Ireland was granted a tax advantage for VAT. The tax on the value added in that country is 10 to 12 percent rather than the 20 percent assessed in the rest of the European Union. If considering moving there to save a net of 5 to 10 percent in taxes, supply chain managers need to weigh this savings against other costs, including labor and transportation infrastructure.

Certain taxes can also be eliminated using a tax holiday, which waives taxes on specific inventory, property, plant, or equipment for a temporary or indefinite period.

Procurement and Taxes

When rethinking procurement strategy, multinational corporations may decide to set up a central, global procurement and sourcing center to create efficiencies from consolidation of staff and equipment. If, in addition, the company locates the facility in a low-tax region, the tax savings will magnify the savings from efficiencies of scale. If a centralized procurement facility is created, it could also reduce tariffs, another type of tax.

Taxes and Logistics Networks

Some organizations review their logistics networks every five years or so to see if they can find ways to improve the efficiency or effectiveness of product flows. While they're cutting lead times, reducing manufacturing costs, and shaving transportation outlays, they can also reduce their global tax liability by closing facilities in high-tax jurisdictions and moving them to countries with lower tax rates.

Taxes and Information Technology

One tax-saving strategy is the purchase of supply chain software to improve planning and responsiveness. This could be an enterprise resources planning (ERP) system that automatically determines the right tax payment for the company and locates all justifiable tax credits and deductions. Such systems can also be useful in complying with corporate governance regulations, such as the U.S. Sarbanes-Oxley Act.

Reasons Misalignments or Gaps Occur

A strategy that works today may not be as effective in the future. Supply chains are dynamic in nature, and those that focus on responsiveness are especially so. What drives these changes? There are several important factors that can cause an organization to need to alter its supply chain strategy:

- Change in market conditions

- Change in business direction
- Disruptive technology
- Anticipated change in market
- Business combination or merger
- Product life cycle changes

Change in Market Conditions

Changes in market conditions can happen with stunning rapidity. But they can also evolve steadily and incrementally over time. The key is for supply chains to spot these changes early and adapt quickly. Some examples follow.

COVID-19–Related Supply Shortages

COVID-19 disrupted many businesses' ability to operate. Not only did some factories need to shut down for certain periods, but some materials faced new export restrictions and once reliable international sources of supply were completely halted. The need for domestic production of many materials suddenly had great importance. For example, many of the precursor materials for mRNA-based COVID-19 vaccines and other DNA-based therapies could be found only in China and South Korea. Since so many organizations rely heavily on supplier expertise, such as an automobile manufacturer relying on a touch-screen supplier, many organizations found that they were reliant on small suppliers who were high risk because they operated in only one country and/or one plant.

These supply shocks forced many organizations to reexamine their supply chains. According to an article by Willy C. Shih in the *Harvard Business Review*, organizations need to find ways to add resilience without weakening their competitive position (e.g., failing to be price-competitive). A key way to do this is to take a deeper dive into one's suppliers and their suppliers. This process is expensive and time-consuming, so traditionally organizations have focused on their major suppliers or areas with the most room for bottom-line improvements. The article includes suggestions by supply-chain executive Tom Linton and MIT professor David Simchi-Levi to perform a mapping process on suppliers that determines their relative risk of creating disruptions. Suppliers with less geographic diversification or no presence in the home country and whose products have few alternate sources would be high-risk. Suppliers who would have the most impact on revenue if the source is lost would also be high-risk. Suppliers with metrics proving great disruption recovery time (e.g., SCOR model measures such as supply chain flexibility and supply chain adaptability) would be lower-risk.

Other ways to reduce supply risk suggested by the article include the following:

- Diversify the supply base. Some organizations are adding a "China plus one" strategy, meaning that they still source from China but add at least one supplier in a different country as well, such as Vietnam, Indonesia, or Thailand.
- Use cost of disruption as a factor for setting safety stock levels.

- Use the need to relocate or to add redundant capacity as a way to build in new process efficiencies and lessons learned from other plants.
- Invest in automation not only as a way to reduce variable costs but as a way to help increase social distancing and reduce risks of disease spread.
- Rationalize the number of product families or products. Toilet paper producers, for example, contributed to the shortages of this product because they had so many varieties to produce (least expensive single-ply for businesses and hotel chains and multi-ply in many package sizes for consumers) that they could not meet demand for any particular variety.

An article from Business Wire related to the impact of COVID-19 cites an opinion by Gabriel Smith, a pricing expert at Pricefx, who believes that the Just-in Time revolution's focus on cost cutting through inventory reduction has gone too far, since it expects every supply chain element to be perfect. He recommends putting a premium on availability into inventory cost calculations and simplifying one's pricing models so that pricing is more transparent and more based on actual profit drivers. The latter changes can keep costs low despite having more suppliers and/or more inventory.

Nestlé and Demand Disruptions

Retailers selling goods in brick-and-mortar stores in China, including Unilever and Nestlé SA, were hit hard by a fast and sharp drop in retail demand. Overestimated retail demand forced Unilever to post 20 percent drops in both third and fourth quarter 2014 China sales, while, according to a *Wall Street Journal* article from June 2015, Nestlé was burning instant coffee it couldn't sell. The article goes on to state that while Unilever claimed the slowing economy played a role, the trend had much to do with the rapid increase in consumer online shopping.

The story highlights how difficult it is to keep a supply chain flowing smoothly when something minor, such as delivery patterns, shifts. Online purchasing has high competition, so not all online sales will be through one organization, even if it does have well-developed e-commerce. While large organizations were once able to negotiate with retailers for preferential display space, as Nestlé's China food and beverage director Reinhold Jacobi says, "If you go online, everyone gets the same screen space."

Zara and Mango

In the market for fashionable apparel, change is a given rather than a surprise. Every season can bring a shift in taste that makes all processes, designs, and materials outmoded. So Zara, Mango, and other fashion-conscious clothing companies and brands have found ways to begin the seasonal design process early. By paying careful attention to trends on the street, they can get a head start in ordering materials and developing prototypes of designs that seem likely to appeal to their target customers in the upcoming season. But they delay final design decisions and the start of manufacturing until real data come in.

Change in Business Direction

Another reason to modify a supply chain strategy arises when a company comes to market in a new way. It may be entering uncharted territory with no real data to use in making decisions and little ability to forecast demand and set production schedules. A new product line may require complete recasting of the supply chain—new raw material suppliers, new manufacturing processes, logistics changes to reach new markets, and new strategies for reaching the end customer.

Toyota faced those challenges when it introduced the Prius, its first gasoline-electric hybrid car. There were no comparable vehicles in the market at the time, so there was no demand history to use in forecasting sales in the aggregate or for segmenting the potential market.

Toyota dealt with the challenge of forecasting by changing its logistics network in the United States to reflect its uncertainty about where it would be delivering the new models and what sort of buyers might be interested in them. They suspected that new market segments might be attracted to the offbeat styling, technical inventiveness, and “green” characteristics of the Prius. Instead of allocating cars to dealers based on past performance, they sent Priuses from the production line to central distribution centers for shipping to dealers only in response to customer orders. With the larger pool of cars in central locations, they reduced the risk of stockouts caused by unexpectedly large consumer demand in any one region.

Toyota also allowed for customization of cars at the distribution centers in response to requests for specific features—a postponement strategy made possible by modular design. The system was more expensive, but it provided the required flexibility in delivery. The percentage of the new model sold in northern California far exceeded the usual percentage allocated there, while sales in the southeast were far less than demand patterns for other Toyota models would have predicted. Without the centralized logistics setup, the Prius would no doubt have gone immediately out of stock on the west coast while sitting unsold on car lots in the southeast. So the investment in a new supply chain strategy provided net value when compared with the probable costs of redirecting cars from the southeast all the way across the country to California and risking the loss of customers due to the resulting delays.

Disruptive Technology

New technologies can change the rules of the game and allow new competitors to quickly take market share from an organization if it doesn't recognize the implications of the technology quickly and also adopt it. For example, when Netflix announced that its primary business model would be electronic delivery of movies, its competitor Blockbuster and many others may have scratched their heads, since DVD delivery was the business model Netflix had used to grow so large in the first place. However, their move proved to be prophetic, as their rivals were too late to adopt a similar model and went out of business.

Anticipated Change in Market

Innovation is the key to strategic flexibility when there is time to implement changes in advance of an anticipated market change. Innovation in product design, supply chain design, and organizational design plays a major role in keeping supply chains flexible enough to respond to rapid changes in supply or demand as well as more gradual evolution of markets and technologies.

As the case of the Prius indicates—and to a degree the strategies of Zara and Mango—supply chain strategies can be modified in anticipation of changes in demand rather than waiting until they come as a surprise. This might be considered an advanced form of forecasting, and since forecasts are always wrong, a very risky strategy. A clothing design operation has no choice but to forecast, since it has to anticipate trends in fashion on a continuous basis. If a new look will depend on natural fabrics instead of synthetics (or vice versa), new suppliers will be necessary, and they will have to be under contract before the season begins. Zara and Mango are effective because they are committed to creating a design process that allows for revamping supply strategies at the last possible minute when real data are beginning to replace forecasts.

Toyota's success was due to its innovative approach to the marketplace; in anticipation of new demand patterns resulting from environmental consciousness and the potential impact of rising petroleum prices, the Prius was created. The company was additionally successful because they were proactive in setting up a new supply chain in advance of Prius sales that was suited to an innovative product.

Sometimes it's an organization's strengths that make it most vulnerable. Trust in other supply chain partners can cause problems when they are not up-front with changes to their strategies. In addition, supply chain efficiency can become a serious liability if the chain loses its flexibility because they have removed all the buffer from inventories or pared process times down to the Just-in-Time delivery velocity. A supply chain that has become fast and lean may just keep right on running in a given direction until it starves to death for lack of a market.

Business Combination or Merger

When an organization acquires or merges with another organization, their supply chains may also need to merge and reconfigure. Some redundancies can be minimized, while other redundancies might be maintained to improve flexibility and reduce risk. A careful review of each function will be needed to see what can be integrated, what is best kept separate, and what needs to be eliminated. Another consideration is customer experience and perception. While some supply chain changes can be made without any impact on the customer, special consideration is required before making changes that impact customer delivery times, costs, or even the persons with whom customers are accustomed to working.

Product Life Cycle Changes

A product's location in its product life cycle may require different supply chain strategies as it is introduced, as it grows in demand, as it matures in demand, and as it declines in popularity and other

products start taking its place.

Resolving Misalignments or Gaps

When working to resolve misalignments between supply chain strategy and overall organizational strategy or to resolve gaps in a strategy, the first step is to recognize when such issues exist. Another prerequisite is to study the past so that the highest-impact improvements can be identified and prioritized. Since there are many areas of alignment, the discussion here focuses on alignment with complexity requirements, with supply chain partners, and with financial requirements. Organizations can use tools such as network modeling or operations research to determine how to structure a new network.

Does the organization's culture reward or punish failure? When failure is punished and only success is celebrated, managers of all sorts will fear being critics. Unfortunately, critics are just the sort of persons who are needed to point out when a strategy has misalignments or gaps. These gaps will eventually become so obvious that everyone will recognize that they exist. However, by then the impact on organizational market share and other factors will likely be difficult or impossible to repair. An organization can start on the path to becoming a culture that rewards critics for speaking up by using tools such as anonymous surveys or brainstorming meetings where everyone is asked to give reasons why a given strategy might fail. Change management will also likely be needed.

A third-party consultant or organization may also be in a good position to provide an objective analysis of the organization and its gaps. Such an organization, or the organization itself, can use tools such as a SWOT analysis to discover the organization's gaps. Of course, making the decision to act on difficult news takes courage as well, but this is a change that may need to start at the executive level.

If supply chains are to be able to respond in advance of market changes, they will have to play by different rules than many have followed in the past. Here are some of the lessons supply chains have learned:

- **Pursue cost efficiencies and increased velocity but not at the exclusion of flexibility.** The strategy of shipping only in full truckloads or full containers cuts transportation costs, but it can also leave a partial load of product waiting at the dock when it should be on the road to a stocked-out facility downstream.
- **Develop multiple supply chains that are appropriate to each product line.** To achieve those full truckload shipments, some companies will mix products. While that's a good strategy for speeding up delivery of some products in the mix, it may be highly inefficient for others. The high-dollar, lightweight items could be flown to their destination rather than staying in the truck, train, or container. One can customize suppliers to provide whatever each product line needs—speed to market, quality at a higher price, or ability to change rapidly.

- **Watch trends in demand at the consumer end of the chain, not just at the next stop downstream.** Visibility to the end of the supply chain can speed up response to changes in the market.
- **Watch the larger trends in global markets**—changes in demographics, political changes, patterns in rules and regulations, access to raw materials, and so on. Get local assistance for advice on supply chain strategies when you enter an unfamiliar foreign market.
- **Design products for maximum supply chain flexibility.** Put suppliers on the design team to offer help in creating modular designs, allowing fewer components to be assembled into more products. Time the assembly to happen as close to actual orders as possible.

Aligning with Complexity Requirements

A way to address misalignments or gaps is to evaluate the complexity of the supply chain. A supply chain should be only as complex as it needs to be. Complex supply chains take more time and money to establish, monitor, and control, and they become more difficult to keep agile and responsive to changes in demand.

Sources of supply chain complexity include maintaining multiple supply chains for different goods or services, maintaining an extensive asset footprint for production or distribution, the variety of products sold, the amount of configuration needed for products and at what stage, and the number of customization options available to customers.

Limiting product and service offerings is a key way to minimize complexity while maintaining flexibility, since reducing asset footprints or reducing the number of different supply chains will severely impact flexibility and customer experience factors. The Performance Measurement Group (PMG), an internal PwC organization, consists of supply chain performance experts who collect data and perform benchmarking analyses of companies across the globe to assess supply chain performance. Their research indicates that best-in-class supply chains have a similar number of customers and production and distribution assets as their average peer group but roughly 50 percent fewer distinct items for sale (fewer SKU [stock keeping unit] groups). Maintaining only variety that is actually in demand increases flexibility because there will be lower risk of unsold inventory and stockouts.

The question to ask (and related metrics to develop) relate to whether the additional options actually increase profits or just increase revenue while increasing expenses such as inventory holding costs even more.

Aligning with Supply Chain Partners

When gaps or misalignments exist between supply chain partners, often this requires determining who the channel master is and how much influence the organization has. If it is the channel master, how

sensitively has it used its clout in the past with partners? Are they treated as respected partners, or have they been pummeled for price concessions? The latter group may be resisting full alignment with the strategy.

Non-dominant players may have more influence with some customers and suppliers than others. The key to segmenting customers and suppliers is understanding if you are in a buyer's or a seller's market. If there are multiple suppliers for a customer, each supplier will have relatively less clout, as is true in the automotive industry. If you make a key component that few suppliers can duplicate, you will have more influence with your customers, as is often true for innovative technologies. The idea is to use that influence to promote collaboration over control.

Aligning with Financial Requirements Using Supply Chain Financial Modeling

Financial modeling involves determining the financial feasibility and return on investment (ROI) of a product/service strategy or supply chain strategy.

Optimized network models supply cost estimates for financial modeling. Since it is just the increase in costs and the increase in benefits that are important to a decision to create, change, or improve a product and/or supply chain, financial experts use marginal analysis to study the marginal costs and benefits of the option being considered. Marginal costs include constructing, leasing, or contracting out all of the parts of the supply chain that need to be improved, reworked, or developed. They will compare these to the marginal benefits received from new or increased demand and the resulting increases in sales revenues or profit margin. For the benefit side of a benefit-cost analysis, market research provides information on projected demand for the products and services that will be produced as well as target pricing. This information can then be used to estimate revenues for future periods.

Financial modeling has more nuance than just taking the benefits and dividing them by the costs, though this is the basic formula for ROI. Since money that is borrowed requires interest payments and money that is earned can be invested to earn interest, financial analysts factor in the time value of money. Briefly stated, money to be received in the future is discounted to the value it would be worth if received today at current interest rates, called the present value. If you will get US\$100 a year from now and interest rates are 10 percent per year, and if someone gives you US\$90.91 now, the principal plus interest is calculated as $US\$90.91 \times 1.1 = US\100 , so getting US\$90.91 now is the same thing to a financial analyst as getting US\$100 a year from now at that interest rate.

This concept is used in a number of financial metrics, including net present value (NPV) and discounted payback period.

With net present value, each year's future cash inflows are discounted back to their present values, and the present values of all cash outflows are also calculated. The difference between these amounts is a

measure of profit in today's money. Any NPV equal to or greater than zero is a positive sign, but, obviously, the higher it is, the better.

Discounted payback period determines how long it will take to recoup the initial investment or break even. It also discounts the future cash flows to the present value before applying them. A supply chain investment that will take three years to break even is far less risky than one that will take six years. This was a key reason that Target decided to close its operations in Canada in 2015. An analysis determined that the Canadian operations would not become profitable until 2021, and apparently this six-year payback period was not acceptable. What constitutes an acceptable payback period may have to do with alternative investment opportunities and the product being offered. For example, if a product will be obsolete quickly, it will need a fast payback period or the capital investments will need alternate uses such as a follow-on model that can be produced with minimal further investment.

There are a large number of other metrics that financial analysts can compile and help interpret. One of these is economic value added. The *APICS Dictionary*, 16th edition, defines **economic value added (EVA)** as follows: "In managerial accounting, the net operating profit earned above the cost of capital for a profit center." EVA is useful because it specifically accounts for the capital investment cost before it calculates profit.

The results of financial modeling will indicate what level of capital investment will be possible. This can help supply chain managers propose product, service, or supply chain designs that are likely to meet business requirements for profitability.

Network Modeling and Operations Research

Network modeling (also called network design) and operations research are tools that can be used to revise strategic plans and network designs for a supply chain.

Supply chain network modeling involves developing the capabilities to find and enact the least-cost solution for the entire network (efficient) or the ability to manage demand and respond to actual demand (responsive) through some combination of customer focus and/or agility. While network modeling is a large subject, we will restrict the discussion here to the subset of network modeling in which expert analysts create a mathematical model of the supply chain for supply chain managers.

A good model will represent the supply chain in all of its necessary complexity but be no more complex than it needs to be (avoiding being needlessly complex and thus error-prone). It is a representation of a supply chain, not a supply chain itself, and so is complex enough when it can reliably help decision makers choose between available options.

Mathematical models have inputs, processes, and outputs. A model's input parameters can be adjusted to account for where facilities might be located, the number of these facilities, their function, their costs and related transportation costs, and so on. The model will have processes (mathematical relationships

and formulas) that automatically translate the inputs into outputs. The outputs will indicate total network costs as well as any other key performance indicators related to strategy that the model developers include. These models are often developed in a spreadsheet such as Microsoft Excel, but more sophisticated modeling tools also exist. Modeling expertise is needed to develop, check, and validate such models. Model errors are easy to create, and there is a risk that the wrong decision will be made based on invalid outputs.

The *Dictionary* defines **operations research (OR)** (called operational research in the U.K.) as

- 1) The development and application of quantitative techniques to the solution of problems. More specifically, theory and methodology in mathematics, statistics, and computing are adapted and applied to the identification, formulation, solution, validation, implementation, and control of decision-making problems.
- 2) An academic field of study concerned with the development and application of quantitative analysis to the solution of problems faced by management in public and private organizations.

Operations research is typically concerned with finding the minimum (e.g., minimum cost or risk) or the maximum (e.g., maximum profit, yield, or performance). The mathematical models developed with network modeling use operations research to solve for optimal network design. Since the problems to solve in an international supply chain are very complex and have many tradeoffs, finding an optimum level for parameters that cannot all be simultaneously maximized or minimized requires computer science. The benefit of harnessing this is that decision makers have some assurance that the choices they are making in regard to expensive capital investments are likely to be wise in the long run.

Operations research uses a number of tools to find the best number and location of suppliers, manufacturing and assembly facilities, warehouses and distribution centers, and retail locations. The best solution depends on supply chain strategy. Some networks will minimize total supply chain cost while others will provide best value in terms of the most flexible, the highest quality, or the fastest flow of products through the network. Current best practices promote finding a solution that maximizes flexibility while minimizing cost so that the supply chain can both be resilient to frequent changes in the environment and provide the maximum potential for organizational profit.

Operations research relies on mathematical modeling, statistical analysis, simulation and optimization, economic methods, queuing theory, expert systems, decision analysis, and other tools. While it is beyond the scope of this text to describe these tools, let's look briefly at one common method: the Monte Carlo simulation. A Monte Carlo simulation randomizes each variable within its available range and runs thousands of simulations, and then it generates statistics to summarize the average results as well as other statistics such as the minimum and maximum. This frames the solution in terms of its possible range of results rather than just being a point estimate. A model that makes risks and opportunities obvious helps decision makers design both resilience and cost efficiency into the model.

Section B: Sustainability

This section is designed to

- Define sustainability and corporate social responsibility
- Describe what is meant by the triple bottom line and its three aspects—economic, environmental, and social
- Discuss micro- and macroeconomic considerations for sustainability
- Explain how to balance short- and long-term economic performance
- Understand the compliance requirements of mandatory versus voluntary programs
- Outline the principles of the United Nations Global Compact
- Describe the Organization for Economic Co-operation and Development's Guidelines for Multinational Enterprises
- Describe the Global Reporting Initiative and its reporting standard
- Define conflict minerals and related reporting requirements
- Define accreditation and certification
- Show how accreditations and certifications can improve the efficiency of business operations, productivity, and the bottom line
- Describe ISO
- Describe ISO 9000 and ISO 14000 Series Standards, ISO 26000, SA8000, and ANSI Z.10 and their respective roles.

The section addresses the triple bottom line of economic, environmental, and social sustainability along with sustainability guidelines and standards, including some methods of reporting or aligning organizational policies and procedures to international expectations in these areas.

Topic 1: Sustainable Supply Chains

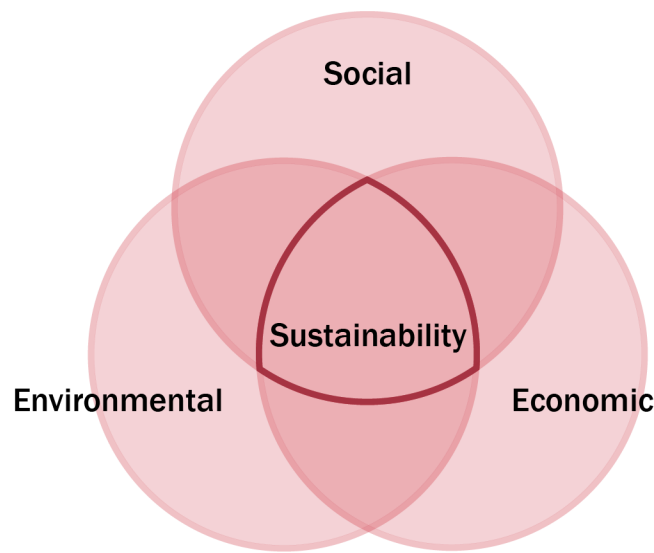
Sustainable supply chains can use the triple bottom line concept to redesign their business model to reflect economic, environmental, and social value. Sustainability can be required by law or regulation or be voluntary.

Triple Bottom Line

According to the *APICS Dictionary*, 16th edition, **sustainability** involves the “activities that provide present benefit without compromising the needs of future generations.”

The triple bottom line (TBL) concept has three components that create a sustainable business model, as shown in Exhibit 8-10.

Exhibit 8-10: Triple Bottom Line



The TBL links a company's ability to keep operating (economic sustainability) with the two other key measures, environmental and social contributions. Originally coined in 1987 by the Bruntland Commission in Europe, this term was popularized by John Elkington in his book *Cannibals with Forks: Triple Bottom Line of 21st Century Business*.

Elkington believes that for an organization to be economically viable over time, it must reinvest some of its profits in market growth. One area of reinvestment is in improving the organization's reputation. Today's customers and societies are demanding that organizations make a positive impact on the environment and society. Organizations that listen to these demands and make the required investments should see more market growth than those that ignore such demands. Making all three of these components into "bottom lines," or top-level organizational success indicators, usually requires a company to modify or change its business model. It cannot be an afterthought. Integrating triple bottom line thinking into the various aspects of the business involves creating a business plan that reflects the organization's commitment to conservation and stewardship. Such a plan spells out the company's mission, marketing, operations, pricing, and growth strategies and explains how it will integrate environmental and social elements into its business strategy. If the business plan determines ways to satisfy all three of these bottom lines at once, this is what Elkington calls the sustainability "sweet spot." This is represented as the center of the Venn diagram in Exhibit 8-10.

These strategies should cascade into the planning, goal setting, and processes of key functions within the company. Once this occurs, the organization should have a truly comprehensive accounting and performance reporting mechanism to measure its progress on multiple levels.

Economic Performance

In order to design and operate a sustainable business and supply chain, we need to build a foundation of knowledge about sustainable business practices and how they contribute to the financial well-being of a company and impact its supply chain. Economic, or financial, performance is tangible and can be viewed from both short-term and long-term perspectives, but there is an incentive to promote the short-term over the long-term in today's business culture. The TBL provides incentives to balance short- and

long-term perspectives. Since economic performance is the traditional bottom line for an organization, in the TBL, economic performance is the first bottom line.

So how will you balance the financial needs of the organization in the immediate future as well as in one, five, or ten years? What is the right mix of metrics and incentives for the organization and its supply chain? Are the critical players on board and in agreement?

Oftentimes in organizations with sustainability initiatives already underway, there is no alignment of the financial-related goals of the different functions involved in the supply chain, which results in tradeoffs between short- and long-term performance. For instance, in “Fudging the Supply Chain to Hit the Number,” authors Godsell and van Hoek found that sales managers and financial managers were too eager to make their short-term targets and would consequently sacrifice best practices of supply chain management in order to make the numbers look better. There is often a gap between these two functions and the supply chain team, which is quick to offer examples of their integrated supply chain efforts being derailed by sales and marketing’s activities.

Here are some examples of the tradeoffs companies sometimes make between short- and long-term performance:

- In order to meet its end-of-month or reporting period targets, the sales department moves orders to periods about to end by giving the customer incentives to order “now,” such as discounts or competitive payment terms. This impacts the supply chain by putting a crunch in the capacity at the end of the period to fulfill these artificially inflated customer orders and leaves little demand for the beginning of the next period. One way to resolve this is to provide incentives to the sales departments on margin as well as revenue, because these last-minute orders carry a lower margin. Lower margins are not good for short- and especially long-term performance.
- Sometimes the wrong metrics are being used to make short-term customer service appear better than it actually is. Instead of tracking orders that are delivered by the customer’s requested due date, companies often track delivery by a promise date that it sets. What needs to be done is to track customer service using both request date and promised date, because the request date originates with the customer and directly impacts customer satisfaction. Customers can take their business to a company that will meet their request date. However, since the request date may not be reasonable or feasible, also tracking a promised date can show that the organization was working to set realistic expectations. Many customers will happily accept a different date than requested if it is explained up front and then fulfilled as promised.
- Creating a large anticipation inventory, particularly of seasonal products, is another frequent occurrence that looks like it is beneficial but can actually require increased warehouse capacity and raise short-term inventory holding costs. For example, a manufacturer usually must place its orders with suppliers in February for the following Christmas or Hanukkah season, ten months before the

event. However, there are inevitably shortages of popular products and too much stock of others. A more effective approach is to segment product lines into two types: shorter cycle times for higher variability items versus longer cycle times for products with more stable demand.

- Manipulating customer orders or inventory on a balance sheet is called window dressing (when it is done in legal ways), but it harms long-term sustainability. When it comes to manipulating orders, this is one way it happens: A fairly conservative forecast is made for the following quarter's sales reported to the stock market. When those sales targets are met before the end of the quarter, new shipments of customer orders are held until after sales results have been reported to the market so as not to over-perform. Then customer shipments resume again, resulting in reports that show sales peaks at the start of each reporting period. However, these "faux" sales peaks increase supply chain variability, which in turn requires additional capacity being added, thereby increasing costs and decreasing shareholder value. The tactics can harm customer service too, because delays just for revenue recognition purposes do not have the customer's needs in mind.

Environmental Performance

The following terms from the *APICS Dictionary*, 16th edition, help illustrate the various ways organizations can define themselves as environmentally responsible:

Environmentally responsible business : A firm that operates in such a way as to minimize deleterious impacts to society.

Environmentally responsible manufacturing : A collection of manufacturing activities that includes design of the product, facility, manufacturing processes, logistics, and supplier relationships that reduce or eliminate environmental waste through innovation and improvements.

Environmentally sensitive engineering : Designing with consideration of how a product or its packaging will ultimately be disposed.

Environmental issues and efforts include sustainable and safe products and services (including packaging), resource use, production processes, and reverse logistics. Improvements in these areas are tangible and can be measured, usually over a period of a few years.

An environmentally responsible supply chain manager must think of the overall functions that are included in the entire supply chain and look for causes and effects related to environmental impact. Examples of linked supply chain decisions that can benefit environmental sustainability follow.

Procurement

- Can you select vendors who use ISO 14000 (standards that help companies improve environmental performance) or who can be certified by the organization?
- Is it possible to use recycled materials instead of new?

- Do we need to use nonrenewable resources, or can we find substitutions?

Manufacturing

- Is the product designed for the supply chain?
- How might the manufacturing process be made more environmentally friendly?
- Can the use of toxic, dangerous, or hazardous materials be reduced or eliminated?
- What environmental risks might arise during the production process? Will they impact the safety of employees or cause an accident that would damage the environment?

Warehousing and Transportation

- Can we use existing facilities or rent facilities that are environmentally designed?
- How will inbound or outbound traffic impact the local environment?
- Can we use recyclable packaging and shipping materials?
- What type of carrier choice would be best environmentally as well as economically?
- Is the carrier licensed, certified, or trained, as needed, to handle our products?
- Which transportation mode or modes would leave the smallest carbon footprint?

Reverse Logistics

- How will we set up a process for gathering products for recycling, reuse, etc.?
- Where will we store any toxic, hazardous, or dangerous materials or components?
- What industrial processes will be used to separate or disassemble products?
- How will these products or components be stored safely?
- How will the public view this opportunity for recycling? How can we take it one step further environmentally?

You can also use the environmental SCOR® model component called Green SCOR. Its performance attributes focus on environmental concerns. Research sponsored by the U.S. Office of the Deputy Under Secretary of Defense (Installations and Environment) resulted in the following environmental definitions:

- **Reliability.** Reliability is the ability to deliver the correct product to the customer. Reliability reduces waste from product discards and reduces air emissions and fuel use from extra transportation for returned products. Proper documentation enables all players in the supply chain to keep better track of hazardous materials or toxins that are embedded in certain products, thus allowing them to arrange for proper storage, handling, and disposal.
- **Responsiveness.** The environmental definition of responsiveness relates to measuring the changes in material movement velocity caused by processes intended to mitigate environmental impacts, such as pollution control or other regulatory steps in a process.

- **Flexibility.** Flexibility is the degree to which a company can meet the environmental demands of its customers. This pertains to the company's products and their production, transportation, recyclability, etc.
- **Costs.** These expenses include the costs of environmental compliance and cleanup as well as energy costs.
- **Asset management.** Sustainable asset management practices take governance, environmental, and social aspects into consideration when making asset and investment decisions.

Social Performance

Social performance, sometimes called corporate social responsibility (CSR), involves respecting and supporting the needs and rights of employees, communities, and indigenous peoples. For employees it can involve nondiscriminatory hiring and labor management, providing living wages to employees matched to the cost of living in a region, providing reasonable benefits and accommodations, abiding by health and safety regulations, and respecting the rights of persons to form unions when allowed under the law. Community support can take the form of hiring local workers and reinvesting in local businesses by getting local supply when feasible. Charity efforts can also be directed to local causes. For indigenous peoples, this involves fairly compensating these groups for any organizational impact on them and respecting treaties. Commitments to social performance often also need to be extended to supply chain partners, especially when manufacturing is primarily outsourced.

Social performance can also involve encouraging employees to get involved in sustainability efforts. For instance, Intel did this by motivating their employees in several ways related to the environmental portion of their sustainability efforts. (While the subject is on the environment, the employee participation and request accommodating portions are the social part.)

- A system was established to measure green progress on three fronts: product efficiency, business operations efficiency, and stewardship.
- Intel asked its employees for suggestions on energy-saving and efficient products, software, and commuting options.
- They offered employees monetary bonuses for their efforts.

Intel accommodated employee demands by installing solar panels and buying carbon offsets. (A carbon offset is an investment in a renewable energy, forest protection, or reforestation project that can be used to offset the carbon dioxide-producing activities of an organization or individual.)

A true commitment to social responsibility can influence competitive advantage, the organization's global and local reputation, employee morale and commitment, the opinions of its many stakeholders, and relationships with customers, suppliers, the media, the community, and other companies.

In Vachani and Smith's article "Socially Responsible Distribution: Distribution Strategies for Reaching the Bottom of the Pyramid," the authors explain that "socially responsible distribution" encompasses efforts and activities to give market access to poor producers and consumers in less-developed nations. These efforts help make up for their minimal physical links to markets, marginal buying power, and lack of information and communication infrastructure. Vachani and Smith identified three means of aiding these producers and consumers: lowering the costs of distribution, identifying different routes or means of reaching rural producers and consumers, and encouraging private-sector businesses and communities to invest in their future and to be socially active and partially responsible for that success.

Implementing Sustainability

Many organizations talk about sustainability, but not many are translating their words into action. In "Corporate Social Responsibility in Global Supply Chains," Mette Andersen notes how despite environmental annual reports, voluntary efforts, and sustainability strategies, many companies are still not able—or not committed—to implementing sustainability in their own supply chains.

One of the companies that is taking action is IKEA, a Swedish home furnishings retailer established in 1943. According to IKEA's supplier portal, as of 2021, IKEA had 1,600 suppliers in 55 countries with an 11-year average length of supplier relationship. IKEA's strategy is to engage in long-term relationships with fewer suppliers, and the company is committed to helping these suppliers do their best environmentally. The company has developed a code of conduct that the suppliers must adhere to in order to work with IKEA. The code delineates the requirements for the outside environment and the social and working conditions in an initiative IKEA calls IWAY. If a supplier is not able to meet those standards in an ongoing manner, they are asked to develop an improvement plan that they will implement. Follow-up audits are conducted at later dates. As long as there are signs of improvement, IKEA and the supplier will continue to work together.

The IKEA culture has long been known as one that trains its employees well on production-related environmental and social issues. Its employees thrive on being empowered with this knowledge, which helps them perform better and in a more green approach, but this also then carries over to IKEA's suppliers. They term this transfer or sharing of knowledge as a "knowledge enhancing mechanism."

Here are a few brief tips to get your organization and supply chain to become more sustainable:

- Start with things that fit in the "sweet spot" of solutions that simultaneously provide economic, environmental, and social benefits. (Elkington's book has examples of this, such as Coca-Cola working to use less water in India to reduce the stress on the community and environment while saving money on water.)
- In online ordering systems, place the more sustainable choices as the first options in lists.
- Make requests for proposal/invitations to tender and contracts specify sustainability as a criteria.
- Use service contracts to provide vendors with an incentive to reduce materials (e.g., buying treated lumber rather than lumber treatment chemicals gives the supplier an incentive to minimize the

amount of the chemical or make the product environmentally friendly.)

- Do an audit on what composes the waste in the supply chain and determine if some parts of it could be prevented from entering the waste stream in the first place.
- Get an environmental, safety, or quality certification from an accredited third party.

Sustainable Supply Chains and Compliance

When sustainability regulations exist, they may take the form of voluntary partnerships, formal regulations with required compliance, or individual organizational initiatives. For voluntary programs or individual initiatives, the organization will need to weigh the costs of implementing compliance programs against their benefits. From a risk perspective, this could include lower reputation risk and lower risk of lawsuits for environmental or community impact of the operations of the business. For mandatory laws and regulations, the same costs apply, but the cost of noncompliance such as fines or legal liability may outweigh other considerations.

Voluntary Program Compliance

Examples of voluntary programs include programs to encourage reuse, recycling, and recovery of industrial materials and responsible handling of products at the end of their useful life. Material content reporting is part of such efforts. One example is the Global Reporting Initiative (GRI), which disseminates globally applicable sustainability guidelines for voluntary use.

One benefit of voluntary compliance is the ability to implement sustainability at a measured, cost-effective pace rather than waiting until mandatory compliance requires frantic effort. Another benefit could be an improved and less costly reverse logistics infrastructure in the long run. The costs could include infrastructure investments such as more-efficient or less-polluting equipment, more-expensive contracts with local suppliers, and new report preparation and disclosure costs. Another potential cost or benefit is that with increased disclosure comes increased scrutiny by the press or activists, which may or may not be positive.

Nokia provides one example of a company that has developed its own reporting system by applying GRI guidelines. This reporting system is accessible in our online Resource Center. It includes a summary of Nokia's extensive sustainability report, which includes disclosure of energy consumption, carbon dioxide emissions, water consumption, waste, and ozone-depleting substances.

Organization-Specific Sustainability Programs

Sustainability can also be implemented through independent programs. For example, the U.S. shoe manufacturer Timberland developed the following set of "EcoMetrics" to assess the environmental impact of its products:

- Energy to produce
- Global warming contribution

- Material efficiency (weight of product in relation to weight of material used in making it)
- Additional attributes (for example, use of renewable energy in manufacturing the product)

The organization has made sustainability into a market differentiator, and a clear benefit is loyalty from market segments that value sustainability.

For another example, Nike has made a commitment to sustainability even though it does not call its products “green” per se. There is a link to a video on this example in the Resource Center.

Government and Regulatory Compliance

Business organizations are subject to regulations developed and enforced or monitored by governments and their regulatory agencies.

A common area of regulation is vehicle emissions, which impacts vehicle manufacturers directly but may also impact other organizations if they or their 3PLs need to update their fleets. These standards often effectively require vehicles to meet the most stringent laws in a major market (e.g., California) to avoid needing to produce multiple product types. A positive outcome of these regulations is that technology has improved. For example, diesel engines for on-road and marine applications are now more efficient and produce less pollution. Regulations can also create some supply chain expenses, such as when local communities restrict the hours in which trucks can make deliveries in a community, which can restrict routing efficiency. In another example, regulations that balance when ships can come in can cause the same issues, but this may prompt the ports to become more efficient over time.

Other areas of government and regulatory compliance include material content reporting and handling of dangerous or hazardous goods.

Material Content Reporting

Reporting of material content is part of a larger movement toward sustainable trade practices that promote a clean, safe, healthy environment, including reuse, recycling, and recovery of industrial materials and responsible handling of products at the end of their useful life.

Dangerous and Hazardous Goods

According to the U.S. Department of Transportation (DOT), items or goods are called hazardous materials (hazmat) or dangerous goods (DG) internationally when they are “capable of posing an unreasonable risk when transported in commerce to health, to safety, and to property.” For such goods, both the shipper and the carrier bear legal responsibility for compliance with related regulations. Many governments require organizations to have contingency and disaster preparation plans in place to mitigate both the environmental and economic consequences of a disaster. Organizations that store or process hazardous materials also need to keep hazmat logs.

The U.S. DOT identifies ignitability, corrosivity, reactivity, and toxicity as four characteristics of concern due to health and U.S. Environmental Protection Agency (EPA) requirements. The level of danger is also rated.

provides a list of specific dangerous goods that has wide international acceptance. Note that these are United Nations classifications (UN Class).

Exhibit 8-11: Dangerous Goods

UN Class	Dangerous Goods	Classification
1	Explosives	Explosive
2	Gases	Flammable gas Nonflammable, nontoxic gas Toxic gas
3	Flammable liquids	Flammable liquid
4	Flammable solids	Flammable solid Spontaneously combustible substance Substance that in contact with water emits flammable gas
5	Oxidizing substances	Oxidizing substance Organic peroxide
6	Toxic substances	Toxic substance Infectious substance
7	Radioactive material	Radioactive material
8	Corrosive substances	Corrosive substance
9	Miscellaneous dangerous goods	Miscellaneous dangerous goods

Items on the dangerous goods classification list have different handling requirements. A toxic substance, for instance, requires very different handling than a toxic gas.

Proper communications of material risks is a key regulatory area. Hazard symbols are an example. Hazard symbols are internationally recognized icons that are more important than text, since they can be understood by people who speak different languages. For example, below is the symbol for biohazard. (There is a link to a list of other hazard symbols online in the Resource Center.)

Exhibit 8-12: Biohazard Symbol



The international agreement in which dangerous goods controls are documented is the United Nations Recommendations on the Transport of Dangerous Goods (UNRTDG), first published in 1956 by the United Nations Economic and Social Council. Known as the “Orange Book,” these recommendations relate to the classification and labeling of dangerous goods and the requirements for packaging, tanks, and containers. Although the recommendations have no legal force, they present a basic scheme of provisions that allows uniform development of enforceable national and international regulations.

Ships that transport dangerous or hazardous materials or goods are governed by the International Maritime Dangerous Goods (IMDG) Code. The code covers such matters as packing, container traffic, and stowage, with particular reference to the segregation of incompatible substances. Since its adoption in 1965, the IMDG Code has kept pace with the ever-changing needs of industry. Amendments are made on a two-year cycle and are adopted by all authorities responsible for regulating the different modes of transport. With some exceptions, the Code became mandatory in 2002.

In the United States, the laws regarding dangerous goods are known as “hazardous materials regulations.” Canada has its own laws governing “transportation of dangerous goods.” In Great Britain, the Health and Safety Commission (HSC) regulates all work-related health and safety risks. A book titled *Recommendations on Dangerous Goods* is published and updated every other year by the International Civil Aviation Organization (ICAO). The ICAO and the International Air Transport Authority (IATA) also publish special instructions on transporting dangerous goods. Air transport is the most strictly regulated mode of transportation.

Here are some areas of specific regulatory concern in the transport of dangerous goods:

- **Identification and classification** is required for shipping containers and some vehicles containing dangerous goods. This includes a shipping name and, if necessary, a technical name, both on the container and on any packaging inside the container. Emergency response information must be posted in case of accidents. Dangerous goods may not be concealed for security purposes.
- **Packaging** may have to conform to official specifications, such as those issued by the United Nations.
- **Training** is required for anyone handling dangerous goods, including a certification course and periodic refresher courses that must be completed successfully before a person can handle such goods.
- **Documentation** must accompany the shipment. In most cases this includes a signed statement from the shipper that regulations have been followed in preparing the cargo for shipment.

European Union Efforts

The European Union is also contributing to the sustainability movement with legislation relating to material content disclosure, reuse of materials, recycling, and related issues. The EU Waste Electrical and Electronic Equipment (WEEE) directive mandates that suppliers take back equipment at the end of its economic life, and it also sets targets for recycling and recovery of material used in electronics. The directive arises from concerns about specific materials used in electronics products, such as mercury, cadmium, lead, chromium VI, and other heavy metals and flame retardants.

As an example of a mandated sustainability regulation, the European Union's Restriction of Hazardous Substances (RoHS) directive states that electrical and electronic equipment sold in the EU must be substantially free of six substances identified to be toxic to humans and the environment: cadmium, hexavalent chromium, lead, mercury, and two classes of poly-brominated plastics. To give it legal force, the directive was transposed into the national laws of EU member states. Penalties for products containing these substances can be severe, including removal of an entire stock of product from the market. These laws require no documentation or product certification; rather they assume that all electrical and electronic products on the market after the directive's July 1, 2006, deadline should be compliant. However, compliance authorities could require that an organization prove that its products are compliant, which can be a very difficult endeavor. Like other supply chains, electrical and electronic equipment supply chains have become extended. Subcomponent designs are often based on functional requirements rather than being rigidly specified by the organization. This means that a supplier could design a subcomponent to function properly using substitutes. For example, several different types of transistors could be substitutes because they work the same even though they contain very different raw materials. Thus, the RoHS directive has resulted in a need for organizations to minimize their risk of noncompliance by gathering extensive information from not only their suppliers but also their suppliers' suppliers on a continual two-way basis.

The risks involved in noncompliance with mandatory laws generally outweigh the cost considerations; it is a price of doing business in that region. If the costs of compliance prove to be too great to sustain profitable operations, the organization may choose to avoid doing business in that region.

Reporting Requirements for Conflict Minerals

As defined in the *APICS Dictionary*, 16th edition, **conflict minerals** are "minerals mined in conditions of armed conflict and human rights abuses, and are sold or traded by armed groups."

The U.S. Dodd-Frank Act of 2010 included a provision requiring certain companies to disclose their use of conflict minerals if they are "necessary to the functionality or production of a product." Conflict minerals are tantalum, tin, gold, or tungsten mined in the Democratic Republic of Congo (DRC) or adjoining countries. The intent was to hinder the sale of these minerals when they would be used to finance conflict in the DRC region or worsen the humanitarian crisis there. Disclosure is made to the Securities and Exchange Commission (SEC) on Form SD. The practical impact for supply chain managers is that any company that uses any of these minerals needs to conduct a reasonable country-

of-origin inquiry. It will need to verify its suppliers' addresses, audit each supplier, and get each to certify that all materials are in compliance. If it does not use or has no reason to believe it uses conflict minerals, it must file this in Form SD and publish it on a publicly available web page along with the process used to make the determination. If it does use conflict minerals, the organization must perform due diligence on the chain of custody for the minerals and file the form and publish the disclosure on a publicly available website.

Sustainability Risks from Packaging

Packaging and shipping materials can pose sustainability risks. Wooden pallets, for example, have become controversial for a variety of reasons. A number of countries such as the United States and China and regions such as the European Union have adopted international restrictions on incoming materials packed on pallets made of soft woods that may contain harmful insects. Acceptable methods of heat and chemical treatments are governed under International Standards For Phytosanitary Measures regulation ISPM15. Chemical treatments to sterilize the wood have come under fire for themselves being hazardous. Aside from harboring harmful pests, the pallets can be a significant source of waste if they are used only once and discarded (as many have been designed to be used).

Solutions to the problems with wooden pallets include the following:

- Sterilizing the wood with heat or chemicals as per regulation ISPM15
- Reusing undamaged pallets and repairing damaged pallets
- Grinding up pallets that are beyond use or repair for recycling
- Using pallets made of materials such as plastic and corrugated cardboard
- Using slip sheets (corrugated or plastic sheets) instead of pallets, a solution adopted successfully by Home Depot, Xerox, and Apple Computer

The benefits of converting to sustainable shipping materials include lower risk of rejection at ports and possible innovation of even less costly shipping methods that still provide sufficient protection. The costs may include the inability to make full use of prior infrastructure investments and the need to invest in something that is not value-added in the eyes of the customer.

Topic 2: Sustainability Guidelines and Standards

Sustainability guidelines and standards provide guidance on how to become sustainable so that responses can be complete and well thought out. Sustainability standards that focus on reporting help the organization show it is transparent and help market its sustainability successes. These subjects are first introduced.

Sustainability Guidelines and Standards Road Map

Sustainability guidelines and standards include the following:

- United Nations Global Compact
- OECD Guidelines for Multinational Enterprises
- Global Reporting Initiative
- ISO quality and environmental standards (ISO 9000 and ISO 14000)
- Social accountability and safety standards (ISO 26000, SA8000, ANSI Z.10)

Guidelines are broad, principle-based best practices that lack the authority of a standard and may not provide much information on how to implement them.

Standards are best practices developed by the consensus of numerous practitioners and experts in a given profession—or in multiple professions for those standards with more general applicability, such as quality standards. They carry more authoritative weight than recommendations and provide more information on how to implement them. Internationally recognized standards are of special relevance to global supply chains and multinational organizations. Some standards enable organizational certification to the standard, and becoming certified may require review and acceptance by an accredited third-party testing organization.

According to the *APICS Dictionary*, 16th edition, **accreditation** is

certification by a recognized body of the facilities, capability, objectivity, competence, and integrity of an agency, service, operational group, or individual to provide the specific service or operation needed. For example, the Registrar Accreditation Board accredits those organizations that register companies to the ISO 9000 Series Standards.

The *Dictionary* defines **certification** as “documentation of competency by a supplier or by an organization, such as ISO 9000 certification.”

The organization does not need to be audited by an accredited third-party organization when it seeks to conform to a standard that has no certification requirement or if it does not desire to be certified. Using accredited third parties provides an independent confirmation of the third party’s competence and enables others to rely on their work. When standards are internal or do not require certification, another option is for a supplier to invite its customers to audit the organization’s systems for themselves. This is called a second-party assessment. A third option is to accept a supplier’s “declaration of conformity to [specific standard],” which would be attested to by legally binding signatures and based on an internal audit (first-party) or a second- or third-party audit.

The following standards and related certification processes are important to supply chain management:

- ISO 9000 Series Standards on quality and ISO 9001 certification
- ISO 14000 Series Standards on environmental management and ISO 14001 certification
- ISO 26000 Guidance for Social Responsibility (not applicable for certification)
- SA8000 Social Accountability certification
- ANSI Z.10 Occupational Health and Safety Management Systems certification

International Guidelines

International guidelines include the United Nations Global Compact and the OECD Guidelines for Multinational Enterprises.

United Nations Global Compact

The United Nations created the Global Compact as a means of helping businesses voluntarily align their operations and strategies with the ten key principles shown in Exhibit 8-13.

Exhibit 8-13: UN Global Compact (UNGC) Ten Key Principles

UN Global Compact Ten Key Principles	
Human Rights	
Principle 1:	Businesses should support and respect the protection of internationally proclaimed human rights; and
Principle 2:	make sure that they are not complicit in human rights abuse.
Labour	
Principle 3:	Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;
Principle 4:	the elimination of all forms of forced and compulsory labour;
Principle 5:	the effective abolition of child labour; and
Principle 6:	the elimination of discrimination in respect of employment and occupation.
Environment	
Principle 7:	Businesses should support a precautionary approach to environmental challenges;
Principle 8:	undertake initiatives to promote greater environmental responsibility; and
Principle 9:	encourage the development and diffusion of environmentally friendly technologies.
Anti-corruption	
Principle 10:	Businesses should work against corruption in all of its forms, including extortion and bribery.

Source: UN Global Compact. Used with permission.

With the increasing speed of globalization, the United Nations Global Compact can help ensure that markets, commerce, technology, and finance advance in ways that benefit economies and societies everywhere. Many companies, especially those in lesser-developed regions of the world, recognize the need to collaborate and partner with governments, civil society, labor, and the United Nations. The idea is to leverage the moral authority and convening power of the UN and the resources and solution-finding abilities of organizations. This is accomplished through local Global Compact networks that root these principles into national and cultural contexts by fostering a continuing dialogue between businesses and stakeholders and by focusing on specialized areas of concern such as climate change

or women's or children's rights. With nearly 18,000 corporate participants and other stakeholders from multiple countries, the Global Compact is the largest voluntary corporate responsibility initiative in the world and the primary entry point for organizations into the UN system.

The Global Compact has two complementary objectives:

- Incorporate the ten principles into global business activities.
- Catalyze actions in support of the broader United Nations goals.

The UNGC recommends that organizations evaluate their sustainability efforts using the Global Reporting Initiative's (GRI's) Sustainability Reporting Guidelines. In 2010, the UNGC signed an agreement with the GRI to adopt the GRI Guidelines as the recommended reporting framework for sustainability reporting. The GRI in turn adopted the UNGC's ten principles into its latest reporting guidelines.

OECD Guidelines for Multinational Enterprises

The **Organization for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises** are defined in the *APICS Dictionary*, 16th edition, as

a set of recommendations on responsible business conduct addressed by governments to Multinational Enterprises (MNEs) operating in or from adhering countries that encourage and maximize the positive impact MNEs can make to sustainable development and enduring social progress.

(A multinational enterprise is an organization that owns or controls production or services facilities in one or more countries other than its home country. Multinational enterprises have been evolving and include a broad range of organizational structures and business arrangements. The close relations and alliances they have formed with their suppliers and contractors have blurred their boundaries.)

Established in 1961, OECD was created to promote policies that will improve the economic and social well-being of people around the world. It provides a forum in which governments can work together to share experiences and seek solutions to common problems and identify factors that drive economic, social, and environmental change. OECD measures productivity, investment, and global flows of trade. It establishes international standards ranging from agriculture, to taxes, to the safety of chemicals. The OECD is located in Paris, France, and has 38 member countries.

The goal of the OECD Guidelines is threefold:

- To ensure that these enterprises' operations align with government policies
- To reinforce the trust and confidence between enterprises and the societies in which they operate
- To strengthen the foreign investment climate and augment contributions to sustainable development made by the enterprises

Similar to GRI, the OECD Guidelines cover a wide range of important topics: employment and industrial relations, environment, antibribery measures, consumer interests, science and technology, competition, taxation. The Guidelines include implementation procedures that promote visibility, accessibility, transparency, and accountability by the MNEs.

Global Reporting Initiative (GRI)

Sustainability reporting has emerged as an important tool within an overall supply chain management strategy. According to the *APICS Dictionary*, 16th edition, the **Global Reporting Initiative (GRI)** is “a network-based organization that has pioneered the development of the world’s most widely used sustainability reporting framework.” The GRI is committed to the framework’s continuous improvement and application worldwide. In order to ensure the highest degree of technical quality, credibility, and relevance, the reporting framework was developed through a consensus-seeking process with participants drawn globally from business, civil society, labor, and professional institutions. The GRI also has strategic partnerships with the United Nations, the UNGC, ISO, and the Organization for Economic Co-operation and Development. In effect, the GRI is helping businesses develop sustainability and reverse logistics key performance indicators to assess and improve their environmental performance. This form of self-regulation may reduce the need for new laws and regulations.

GRI Reporting Framework

According to the *Dictionary*, the **GRI reporting framework** is

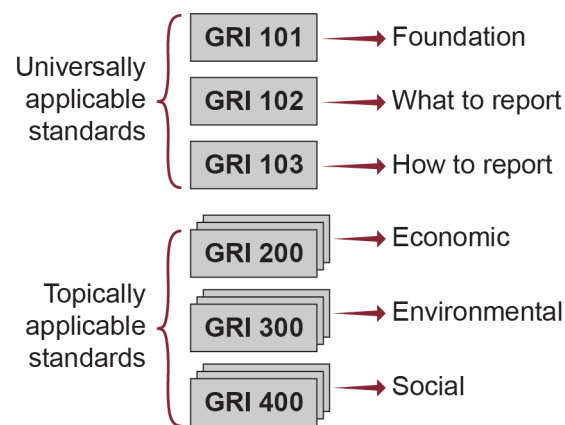
the framework that sets out the principles and performance indicators organizations can use to measure and report their human rights, labor, environment, and anticorruption practices and outcomes.

The framework lays out the principles and indicators that organizations can use to measure and report their economic, environmental, and social performance. The cornerstone of the framework is the Sustainability Reporting Standards.

GRI Sustainability Reporting Standards

The GRI’s Sustainability Reporting Standards transitioned from guidelines to being standards in 2016 (2018 effective date). More topic-specific standards have been released since then. The aim is to help reporters prepare sustainability reports that provide reliable, relevant, and standardized information.

Exhibit 8-14: GRI Sustainability Reporting Standards



As shown in Exhibit 8-14, the set of standards is made up of three universally applicable standards and a large set of topic-specific standards that are organized into three series.

- Universally applicable standards include GRI 101, 102, and 103. GRI 101, “Foundation,” sets out reporting principles that are the criteria to be used to guide your choices to achieve effective GRI reporting. GRI 102, “General Disclosures,” are the questions you answer in your report. This is the “what to report” part of the standard. GRI 103, “Management Approach,” is the “how to report” part of the standard. It addresses how to manage the topically applicable standards. It contains explanations of how to apply the Reporting Principles, how to prepare the information to be disclosed, and how to interpret the Guideline concepts. It helps management to provide a narrative explanation of why a given topic is material (important enough to report on), describe the impact area boundaries (i.e., scope), and management approach to addressing the impact areas. It also focuses on the gathering of the data in order to create a report that contains useful and comparable information.
- Topically applicable standards come in three series—GRI 200, “Economic,” GRI 300, “Environmental,” and GRI 400, “Social.”

The consolidated set of standards also includes a GRI Standards Glossary.

Purposes

The GRI Reporting Standards are an internationally recognized reporting format that can be used for any other organization’s or government’s requirements for reporting on economic, environmental, and social impacts. Another purpose is for voluntary sustainability reporting among supply chain members to manage sustainability risks and optimize supplier performance in order to

- Build capacity
- Foster commitment to sustainability
- Improve performance and risk management
- Improve the flow of reliable sustainability information from supplier to buyer.

Suppliers can proactively communicate their efforts, performance, and goals through a GRI sustainability report, enabling continuous improvement and closer engagement with buyers. Companies

in business or industry associations can improve their sustainability performance, fostering a more stable and profitable climate for local and sectoral business groups.

Reporting Principles

GRI 101 includes 10 principles classified into two categories:

- Principles for Defining Report Content
 - **Stakeholder Inclusiveness:** Identify stakeholders and responses to their reasonable expectations and interests.
 - **Sustainability Context:** Relate performance in the wider context of sustainability.
 - **Materiality:** Include aspects that are significant or would influence stakeholders' assessments and decisions.
 - **Completeness:** Report on all aspects with significant impact so stakeholders can reasonably assess the period's performance.
- Principles for Defining Report Quality
 - **Accuracy:** Use enough accuracy and detail for a fair assessment.
 - **Balance:** Include both positives and negatives to be unbiased.
 - **Clarity:** Make information understandable and accessible.
 - **Comparability:** Use consistent methods to allow analysis of trends and competitive benchmarks.
 - **Reliability:** Reporting methods and processes should be subject to examination of quality and materiality.
 - **Timeliness.** Report on a regular schedule so stakeholders can make informed decisions.

“In Accordance” and Reporting Options

Adhering to the above reporting principles is the cornerstone of report transparency, so all organizations preparing reports should abide by them. To enable your sustainability report to claim to be prepared “in accordance” with the GRI standards:

1. The organization must adhere to these principles with a focus on identifying all aspects that are material to your organization.
2. It also must provide the required disclosures per GRI 102, including information on the context of the information being disclosed.
3. Every topic considered material must be identified and reported upon, which includes identifying the boundaries for each topic. Boundaries are where the impacts occur and what parties are involved. That is, the standards expect reporting not only on direct activities but on the relevant activities of others in the value chain.
4. For every material topic, the organization must also disclose the management approach per GRI 103.

There are two options for “in accordance” reporting: a core option and a comprehensive option. The core option has just the essential information, and the comprehensive option has some additional disclosures regarding organizational strategy and analysis, governance, ethics, and integrity. These and some additional core information about the company are part of what is called standard disclosures. The comprehensive option also needs more extensive performance information because each material aspect requires information about all related indicators. (The core option requires reporting only on at least one indicator per material aspect.)

Topics and Material Impact Analysis

Often companies are unsure what metrics to use to calculate the impacts they are having on specific topics, both to determine materiality and to determine how they are changing impact over time. Companies can begin by using the performance indicators developed by the Global Reporting Initiative or employ criteria from the Dow Jones Sustainability Index and the Carbon Disclosure Act. The UN Global Compact recommends that impacts should be calculated at both the enterprise level and the product level on a regular basis.

Ideally, over time an organization will strive to identify its impacts that span multiple topics. A review of the boundaries can help show areas of overlap. For instance, by creating a new manufacturing facility that would provide stable employment for local residents, a company may inadvertently impact the local water supply it uses to cool its equipment.

Based on the organization’s assessment of risks, opportunities, and impacts, the company develops metrics and goals specific to the organization and then creates a road map to execute its sustainability program.

Exhibit 8-15 lists the topics in each GRI standard series. An organization’s sustainability report presents information relating to just those topics deemed to be material. Summaries of each standard follow by topic area.

Exhibit 8-15: Economic, Environmental, and Social Series of Standards

Economic	Environmental
<ul style="list-style-type: none">• Economic performance• Market presence• Indirect economic impacts• Procurement practices• Anti-corruption• Anti-competitive behavior• Tax	<ul style="list-style-type: none">• Materials• Energy• Water and effluents• Biodiversity• Emissions• Waste• Environmental compliance• Supplier environmental assessment
Social	
<ul style="list-style-type: none">• Employment• Labor/management relations• Occupational health and safety	<ul style="list-style-type: none">• Security practices• Rights of indigenous peoples• Human rights assessment

• Training and education	• Local communities
• Diversity and equal opportunity	• Supplier social assessment
• Non-discrimination	• Public policy
• Freedom of association and collective bargaining	• Customer health and safety
• Child labor	• Marketing and labeling
• Forced or compulsory labor	• Customer privacy
	• Socioeconomic compliance

Source: Global Sustainability Standards Board (GSSB), “Consolidated Set of GRI Sustainability Reporting Standards 2020.”

Economic

Economic sustainability refers to how the organization impacts the economic picture for stakeholders at local, national, and global levels.

- **Economic performance** reports organizational revenues, costs and expenses, payments to owners and taxes, and community investments. It also assesses organizational risks from climate change, if the organization has pension obligations, and if it receives government assistance or tax advantages.
- **Market presence** discusses wages compared to minimum wage by gender and use of local senior management talent.
- **Indirect economic impacts** is about community reinvestment and positive and negative impact on local or other economies.
- **Procurement practices** discusses use of local suppliers.
- **Anti-corruption** is about corruption risk assessments, employee training, incidents, and responses.
- **Anti-competitive behavior** is about legal actions and outcomes regarding restraint of free trade.
- **Tax** is about approach to taxation; governance, risk management, and control of tax; and stakeholder engagement.

Environmental

Environmental sustainability reports on the organization’s impact on ecosystems, land, air, and water from its inputs, including energy and water, and its outputs, including emissions, effluents, and waste.

- **Materials** describes the type and amount of materials used and how much is from recycled sources.
- **Energy** relates to internal and external energy use, intensity of use, and reduction efforts both at the organization and in product energy requirements.
- **Water and effluents** is about water as a shared resource, water withdrawal, discharge and impacts, and consumption.

- **Biodiversity** relates to proximity to and impact on protected areas or endangered species and protection or restoration efforts.
- **Emissions** discusses greenhouse gases.
- **Waste** is about waste generation and impact, impact management, waste generated, and waste directed to/diverted from disposal.
- **Environmental compliance** refers to sanctions and fines paid.
- **Supplier environmental assessment** is about supplier environmental screening and event reporting.

Social

The social series of standards reflects the impact the organization has on social systems, including labor law, human rights, health, safety, privacy, and socioeconomics. The bases for many of these social standards include the UN Universal Declaration of Human Rights, the UN Declaration on the Right to Development, a UN declaration related to indigenous peoples' rights, and UN conventions on civil and political rights and economic, social and cultural rights. Some UN International Labour Organization (ILO) conventions are drawn upon, including those on forced labor and child labor. The standards also use a number of national charters that protect human rights.

- **Employment** is about new hires, turnover, benefits for full-time versus part-time employees, and parental leave.
- **Labor/management relations** is about minimum notice periods for operational changes.
- **Occupational health and safety** is about having a system, identifying hazards and their risk, occupational health services, worker participation and training, promotion of worker health, prevention, workers who are covered, injuries, and ill health.
- **Training and education** is about average hours of training, training programs, and performance reviews.
- **Diversity and equal opportunity** is about the diversity of employees and governance bodies and the ratio of pay between men and women.
- **Non-discrimination** is about incidents and corrective actions.
- **Freedom of association and collective bargaining** is about the level of support for rights of your or your suppliers' employees to collectively bargain or associate.
- **Child labor** and **forced or compulsory labor** each identify risk of incidents and preventive measures.

- **Security practices** is about training security personnel on human rights.
- **Rights of indigenous peoples** addresses incidents and actions.
- **Human rights assessment** is a summary aspect on human rights.
- **Local communities** is about programs to engage, assess, and develop local communities as well as any negative impacts.
- **Supplier social assessment** is about screening suppliers and violations and responses.
- **Public policy** is about the size of political contributions and their recipients.
- **Customer health and safety** is about known areas for improvement and regulatory and voluntary noncompliance issues and outcomes
- **Marketing and labeling** discloses mandatory labeling requirements, noncompliance incidents, and customer satisfaction survey results, whether banned or disputed products are sold, and regulatory or voluntary noncompliance and outcomes related to advertising, promotion, or sponsorship.
- **Customer privacy** is about substantiated breaches of privacy.
- **Socioeconomic compliance** is about product fines and sanctions.

More information about the GRI and its Reporting Standards can be found in the online Resource Center.

ISO Sustainability and Related Standards

The International Organization for Standardization (ISO) is a worldwide federation of the national standards institutes of 165 countries. It is a nongovernmental organization (NGO). ISO is a trusted partner in the global community for the development of globally relevant international standards. The current ISO portfolio includes more than 21,000 standards and other types of documents. Different certification processes and standards are available for many types of industries, ranging from agriculture and construction, through mechanical engineering and manufacturing and distribution, to transport, medical devices, food technology, environmental protection, oil and gas, ship building, and information and communication technologies. ISO also has standards for good management practices and for services.

Why is ISO important? Implementing international standards or guidelines or maintaining a certification can provide the following benefits to companies:

- Helps improve efficiency of business operations, productivity, and the bottom line
- Facilitates national and international trade, prevents trade barriers, and makes trade fairer

- Reduces negative impacts on the environment
- Provides governments around the globe with a technical base for health, safety, and environmental legislation and conformity assessment
- Promotes best practices and the sharing of innovative technological advances and good management practices

The following are important key aspects of ISO:

- **Voluntary.** ISO standards are voluntary. As an NGO, ISO has no legal authority to enforce the standards' implementation. Conformance relative to ISO standards is an affirmative indication or judgment that a product or a service has met the requirements. However, some ISO standards (mainly those concerned with health, safety, or the environment) have been adopted by countries as part of their regulatory framework. In some cases, although ISO standards are voluntary, they may become a market requirement (e.g., ISO 9001 Quality Management Systems).
- **Market-driven.** ISO develops standards for which there is a market need. An international cross section of experts in the field (e.g., industrial, technical, and business sectors) who have asked for the standards and other parties with relevant knowledge (such as representatives of government agencies, consumer organizations, academia, and testing laboratories) collaborate as technical committees to develop the standards.
- **Consensus.** The fact that ISO standards are developed in response to market demand and are based on consensus among the interested parties ensures widespread applicability. Standards are reviewed at least every five years to decide whether they should be maintained, updated, or withdrawn. The review process ensures that the standards remain state of the art.
- **Registration.** Registration is the audit of an organization's implementation and conformance to ISO standards. It should be noted that the conformance to standards themselves does not contain any requirement for registration. Requirements for registration come from customers or governments. In some instances, registration is required by a customer or a government agency as a condition of doing business. Some companies also choose to seek registration to market capabilities.
- **Generic management system standards.** Many ISO standards are highly specific to a particular product, material, or process. However, ISO 9000 and ISO 14000 Series Standards are examples of "generic" standards, which means that the same standard can be applied to any organization, large or small, and any product or service, in any sector of activity. Such generic standards are applicable to business enterprises, government departments, or nongovernment public administration. ISO 9001:2015 provides a set of requirements for implementing a quality management system; ISO 14001:2015 provides generic requirements for an environmental management system.

ISO certification must be renewed every three years. When a new ISO version of a standard becomes available, certified organizations have a three-year period to make the transition. Because ISO certification has become so widespread, it has become an expected requirement in requests for proposal (RFPs)/invitations to tender (ITT).

Whether an organization achieves ISO registration or merely implements and maintains ISO compliance, the results will be of benefit in supply chain management.

Quality Standards

ISO 9000 is a series of standards related to quality, which helps with sustainability by reducing scrap, defects, and returns.

ISO 9000 Series Standards

The *APICS Dictionary*, 16th edition, defines the **ISO 9000 Series Standards** as

a set of international standards on quality management and quality assurance developed to help companies effectively document the quality system elements to be implemented to maintain an efficient quality system. The standards, initially published in 1987, are not specific to any particular industry, product, or service.... The standards underwent major revision in 2008 and now include ISO 9000:2008 (definitions), ISO 9001:2008 (requirements), and ISO 9004:2008 (continuous improvement).

Note that ISO 9000:2015, ISO 9001:2015, and ISO 9004: 2019 are the current versions of these standards.

ISO 9001:2015, Quality Management Systems Certification

ISO 9001 specifies the requirements for a quality management system (QMS). To satisfy ISO 9001's requirements, the organization needs to demonstrate that it can consistently provide products and services that meet all applicable regulatory and statutory requirements while working to enhance customer satisfaction by applying the principles within ISO 9001 effectively. This includes continually improving the quality management system and being able to provide assurance that the products and services conform both to customer requirements and applicable regulatory and statutory requirements.

ISO 9001:2015 is a framework for developing quality processes at an organization and designing quality into product design, research and development, production, implementation or installation, and service.

ISO 9001 focuses on customer requirements, top management commitment to quality, a process-centered approach, and continual improvement. It helps organizations achieve product consistency and high quality. For supply chain managers, ISO 9001–certified suppliers are more likely to be able to meet needs and expectations and to comply with all relevant regulations. Note that while ISO 9001 certification indicates conformity to the quality process, it is never a statement of product conformity. It

relates to the ability to be consistent and high quality rather than to specific goods or services. For example, the product may meet stated requirements and all applicable regulations but not meet actual requirements.

Certification to ISO 9001 requires that organizations perform their own internal audits of their quality processes and procedures. Accredited organizations can optionally be used to audit the organization and grant ISO 9001 certification. Organizations that pass these audits can state that the relevant processes conform to ISO guidelines.

If a certified supplier appears to have ongoing quality issues, this should be escalated first through the supplier itself with appropriate feedback and then, if not resolved, brought up with the independent third-party certification body (registrar). If still not resolved, complaint can be made to the accreditation body (if the certification body is accredited).

Environmental Standards: ISO 14000 Series Standards

ISO 14000 is a key method of providing assurance that the organization is living up to its environmental commitments.

The *APICS Dictionary*, 16th edition, defines the **ISO 14000 Series Standards** as

a series of generic environmental management standards developed by the International Organization for Standardization, which provide structure and systems for managing environmental compliance with legislative and regulatory requirements and affect every aspect of a company's environmental operations.

The standards help companies to minimize harmful effects on the environment due to their activities and to continually improve environmental performance. Originally developed as an outcome of the 1992 Rio Summit on the environment, these standards provide a framework for a company to develop an environmental management system as well as an audit program. An environmental management system (EMS) enables an organization to

- Identify and control the impact of its activities, products, and services
- Continually enhance its environmental performance
- Develop a systematic method for establishing environmental objectives and targets as well as measures of its ability to achieve them.

The ISO 14000 family of standards includes the following.

- **ISO 14001:2015** offers a framework for a strategic, holistic approach to an organization's environmental policy, plans, and actions. It explains the generic requirements for an EMS to be used by businesses or industry. It requires that an organization be committed to complying with applicable environmental legislation and regulations as well as to continuously improving its efforts. Organizations at any level of sustainability implementation will find this useful. The 2015 revision

describes incorporating environmental management into strategic planning and leadership, emphasizes proactive implementation of sustainable practices, looks at how to track performance trends for improvement, focuses on life cycle thinking, and adds a communication methodology. This is the only standard in the series against which it is currently possible to be certified by an external authority.

- **ISO 14004:2016** provides guidelines on the specific elements of an EMS and its implementation and explains the main issues involved. It can serve other purposes as well: providing assurance to stakeholders, complying with regulatory laws, serving as proof of the organization's claims about its environmental practices, and illustrating its conformity.
- Other sections provide information about principles of environmental auditing; sampling, testing, and analytical methods; qualification criteria for environmental auditors; labeling concerns; and life cycle issues.

While there are as yet no global standards governing electronics or other products in regard to material content reporting, reduction of hazardous materials components, or responsible end-of-life recycling and disposal, the trend in that direction seems likely to continue to grow.

ISO 14001:2015 Certification

Certification to the ISO 14001:2015 standard can help the organization meet legal and stakeholder requirements related to environmental performance and improve public image, and it may give the organization a competitive advantage or financial benefit.

Industry-Specific Guidelines and Standards

ISO 14000 has had such an immense impact on so many organizations' business practices and trade that ISO has also developed guidelines and standards for specific industries, groups, and areas of interest, such as

- Automotive
- Customer satisfaction
- Education
- Energy
- Food safety
- Information security
- Health care
- Local government
- Medical devices
- Petroleum and gas
- Risk
- Ship recycling

- Supply chain security.

Familiarity with the standards that are applicable to your industry is recommended. A link to the ISO website with industry-specific standards is provided in the online Resource Center.

Not only are there ISO standards for these areas, but in some cases there are documentation requirements developed by organizations such as the U.S. Food and Drug Administration (FDA), the U.K. Medicines and Healthcare Products Regulatory Agency (MHRA), and so on. The U.S. FDA has developed regulations requiring thorough documentation of the chain of custody or audit trail of drugs. Distribution centers and carriers need to understand the documentation and information that must accompany pharmaceutical products as they move from company to company. Documentation of temperatures must also be provided regarding cold chain storage for items that must be kept within a given temperature range, for example, certain foods and vaccines.

Social and Safety Standards

ISO 26000 and SA8000 are examples of methods used to assure customers and the community that the organization is living up to its goals related to corporate social responsibility.

Worker safety is an important aspect of social sustainability. ANSI Z.10 is an example of these types of accreditations and certifications.

ISO 26000:2010—Guidance for Social Responsibility

ISO 26000:2010 refers to guidance for social responsibility. According to the *APICS Dictionary*, 16th edition, **ISO 26000** is

an international standard adopted by the International Standards Organization to assist organizations in contributing to sustainable development beyond legal compliance through a common understanding of social responsibility. ISO 26000 is not a management system standard and it's not intended or appropriate for certification purposes or regulatory or contractual use.

ISO 26000 provides a structure for organizations in the private and public sectors to think about how they can act and operate in a socially responsible manner. The underlying goal of social responsibility is to make contributions to sustainable development.

ISO 26000 addresses seven primary subjects within its guidelines, including organizational governance, human rights, labor practices, the environment, fair operating practices, consumer issues, and community involvement and development. ISO encourages an organization to first take the time to do two critical things:

- Recognize its social responsibility within its sphere of influence
- Identify and engage with its stakeholders

Once those have been accomplished, the organization is ready to analyze the seven core areas and determine how it will integrate social responsibility into its decisions and activities.

Social Accountability International SA8000 Guidelines

The *Dictionary* defines **SA8000** as

a widely recognized international standard for managing human rights in the workplace. It provides an auditable framework for assuring that social accountability is being stewarded by an organization.

The SA8000:2014 standard produced by Social Accountability International is an auditable social certification standard designed to promote decent workplaces in any industrial sector by providing a common language for measuring social performance. It is based on many of the conventions and declarations of the UN (especially the Declaration of Human Rights) and the International Labour Organization and on national laws.

The standard is built around the idea that continuous review needs to be built in by specifying management systems, structures, and procedures that organizations need to adopt into their normal operations. Thus the organization's policies and procedures need to reflect the following nine principles of SA8000:

- **Child labor.** Neither use nor support child labor, supported by policy and procedure. (A child is a person under 15 years of age unless local laws set the age higher than this. A young worker is a person above the age of a child but under 18 years of age.) Young workers are allowed if they don't work during school hours or at night or for more than 8 hours per day or 10 hours including transportation. Provide funds to attend school as needed. Expose no minors to physical or mental hazards.
- **Forced or compulsory labor.** Neither use nor support forced labor including prison labor and human trafficking. Never retain ID papers, require "deposits" to the organization on hire, withhold pay to force labor, or charge employment fees. Employees are free to leave the premises or quit.
- **Health and safety.** Provide a safe and healthy workplace by minimizing risk and eliminating hazards when feasible, protecting new mothers, providing protective equipment, having a health and safety officer and committee with union or worker representation, providing appropriate training, and using documented safety procedures. Facilities shall be clean and sanitary, including bathrooms, water, break spaces, and dormitories. Employees don't need permission to escape imminent danger.
- **Freedom of association and right to collective bargaining.** Respect the right to form unions through word and deed, unless prohibited by law, in which case employees shall have the right to elect representatives. Avoid discrimination, intimidation, or harassment of union members.

- **Discrimination.** Don't discriminate in any form of pay or promotion against any class of person, and allow persons to observe tenets or practices of the groups to which they belong. Prohibit threatening or abusive behavior of a verbal, physical, or sexual nature. Never use pregnancy or virginity tests.
- **Disciplinary practices.** Never tolerate corporal punishment, mental or physical coercion, verbal abuse, or harsh or inhumane treatment.
- **Working hours.** Comply with all laws and union agreements on working hours, holidays, and overtime. Give one day off per week unless allowed by law or union work-time averaging agreements exist. Overtime must be voluntary except to meet short-term business demand and never regularly requested.
- **Remuneration.** Pay a living wage and always meet minimum wage laws. Never deduct pay for disciplinary purposes except when permitted by national law and union rules. Never pay in coupons or promissory notes, and make pay promptly available along with clear information on pay and benefits. Pay overtime premium rates. Never use labor-only contracting, consecutive short-term contracts, or false apprenticeships to avoid labor laws.
- **Management systems.** Conspicuously display a notice of the voluntary decision to comply with SA8000 and all national and local labor laws. Develop and communicate policies and procedures to implement SA8000. Keep relevant records to demonstrate conformance. Regularly conduct management reviews. Provide policies on request.

SA8000 Social Accountability Certification

SA8000 cuts across multiple industries. The standard is a way for retailers, brand companies, suppliers, and other organizations to maintain just and decent working conditions throughout the supply chain.

Certification to the standard is available but needs to be redone for each specific work site. Certification is available for almost any industry but is not currently available for fishing, offshore, or maritime industries. Certification is also not possible in Myanmar (Burma) due to International Labour Organization sanctions. Social Accountability Accreditation Services (SAAS) provides certification bodies with information on the steps that need to be taken to be accredited to perform SA8000:2014 certification audits.

ANSI Z.10-2012—Occupational Health and Safety Management Systems

As defined in the *APICS Dictionary*, 16th edition, **ANSI Z.10** is

a voluntary consensus standard on occupational health and safety management systems. It uses recognized management system principles in order to be compatible with quality and environmental management system standards such as the ISO 9000 and ISO 14000 series.

ANSI Z.10-2012 is a standard designed to help organizations design, implement, and continuously improve health and safety management systems to minimize the risk of occupational injuries, illnesses, and fatalities.

This American National Standards Institute (ANSI) standard focuses on principles rather than detailed specifications to allow organizations to implement it in a manner suited for their given industry. It is compatible with ISO 9001 and 14001 and with common practices and regulations in this area in the U.S. Achieving a certification in this area shows that the organization is willing to go above and beyond the minimum regulatory requirements set by government organizations such as the Occupational Safety and Health Administration (OSHA) in the U.S.

The ANSI-ASQ National Accreditation Board (ANAB) is the U.S. accreditation body that accredits third-party certification bodies to provide certifications for this standard as well as for ISO 14001 and ISO 28000.

Section C: Technology Trends

This section is designed to

- Consider emerging trends, including the cloud, machine learning, data analytics, sensors, telematics, control towers, quantum computing, drones, and more
- Understand how the supply chain digital transformation requires an intelligent supply chain that can integrate emerging technologies
- Describe how an intelligent supply chain depends most strongly on blockchain, intelligent asset management, and the Internet of Things
- Describe technology selection criteria and choice, technology risks, and technology strategic alignment
- Explain when to apply project management to supply chain initiatives and when to manage initiatives as normal operations
- Discuss the basics of project management
- Describe how to manage projects in terms of scope, time, and budget
- Identify the steps for managing change and incremental improvements within the supply chain and its partners
- Explain how to incorporate change management into any large initiative, especially if it requires changes to organizational culture
- Maintain technologies using well-defined processes to promote value and longevity.

Without technology, the current concept of supply chain management would not exist. Technology has allowed businesses to move from department-centric spheres of control to a focus on business processes that spans departments and extended supply chains. As technology has evolved, it has enabled increasingly complex business strategies, metrics, and analysis, which in turn have sped up the pace of business and given business a global reach. Technology is quickly becoming a world-class performance enabler because it helps interconnect the key elements of a value-driven network.

Here we describe a large number of emerging technologies and show how successful integration of various technologies can lead to an intelligent supply chain. After these discussions, we show how to evaluate and implement technologies in ways that minimize risk. Project management and change management are discussed as key enablers of change. Technology maintenance is also addressed.

Topic 1: Emerging Technology Trends

Here we review some general emerging technology trends, and then we discuss intelligent supply chains, which rely on many emerging technologies, in particular, blockchain, intelligent asset management, and the Internet of Things to provide supply chain visibility and control.

Emerging Technologies

Emerging technologies described here include cloud computing, artificial intelligence, machine learning, data analytics, sensors, telematics, control towers, quantum computing, 3D printing, wearable technology, augmented reality, robotic process automation, autonomous/automated guided vehicles, and drones.

Cloud Computing

Cloud computing is a distributed set of servers, databases, applications, and networks that provides online access as leased platforms, data storage space, or applications. Rather than storing data on a particular database's hardware, for example, a cloud solution does not permanently designate space to any one client or use but instead allocates it on a floating basis to enable flexibility in expanding or contracting based on needed capacity. This makes the systems efficient.

Cloud applications are accessed on a web browser and are offered as leased solutions called software as a service (SaaS). For example, rather than purchasing a transportation management system, the software could be leased, which, in addition to providing the basic functions, could be integrated with traffic data and so on. Such solutions can greatly reduce implementation and upgrade costs and speed time to value. The vendor automatically upgrades the software seamlessly. Supply chain partners can also easily sign up for the same service and participate to gain real-time visibility into demand or supply issues. There are also procurement networks that enable buyers and sellers to find each other and to automate their transactions.

Similarly, organizations can eliminate their owned platforms or infrastructure and lease platform as a service (PaaS) or infrastructure as a service (IaaS). SaaS providers may be PaaS customers, and PaaS providers may be IaaS customers.

Cloud computing downsides include the ongoing lease cost, the fact that ending the lease ends the service, the risk of internet failure restricting access, and the risk of the organization's sensitive data being in the hands of a third party. These systems tend to have good protections, however, including backing up data in more than one geographic location. Another issue to explore is system response times. Warehouse management systems are slow to migrate to SaaS in part due to the fast response time needed for materials handling or connecting to terminals.

Artificial Intelligence, Machine Learning, and Data Analytics

Artificial intelligence (AI) is advanced software capable of self-improvement. Machine learning is software that mimics human decision making. It relies on preset logic, policies, and controls. Decision support systems are an example. Data analytics is the processing and manipulation of large amounts of data (called "big data" when the amount of data is very large and a lot of processing is required) from multiple sources to generate useful insights and actionable information.

These types of systems are becoming better and better at pattern detection such as for fraud or bottlenecks. They support continuous process improvement through optimization algorithms, for example, for optimization of distribution networks, inventory levels, picking and shipping order, and marketing promotions. Promotions could even be customized to specific customer segments or adapt to demand changes on an hourly basis.

Advanced types of data analytics such as predictive analytics rely on AI or machine learning to predict things like equipment maintenance requirements. This can help reduce excess parts inventory and improve equipment longevity. It can also help predict the best locations for positioning maintenance staff. Similar systems can help allocate resources for manufacturing or service provision.

Sensors and Telematics

Sensors and telematics are remote sensing and remote control technologies that rely on photosensors, radio frequency identification (RFID), lasers, and so on to provide automated data capture and control from a remote control center.

Sensors and telematics can provide process visibility and automation to a greater range of industries than in the past. In addition to improving internal systems, data from such systems can be shared with supply chain partners to better balance supply and demand and manage inventory levels. For example, an automated bar code scanner or RFID sensor on a conveyor belt can scan goods as they pass by. These technologies also help with asset utilization, such as indicating when a vehicle is idle versus in use. Driving habits can also be assessed. Data analytics or big data systems may be needed to create useful information out of the data from multiple sources. The information can be presented on interactive dashboards or other simplified interfaces.

Control Towers

A supply chain control tower is much like an airport control tower in that it is intended to provide centralized visibility and control. A supply chain control tower consolidates real-time, end-to-end data from around the supply chain to enable visibility, analysis, prediction, and control. These control towers are most commonly offered as cloud-based solutions. The software has dashboards that enable operators to drill down into the details for better visibility and to exercise control such as by doing real-time order planning and exception management. The software may also have artificial intelligence, machine learning, and data analytics capabilities. However, there is no standard definition of what a control tower is, so it is critical to do due diligence on requirements and gaps before investing in a control tower. Existing systems may already have many of these capabilities.

There are many subtypes of control towers, such as

- Transportation control towers that analyze on-time orders, transport costs, and performance and enable control such as track and trace, exception management, single-tier inventory sourcing, and transportation optimization

- Supply chain control towers that analyze on-time in full (OTIF) orders, total cost to serve, and 3PL/broker performance. These towers enable control such as full visibility, a broader set of exceptions, multi-tier inventory sourcing, and optimization that uses internal and external capacity for storage and transportation.

Quantum Computing

Quantum computing is an entirely different way to build a computer. While a supercomputer is just a really extensive version of a regular computer, a quantum computer uses principles from quantum physics and nanoscale superconductors chilled to nearly absolute zero to enable simultaneous mapping of all the millions or billions of permutations of a problem in a vast multidimensional space. Using principles of wave form interference, the correct solutions are magnified in amplitude while the incorrect solutions shrink. Because a quantum computer can look at all answers simultaneously rather than sequentially, it is radically faster than a supercomputer for optimization problems. Consider this example provided by IBM of finding one item in a list of one trillion where it takes one microsecond to check each item. A supercomputer would take about a week to find the answer; a quantum computer could do the task in about one second. While quantum computing is still considered to be in the early stages of development, such computers exist, and organizations like IBM are ramping up related hardware and software engineering.

Since supply chains are all about optimizing systems with numerous tradeoffs, quantum computing services might be leased as a service to optimize many things such as delivery routes to multiple cities to find the option with the smallest fuel cost. In a sustainability example, IBM has teamed with ExxonMobil to use quantum computing to discover new materials to reduce carbon emissions.

3D Printing

3D printing is printing on demand of 3D objects based on 3D digital models, typically by adding a material such as plastic or metal one layer at a time. 3D printing can be used for on-demand manufacturing at the point of demand, such as for replacement parts or items with uncertain demand that would not benefit by being kept in inventory. The lack of need to ship the item can provide sustainability benefits. This type of make-to-order may find applications in aerospace, medical devices, defense, automotive, and consumer products.

A key application of 3D printing is rapid prototyping, since any 3D design can be printed and become a real object that can be experienced.

Wearable Technology and Augmented Reality

Wearable technology includes a variety of hands-free devices that are integrated into information systems (e.g., warehouse management systems) to enable visual or voice- or gesture-based interactions rather than requiring keyboard entry or delayed entry of data. Many such systems exist for

warehouse picking and put-away (e.g., pick-to-voice). These systems reduce errors and increase worker efficiency. The systems also leave the hands free to enable physical movements of goods and so on.

Augmented reality (AR) is a feature of vision-based wearable technology that overlays instructions or graphics on top of normal vision to provide interactive guidance. Smart glasses and heads-up displays in vehicles are examples.

Issues with smart glasses include how to accommodate people who wear glasses and how to secure information accessed on such devices. Issues with wearable technology in general include the battery life of the systems.

Robotic Process Automation

Robotic process automation (RPA) does not refer to actual robots such as those used in a plant but instead to the use of software “bots” to automate repetitive interactions with customers or with other automated systems. This includes interactions with customers or third parties such as responses to frequently asked questions or service inquiries. It can take the form of automated emails, texts, or online chat functions. The primary benefit is a large reduction in customer service labor costs. The primary issue is that such systems are not as good as a real person and some customers may be dissatisfied. Some issues will still need to be escalated to a real person.

Autonomous and Automated Guided Vehicles

Autonomous vehicles include self-driving cars and semis, but such vehicles still face regulatory hurdles. The primary supply chain management use of automated vehicles at present is in automated guided vehicle systems. The *APICS Dictionary*, 16th edition, defines **automated guided vehicle system (AGVS)** as follows.

A transportation network that automatically routes one or more material handling devices, such as carts or pallet trucks, and positions them at predetermined destinations without operator intervention.

AGVS is used in manufacturing or warehousing. The devices navigate using markers, wires, vision sensors, radio frequency communications, and so on. Amazon and many other warehouses use robots such as this to move warehouse freight to the pickers rather than vice versa. These systems reduce labor costs, help control inventory, improve worker safety, enhance efficiency, and use less energy. Selection should be based on requirements and cost, but there are many varieties, so there should be a flexible solution to a given materials-handling issue. AGVS may include real-time communication anywhere, GPS, and various types of sensors.

The primary issue with such technology is its cost, though this has been falling over the years. Most systems have a payback period in the range of two years, according to *Technology in Supply Chain*

Management and Logistics. Another issue is the time required for the implementation project, which the same source says can range from six months to a year.

Drones

Drones are autonomous or remote-controlled aircraft with sensor packages. While drones have significant potential, current uses include tracking assets in yards, performing inventory counts, pipeline inspection, or inspection of difficult-to-access areas. Drones face significant regulatory restrictions on their use.

Intelligent Supply Chains and Enablers

Intelligent supply chains refer to supply chains that take advantage of numerous emerging technologies, including the Internet of Things (IoT), intelligent asset management, blockchain, big data, machine learning, advanced analytics, and so on. An intelligent supply chain integrates all of these technologies into a seamless whole. It re-imagines related processes, relationships, and training requirements to enable fast reactions to changes in customer needs or market changes while keeping costs low. Organizations that are succeeding in these areas are said to be at the forefront of the supply chain digital transformation.

Internet of Things (IoT)

The Internet of Things (IoT) describes the networking of non-computer devices such as equipment, drones, automated storage and retrieval systems, shipping containers, electronic shelving (automatic retail price updates), printers, and other devices using internet communications. Each object receives a unique ID. From a track-and-trace perspective, traceable objects such as shipping containers can be linked using IoT technology and GPS devices (such as radio frequency identification [RFID]) to determine their whereabouts in real time.

IoT devices can update the organization's information systems on their status, sensor readings, maintenance status, maintenance needs, and location. They can be used alongside interactive fleet management software to direct or redirect shipping vehicles or with blockchain and intelligent asset management to provide reliable chain-of-custody information for devices or their cargo. However, universal standards for device security still do not exist. There is a risk that these devices can be hacked to gather information or that the devices may be used for nefarious purposes such as creating a denial-of-service attack using many IoT devices simultaneously.

Blockchain

Blockchain is a distributed ledger system in which it is nearly impossible to alter information once it has been recorded in the ledger as a "link" in the chain of records. This is because the ledger is distributed among the participants and all of the versions need to agree with one another. The systems use

complex cryptography and networking rules to make this happen without needing to rely on an independent third party. Blockchain can provide a number of benefits for track and trace, including

- Reliable (irrefutable) evidence of transfer of goods between parties, which in turn creates a chain of custody for goods and their source materials
- Automated capture and distribution of reliable data from IoT devices, such as temperature records of a refrigerated truck
- Preventing insertion of counterfeits into the network by validating serial numbers.

Blockchain is most famous for being the technology behind cryptocurrencies, but it has numerous supply chain applications in addition to those noted above, including smart contracts, asset tracking, parts origins, inspections/audit tracking, secure procurement bidding, and other types of supply chain data (e.g., pharmaceutical tracking).

There are several competing blockchain solutions for water shipping and ports. TradeLens is a joint venture of IBM and Maersk, and it opened itself up to general availability in 2021 and acquired ten new Chinese companies (port groups and intermodal/inland providers) in the first month. Another blockchain system is the Global Shipping Business Network (GSBN), which includes COSCO Shipping Lines and a number of other major carriers and terminal operators.

Intelligent Asset Management (IAM)

Intelligent asset management (IAM) creates a digital version or “digital twin” of an industrial asset. This enables organizations or divisions to control the sharing rights over that asset. The asset’s performance status can be visible not only to maintenance and operations personnel but also to the engineers who designed the asset so they can engage in continuous improvement.

Blockchain, IAM, and IoT Case Study

A technology road map is a tool used to facilitate technology planning, collaboration, and consensus building among various areas of the organization. The road map helps the organization begin with the end in mind and map out the broad steps that will be required to get there over time. These road maps are often used for longer-term planning on agile projects (e.g., for software development) because they are kept at a high enough level that they can be easily revised. This is important in an agile project because customer-driven changes are welcomed even late in development. Since process technology requirements are also subject to change as the market changes or new technologies become available, a road map is often a great tool for flexible planning. Road maps can take many forms, but, in general, they should be easy to interpret, brief, and high level.

Exhibit 8-16 shows a road map for a shipbuilder that has decided to transition to blockchain, IAM, and IoT equipment to help track and coordinate the use and maintenance of its ship manufacturing assets, from large equipment down to tools and dies. Larger powered equipment will have RFID tags that broadcast its whereabouts and maintenance status. Smaller things like tools and dies will have quick

response (QR) codes, and these 2D bar codes will be scanned as items are checked out and moved to various locations. The blockchain system will operate in the background to collect these data at multiple locations and create a time line of how the assets are used. Advanced analytics will determine proactive maintenance requirements and optimal amounts and locations of each type of asset.

Exhibit 8-16: Shipbuilder’s Road Map for Blockchain, IAM, and IoT Initiative

Goals	Year 1	Year 2	Year 3
Business	Meet technology initiative budget and schedule.	Meet asset utilization goals using blockchain tracking for QR and RFID.	Break-even, analysis, messaging, and asset optimization.
Product (i.e., ships being built)	Maintain shipbuilding project schedules during changes.	Enable shipbuilding project change request evaluations related to asset availability.	Enable compressed shipbuilding project schedules.
Process	Develop and train asset checkout and use process.	Develop and train predictive maintenance process.	Develop and train asset optimization process.
Equipment	Install bar code readers and tag small assets with QR codes.	Upgrade heavy equipment with RFID and install detectors.	Adjust equipment and asset levels based on internal demand patterns.
Software	Develop blockchain minimum viable product (MVP). Develop IAM MVP.	Blockchain release 1: equipment RFID interfaces IAM release 1: predictive maintenance and engineering feedback	Blockchain release 2: analytic interfaces IAM release 2: IoT and IAM automated updating

Note how various categories of goals are made clear. Other road maps that have complex dependencies between goals could use a flowchart-type design, with arrows between the various elements to show what aspects of the initiative need to be done before other elements can be started or which sub-initiatives require close coordination.

Topic 2: Technology Assessment and Implementation

Technology can fuel the supply chain digital transformation, or it can be a huge expense that does not provide the envisioned benefits. The amount of work put in up front in evaluating the organization’s capabilities, requirements, and gaps and comparing this information to the actual pros and cons of technology solutions strongly influences what results will be realized. Here we address technology audits and implementation reviews, ensuring alignment, and technology selection criteria and selection. Project management and change management are also addressed here as key technology implementation enablers. The final subject is the ongoing maintenance of technology.

Technology Audits and Implementation Reviews

A thorough analysis of the organization is required before making IT investments. What are the firm's current networking capabilities? What is needed to get to the next stage of supply chain development? A technology audit can answer such questions. It can also help in mitigating risks and allocating technology spending. Technology audits can be performed by internal auditors or external third parties. Technology audits and later technology selection and implementation of new technology are run as projects using project management.

IT audits test for system availability, security, confidentiality, and integrity. They play a critical role in compliance with the U.S. Sarbanes-Oxley Act of 2002 (SOX), which requires U.S. public companies to establish adequate internal financial reporting and IT controls. (Canada has a similar Bill 198, known as "Csox.") For example, an IT audit should reveal that persons who approve purchase orders cannot also receive goods.

The audience for a technology audit is upper management, not IT or a specific department. The audit may investigate multiple companies in the supply chain and report to a cross-enterprise executive committee or boards of directors.

Technology audits include pre- and post-implementation IT reviews, system development life cycle (SDLC) reviews, and database reviews, but only post-implementation reviews are discussed more next.

A post-implementation review addresses whether or not the company has received the expected return on investment (ROI). This review can also be run as a project. Reviewing lessons learned can help the next project be more successful. If the review is included as part of the initial project plan, each manager will have a strong feeling of accountability. A post-implementation review should focus on items that can be measured and therefore managed. Incentives for project team members are key to success in achieving overall supply chain goals. These incentives should include financial success as well as other measures such as customer satisfaction and quality (i.e., a balanced scorecard system). Stock price is not a fair measure for IT investment because it fluctuates in response to many factors.

Audits can reveal

- Software vendor promises that were false
- Failure to provide the promised level of system integration
- That full features of the software are not being exploited because of resistance to change or inadequate training.

The results of audits are rarely entirely positive, but negative results should be used to create positive organizational change.

The external auditor's recommendations on IT should include an explanation of the cost of continuing to use the existing technology versus replacement cost. A benefit-cost study from historical past estimates

and true costs can show where costs were poorly estimated or overlooked. If current or prior investments had a negative ROI, the auditor should indicate how future IT can produce a positive return, such as by using add-ons to current technology.

Mitigating Typical IT Risk

It is important that the proper analysis be conducted before an IT project is initiated. While a benefit-cost analysis is vital to determine if the project should have a positive return on investment (ROI), this is just one of many ways to mitigate typical IT risk.

IT projects can mitigate typical risks by adopting the following approaches.

- **Make incremental improvements.** Management may be tempted to try to solve all problems in one large project. Such projects are hard to manage and prone to failure. Organizations that take incremental steps can add innovation between steps. A large project can have go/no go milestones.
- **Clearly define business requirements.** Because evaluations take weeks and thousands of vendors can be available, management must be convinced from the start to clearly define business goals to ensure that evaluators have met management's principal criteria.
- **Perform due diligence on proposals.** Rather than rely only a marketing presentation from the provider, IT purchasers can limit the risk of a new system by interviewing previous purchasers and using third-party evaluators. Many project failures are traced to processes or proposed software that were not properly understood.
- **Control scope creep.** The activities required to carry out a project should be fully and carefully defined in written documents. There should also be written procedures for defining and estimating the costs of additional work.
- **Control excessive customization.** When packaged software cannot fit the organization's business processes perfectly, a dilemma organizations may face is deciding whether to adapt their processes to fit the standard delivered functionality or to customize the software to allow current practices to remain in place. A good rule of thumb is to look for packages that meet at least 80 percent of needs "out of the box." The remaining 20 percent can be met through customization. While there will be short-term pains in pursuing organizational change over customization, in the long run it will lead to a much lower total cost of ownership, easier software upgrades, and less-expensive training of users. Many companies have faced expensive technology issues because they customized software when they should have updated and changed their business processes. Note that some customizations are riskier than others. At the low risk end, many software packages have built in extra "blank" data fields for custom use; far riskier customizations involve altering raw source code.

Technologies and Alignment

Technology for supply chain management consists of process technology (e.g., operations machinery, warehouse equipment, transportation equipment) and information technology (IT). This may include information processing that helps transform materials or process departmental data. For service industries, technology can help “transform” customers, such as by transforming sales leads into customers or by transforming service requirements into services such as provision of information, experiences, or actions.

A process technology strategy provides guidance for those making decisions about how to apply technology to help the supply chain meet performance objectives. The supply chain strategy must be aligned not only with the organization’s overall business strategy but also with the organization’s **information system architecture**, defined in the *APICS Dictionary*, 16th edition, as follows:

A model of how the organization operates regarding information. The model considers four factors: (1) organizational functions; (2) communication of coordination requirements; (3) data modeling needs; and (4) management and control structures. The architecture of the information system should be aligned with and match the architecture of the organization.

Technology and Equipment Requirements

Technology and equipment requirements start out broad and become more specific. Analyzing requirements at the strategic, tactical, and operational levels helps ensure alignment at each of these levels.

Strategic Requirements

Organizations develop technology systems requirements or specifications to support organizational strategy and goals. The organization’s technology requirements need to align with its strategy for competition and growth. For example, if the organization is a low-cost provider, technology solutions will either need to help lower costs by far more than the technology investment cost or be inexpensive solutions that keep their own capital investment requirements down. If the organization is working to provide differentiation, the technology requirements need to support that differentiation. Other strategic requirements will relate to the organization’s priorities for quality, speed, dependability, flexibility, and cost.

Tactical Requirements

Tactical requirements for supply chain process technologies may include degree of automation, user-friendliness, maintainability, throughput, and ability to satisfy storage or transportation objectives such as need for a cold chain.

From a manufacturing environment, layout, and type perspective, technology and equipment requirements need to fit the choices made for the production process. Flexible machines (and workers) are needed to meet product variety requirements. Heavy capital investment is required for the dedicated and often highly specialized equipment used in line production (assembly line) and mass/continuous production processes. High utilization rates and high-volume production runs result in low unit production costs and high production efficiency.

In a lean manufacturing organization, high utilization of large machinery is not likely the best path to production efficiency. Here the requirements will be for flexible equipment in terms of the ability to make both fast changeovers and fast equipment layout changes, such as into new cells. Use of smaller machines tends to be more conducive to lean's small batch production, need for quality control, and the addition or reduction of capacity in small increments when necessary.

Technology that enables maximum utilization of highly trained workers will be another lean technology requirement. Technologies that help cross-train workers or that make it easier to do the work with less training will be valued. For example, this could be a system that has mistake proofing and visual signals built in so that the task is more intuitive.

As should be clear, technology requirements can relate to every area discussed in this course, from demand management requirements, to reduced lead times and stockouts for better customer satisfaction, to inventory management technology requirements that relate to tracking and controlling the level of inventory and its accuracy, to distribution technology requirements that help partners share information seamlessly, reduce cycle times, and drive net costs down.

Operational Requirements

Obviously, technology requirements will need to be made more detailed and specific after high-level requirements have been determined. For example, for a visibility requirement, requirements for sensors could include environment hardening (durable sensors designed for harsh environments), accuracy, and precision requirements. Requirements should be specified as SMART goals (specific, measurable, attainable, relevant, and time-bound).

Technology Gap Analysis

The *APICS Dictionary*, 16th edition, defines a **gap analysis** as “a tool designed to assess the difference that exists between a service that is offered and customer expectations.” When used for a technology assessment, a gap analysis starts by determining the current state of capabilities related to technology and then gathers and analyzes the requirements of internal and external customers to envision a future or ideal state for those capabilities. The difference between the current and future state is the gap. A gap analysis will help further refine technology requirements.

A gap analysis is more of a process than a single tool. As such, it can make use of numerous tools discussed elsewhere in these materials. This can start with benchmarking to determine one's technology gaps relative to the competition or the voice of the customer to understand how customer requirements have changed since the last customer scan. (Internal customers should be scanned, too, to reveal gaps or inefficiencies in internal workflows.)

Process mapping can use a flowchart to map out the current process and then use this map as a starting point to streamline the process for the future state. A more supply-chain-specific type of process map organizations can use is value stream mapping. This tool adds things like push versus pull symbols and value-added versus non-value-added lead-time analyses.

In some cases, analysis of current capabilities will reveal that an existing technology system can already satisfy certain requirements, either as it is currently being used or by further leveraging the technology such as by training, process changes, or add-on tools. This will help reduce the set of unfulfilled requirements and the cost of bridging the gap.

In other cases, a gap analysis will reveal system, process, personnel, or partner limitations that need to be addressed before a new technology will be capable of being successfully integrated. Such limitations can include

- Underlying information system architecture layers that need to be replaced or upgraded prior to being able to support a new technology, such as a legacy system that would be incompatible, poorly scalable, or too expensive to integrate
- Processes that the technology would not support and that would need to be changed if the technology were adopted, such as an enterprise resources planning system that has different workflows and that would be cost-prohibitive to customize to the organization's processes
- Human resource (HR) skills gaps that would need to be closed using hiring, contracting, and/or formal and informal training, for example, process knowledge gaps, technical expertise gaps, and management and leadership gaps
- HR policy gaps that restrict personnel job expansion, employee empowerment, and so on that would need to be changed for the technology investment to meet its potential
- External partner gaps related to their willingness to change their processes and share information, risks, and/or investment costs.

The cost and time required to make these organizational changes or underlying technology improvements should be added to the overall cost of a technology feasibility analysis.

Technology Selection Criteria, Selection, and Cutover

Organizations adopt emerging technologies that are appropriate for competitive advantage and that fit their risk tolerance levels and limited resources for technology investments. Determining technology requirements and conducting a gap analysis help the organization begin with the end in mind so that it

can set technology selection criteria that are based on actual needs rather than wants. The process of selecting technologies also includes considering risks and rewards (e.g., strategic advantage).

Selection Criteria

Technology selection criteria include competitive advantage, risk levels, feasibility, and validation against requirements.

Competitive Advantage

Technology can convey competitive advantage when it is

- **Scarce.** First-of-its-kind technology and proprietary technology (protected by patent) are scarce. Competitors do not possess this technology.
- **Difficult to move.** The advantages created by the technology can be captured by competitors only by acquiring the organization and its technology.
- **Difficult to copy.** The barriers to competitors for developing the technology is high (e.g., skilled resources/capital investment or the organization has a significant head start on development). The technology security (both physical and digital) makes it difficult to reverse-engineer, emulate, or steal.
- **Difficult to substitute.** This occurs usually because the cost of switching from present to comparable technology is high due to barriers to adoption, including capital investment or the need for underlying technologies, processes, or personnel.

The organization may be developing its own technologies, acquiring firms that have developed proprietary technologies, or be an early adopter of new technologies developed and offered by others. In the last case, competitors may also be adopting these technologies, so the competitive advantage then comes in the form of who is first to market and how long that differentiation will last. Assuming that the technology adds value in the eyes of the customer, once most competitors have the technology, it is no longer an order winner and instead becomes an order qualifier.

Risk

New technology is vulnerable to risk. Risks must be identified and analyzed for impact and probability of occurrence. In general, the risk level accepted needs to be commensurate with the potential for reward, and it needs to fall within the organization's risk appetite (the level of risk it is willing to accept). Risks include the following:

- The technology project could be poorly managed and cost far more than planned for, consume too much time, or fail entirely after significant funds are sunk into it.
- The technology could fail to provide the envisioned level of benefits due to misrepresentation on the part of the seller, misunderstanding of actual requirements on the part of the buyer or seller, or poor

project implementation (e.g., underlying system, process, or human resources limitations that were not considered).

- A change in market needs could wipe out the benefits of the technology—for example, a growing desire for customized rather than identical products.
- The introduction of an even newer technology could negate the competitive advantages (e.g., of speed or flexibility) that the investment promised.
- A change in the external environment could make implementation impossible or costly. For example, a change in regulations could require changes to technology that reduce its benefits. Price increases for components, maintenance, or software configuration could affect the benefit-cost analysis.
- The technology could have unintended consequences. It could cause harm or long-term damage to workers or the environment, with, for example, the use of a hazardous material. Processes should be examined to understand the effects of technology and job designs on worker health and motivation. Jobs can be redesigned to provide more variety and opportunities to acquire new skills; processes can be redesigned to decrease repetitive stress injuries and to invite workers to participate in improving processes.

Feasibility

Feasibility tests involve identifying hurdles to implementing the technology. Both financial and organizational requirements are analyzed.

Performing a benefit-cost analysis is a key aspect of financial feasibility. This involves identifying and comparing all relevant costs and benefits for each alternative being considered. The basic analysis is to simply divide the total benefits by the total costs; values over 1.0 will have greater benefits than their costs. Costs that do not differ between alternatives and prior investments (sunk costs) should be ignored. Costs include initial investment, ongoing costs, and opportunity costs. Benefits of the technology options need to be quantified in monetary terms for this analysis. This can be challenging, since many benefits will need to be estimated and may not be measurable, especially before the decision needs to be made. Advanced financial analyses can take into account depreciation, net cash flows, the time value of money, payback period, expected useful life of the technology, and so on.

For example, performing a benefit-cost analysis of a piece of materials-handling equipment using a total-cost-of-ownership perspective factors in the initial price, the cost of capital used to finance the purchase, maintenance and repair costs (or service contracts), depreciation, and disposal—offset by the monetary value of increased productivity or security, flexibility, cycle-time or lead-time reduction, reduced material use, tax credits, and resale value at the end of the equipment's life.

From an organizational perspective, operations determines what will be required to implement the technology and manage the change. Some of the organizational issues will have implications in terms of costs, productivity, and employee engagement.

- The learning curve required by the new technology affects productivity and calculations of the payback period or the break-even point. The *APICS Dictionary*, 16th edition, defines the **learning curve** as follows:

A curve reflecting the rate of improvement in time per piece as more units of an item are made. A planning technique, the learning curve is particularly useful in project-oriented industries in which new products are frequently phased in. The basis for the learning curve calculation is that workers will be able to produce the product more quickly after they get used to making it.

- The way the new technology is presented to the organization can accelerate its eventual acceptance by the organization and can save costs related to poor change management. These can include decreased productivity and loss of employees frustrated by the new technology.

Discussions about the feasibility of new technology should involve employees whose work will be affected by the technology. Including these employees in early requirements discussions and in later considerations of potential alternatives will leverage their daily and up-close experience with the work. They may see issues and opportunities that are not apparent to managers. In addition, having input into decisions will encourage employees to “own” the technology decision. It will improve employee engagement and increase employees’ acceptance of the new technology.

Validation Against Requirements

Once technology investments are determined to be feasible, it is important to circle back to validate the solution against the requirements. For example, will the technology support the attainment of the organization’s priorities related to a set of generic strategic performance objectives?

- **Quality.** Does it create quality attributes that customers may value? For example, certain process technology may make materials less susceptible to failure later. Does the technology decrease the rate of specification nonconformance?
- **Speed.** Does the technology shorten the processing time or the delivery time (e.g., efficient routes) so that orders can reach customers more quickly?
- **Dependability.** Does the technology improve operations’ ability to deliver products/services as promised? Does it decrease operations’ susceptibility to internal disruptions and improve its resilience after disruptions?

- **Flexibility.** Does the technology support meeting different types of market needs in an efficient manner, allowing customization and configuration? Can it be easily adapted to operations' current capacity needs?
- **Cost.** Does the technology allow greater throughput (which will increase profit)? Does it decrease labor or materials costs? Is there a minimum level of capacity utilization below which the investment creates losses rather than profits?

Selection of Technology

Organizations may use a request for information (RFI) when they are looking to see the range of market solutions for a specific set of requirements. This should result in a short list of prequalified potential vendors. Once the organization knows what it wants, it can send out a request for proposal (RFP) or an invitation to tender (ITT). A less-involved process can be used for less-expensive investments. An alternative is to develop the technology in house or through a partner contract if this is feasible.

Selection between alternatives will start with a wide list of options that is then narrowed down to a short list of candidates that fit requirements and other criteria. All bidders should be given access to the same information. If one bidder asks a question, the answer should be provided to all bidders. The final bidders can be given a chance to provide a presentation or demonstrate the technology. The organization may accept an offer or negotiate with a short list of bidders for the best price, features, and so on. The winning bidder will get the contract.

Note that it is better to have a vendor prove that a technology can satisfy a given requirement than to take their word for it. For example, rather than looking at a generic demonstration of transportation scheduling software, provide the vendor with a sample of actual shipping order data and have them prove that the software can incorporate the data and properly prioritize deliveries.

Technology Cutover Plan

Implementation of technologies requires delivery, checking, and acceptance of hardware and software, integration with existing systems, cutover from the old system to the new system, handover of deliverables and documents from the project team to end users, formal user training, and ongoing support and maintenance.

Prior to cutover, all testing of the technology that is possible prior to going live needs to have occurred. Users need to be fully trained on new processes. All of these tasks are accomplished using project management.

The technology cutover plan details how the new technology will be activated and put into operation and how the old technology will be retired. The cutover from an old to a new technology presents risk and so should feature formal planning. Depending on the complexity, rehearsals may be needed.

Determining the best technology cutover method involves deciding between tradeoffs.

One method is to set a go-live date. The migration of data, switching of interfaces, final testing, and going live occur on a tight schedule. Users start using the new processes. The old system is retired. Hardware might be installed and set up in advance if it will not occupy the same space as the old hardware. This method can be efficient but has risks of downtime (customers cannot use the system, plant shutdown, etc.) if any critical task fails. Failure would involve backing out of the plan and turning the old system back on, so the cutover plan should have a process for this as well.

A lower-risk but more-expensive method involves fully maintaining the old technology or system during a cutover period while the new technology is also being used. In the case of software, data would need to be entered in both systems. The benefit is that if something goes wrong, the old system is still usable. The systems can also be compared to see if the same outputs are achieved. However, this duplicates labor, and qualified staff may not necessarily be available or may need to work overtime. In the case of process technology, if there is space to keep an old system available for use, this could serve as backup equipment or a backup work center. Use of that space is an opportunity cost.

A third option is a rolling cutover, where implementation occurs in phases, such as at one site at a time if the technology needs to be implemented at multiple sites. This method can allow the implementation team to be smaller, because the same implementation and training staff can move from site to site. It also reduces risk because a failure will be localized and lessons learned from prior phases can improve the process.

Implementing Technologies Using Project Management

Implementing major business changes, including but not limited to new technologies, requires project management experience and the use of proven project management methodologies such as those defined by the Project Management Institute's Project Management Body of Knowledge, or PMBOK.

Project management is defined in the *APICS Dictionary*, 16th edition, as “the use of skills and knowledge in coordinating the organizing, planning, scheduling, directing, controlling, monitoring, and evaluating of prescribed activities to ensure that the stated objectives of a project, manufactured good, or service, are achieved.”

Project Management Fundamentals

Projects are temporary endeavors that have unique deliverables. They have a definite beginning and an end. Regular operations, not projects, are used to plan, source, make, deliver, return, and enable standard products or products that are customized within a certain range. Projects, on the other hand, are needed when deliverables must be based on unique customer requirements, which is why the engineer-to-order manufacturing environment uses project management. Technology implementations

need one-time deliverables that are customized to the organization’s requirements, so these also use project management.

Regardless of whether traditional or agile project management is used, projects need clear assignment of responsibilities.

- All projects need to have a formal charter signed by authorized executives that appoints a project manager or equivalent; formally approves the use of funds and resources up to a limit; sets forth high-level time lines, risks, tradeoffs, and assumptions; and has SMART criteria for determining the degree to which the project is a success. The document should be brief, such as one page.
- One or more executives should also champion or sponsor the project. This role maintains enthusiasm and champions the project’s importance and the need for the ideal state to be achieved.
- Project team members need to have the right skills to be involved, because teams are customized to the specific need. This ensures that teams are lean and effective. Team member selection criteria also include availability during the portion of the project in which the person will be needed. While full-time participation improves results, any part-time participation needs to be specifically allocated to the project and approved by the person’s functional manager.
- Other stakeholders also need clear roles, and these can be indicated by using a RACI (responsible, accountable, consult, inform) matrix, as shown in Exhibit 8-17. Only one person can be accountable for a given part of a project (i.e., accountable for success or failure), but multiple people can be assigned responsibility for executing a particular task. Some people, like subject matter experts, will need to be consulted for their feedback. Other people, such as executives, just need to be kept informed.

Exhibit 8-17: RACI Matrix

Engine test	PM	Eng	Perf analytics	VP, Eng	VP, Acct
Run	I	R	I	A	I
Analyze results	I	C	R	A	I
Report	R	C	C	I	A
Follow up	R	C	I	I	A

R = Responsible for task completion

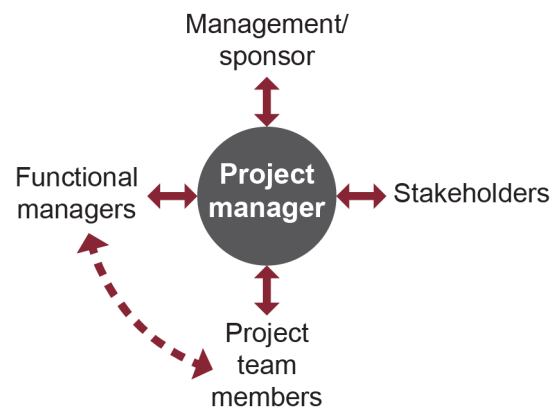
C = Consulted (provides input on the work)

A = Accountable for outcome

I = Informed of progress

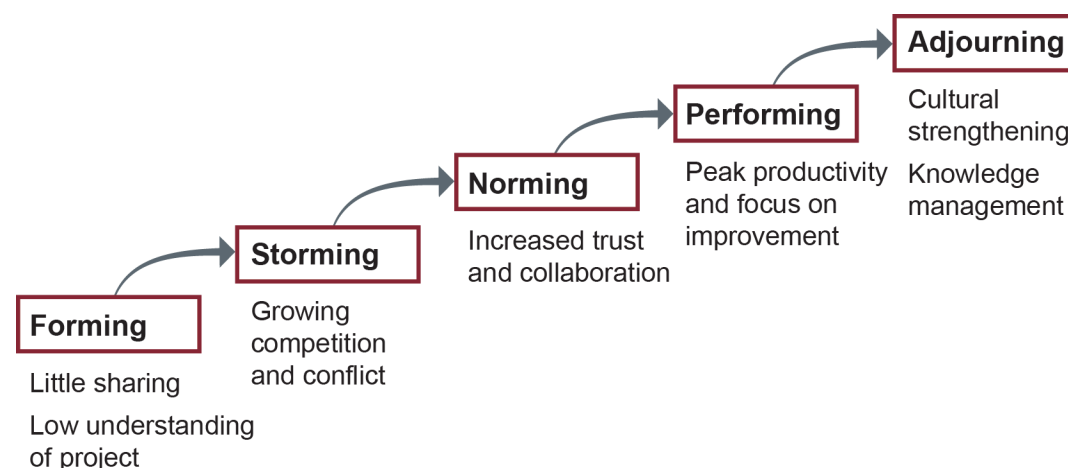
As shown in Exhibit 8-18, the project manager is responsible for communicating with the various stakeholders. The dotted line shows how team members allocated from functional areas still need to communicate with their supervisors when a portion of their time is still devoted to ongoing operations work. A formal kickoff meeting can help formalize these roles, generate enthusiasm, and ensure ongoing communication.

Exhibit 8-18: Project Manager and Communication



Psychologist Bruce Tuckman proposed that teams do not begin their group existence as a highly productive unit. Instead, the group evolves in stages toward greater functionality, as shown in Exhibit 8-19.

Exhibit 8-19: Tuckman Ladder of Team Development



- During forming, team members are trying to understand their roles.
- During storming, conflict and competition for status are expected; the team may also question the project's objectives. The project manager needs to work hard to enforce ground rules and expectations.
- During norming, teams grow in confidence and project managers facilitate collaboration and sustain motivation.
- During performing, the team is at peak efficiency and project managers help with long-term skill development.
- During adjourning, lessons learned are captured, successes are celebrated, and teams are disbanded.

Avoiding Common Pitfalls

Simply claiming to use project management is not the same as properly managing a project.

Organizations need to fully commit to a rigorous process, get the support of top management, train their project managers and teams, and use change management to instill best practices into the organization's culture. Here are some common causes for the failure of projects:

- Budget or schedule (or other important constraint) is significantly missed.

- Project results are ineffective (e.g., unacceptable deliverables).
- Deliverables have no valid purpose (e.g., the project used resources without adding to business value).
- Project sponsors or managers allow scope creep, the uncontrolled expansion of project scope without allocation of additional time or funds.

Exhibit 8-20 shows some common pitfalls along with some corresponding best practices described in *A Guide to the Project Management Body of Knowledge*.

Exhibit 8-20: Pitfalls and Best Practices

Common Pitfalls	Project Management Best Practices
Harangue and coerce.	Lead and coach.
Micromanage team members.	Clearly delegate responsibility.
Treat personnel changes as emergencies due to unclear roles and responsibilities.	Assign activities to specific functional responsibilities for clear personnel transitions.
Guess at variances until too late.	Control and account for resources.
Fail to set plan baselines (e.g., schedule, budget).	Routinely measure against the plan.
Hold meetings to gather percent complete estimates (guesses).	Hold meetings to discuss substantive issues and risks.
Allow change and have unrealistic optimism about any consequences.	Control change and analyze tradeoffs between constraints.
Produce static documentation and never use it because it is out of date.	Keep live documentation updated.
Fail to send out new plan versions (so everyone is using different versions).	Ensure that everyone is using the current plan (configuration management).

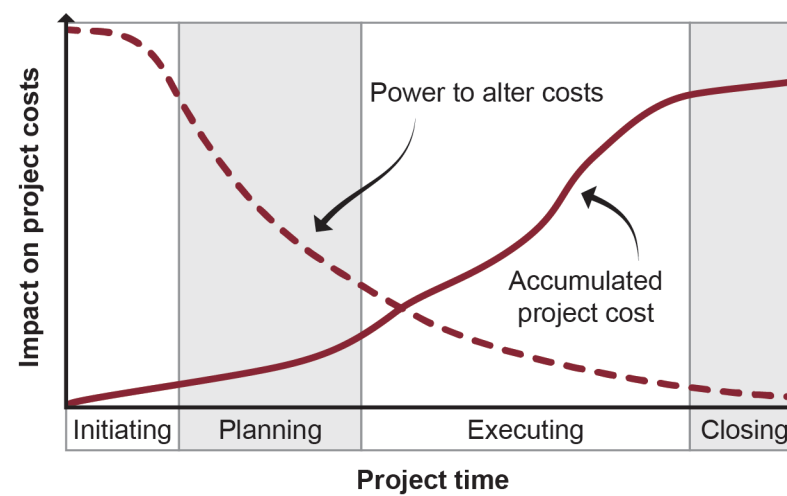
Source: *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, fifth edition, 2013.

Traditional Project Management

For projects with requirements that can be frozen early on, traditional (sometimes called predictive) project management techniques can be used, and this will help control project costs and keep the project on its deadline. The project phases—from initiating, to planning, to execution, to closing—are performed sequentially, somewhat like a stepped waterfall, with monitoring and controlling performed throughout. However, even in traditional projects, the work unfolds through a process the *PMBOK Guide* describes as progressive elaboration. This means that as a project moves through its phases, there is a continual feedback loop that uses information being gained through project work to make planning and execution more focused, accurate, and efficient.

The work done during the planning phase is most critical to a traditional project's success. Even though, as Exhibit 8-21 shows, the largest cost accumulation occurs during the executing phase, planning represents the largest opportunity to affect project cost. Activities and risks that are poorly planned will contribute to increased costs later—a trend that is very difficult to reverse or correct.

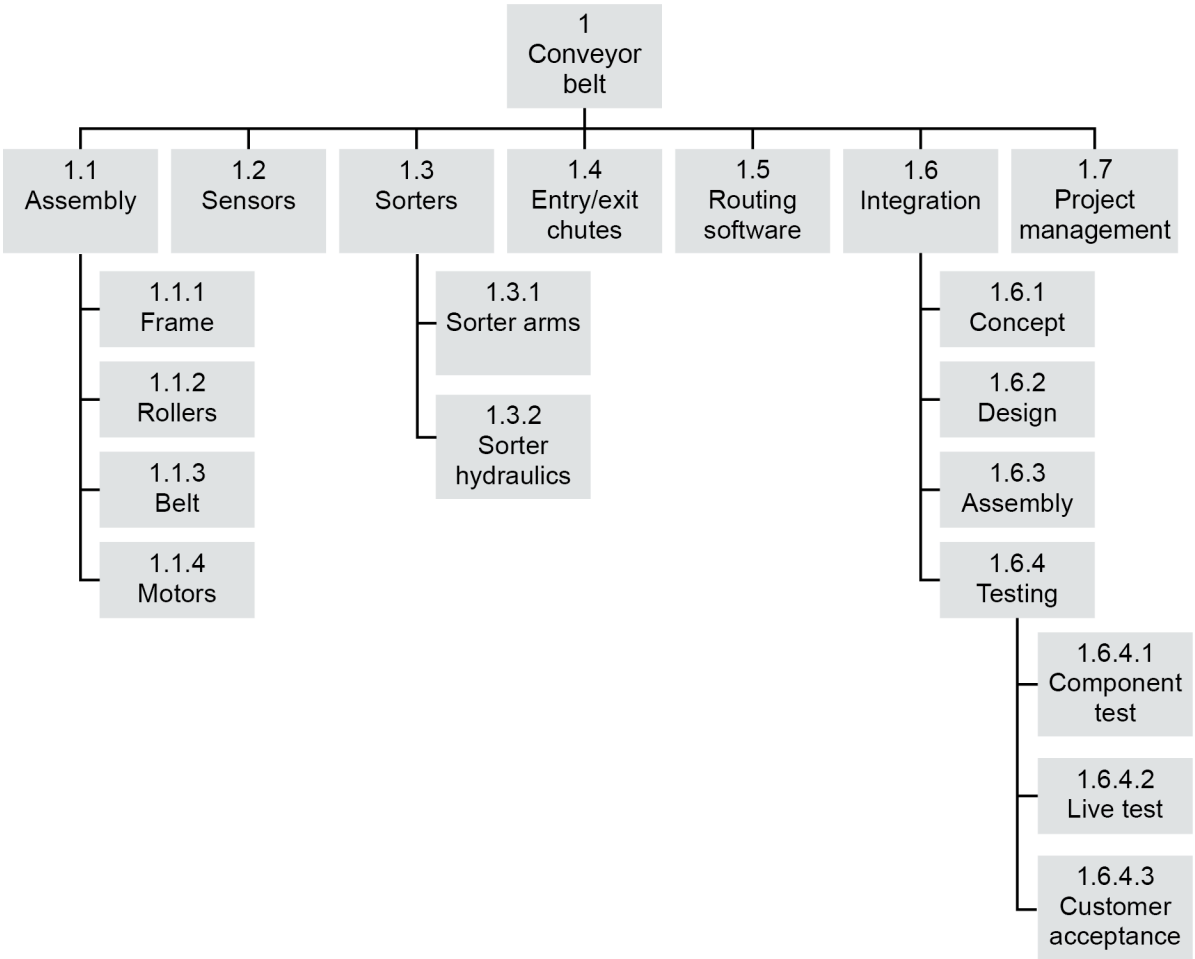
Exhibit 8-21: Project Costs by Phase



Included in the project plan are the critical project baselines, which include the following.

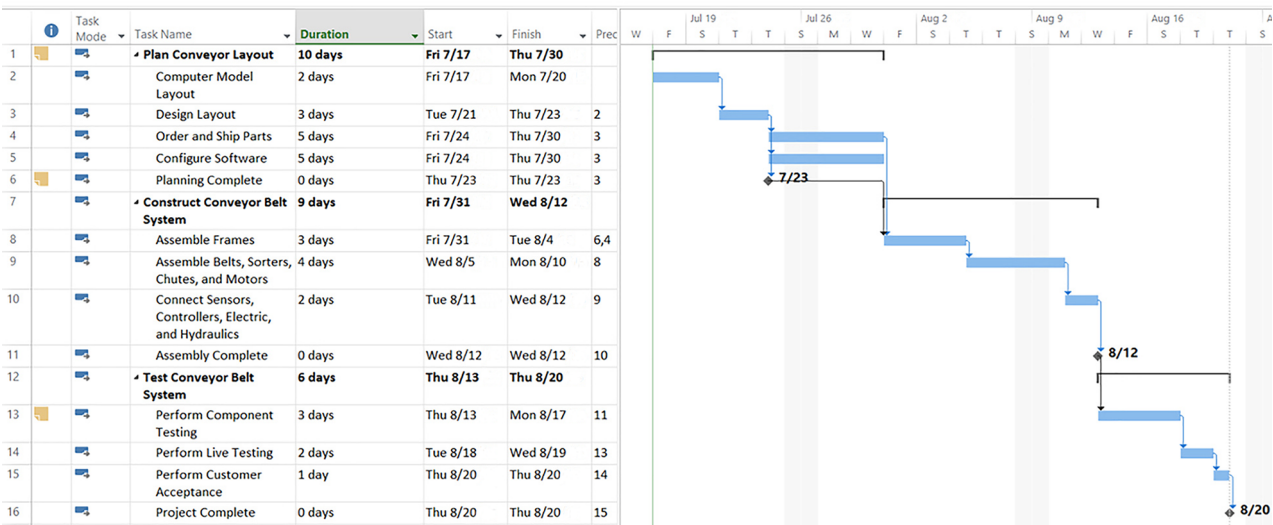
- **Scope baseline.** The scope baseline includes the following.
 - **Project scope statement**—A clear description of the project’s objectives, a list of deliverables, and clarification about what the deliverables include and do not include. The scope statement is a key document since it validates the project’s scope plan (the project manager’s and project team’s perception of deliverables) against the customer’s statement of work (the customer’s perception of deliverables).
 - **Work breakdown structure (WBS)**—The primary planning tool for organizing project work, defined in the *Dictionary* as “a hierarchical description of a project in which each lower level is more detailed.” The WBS is critical, since it provides the basis for planning project material, resources, cost, and timing and for identifying project risks. The WBS should include 100 percent of what will be done on the project. If it is not on the WBS, it is out of scope. A WBS lists deliverables or results that should be achieved, not activities to do, so it is a bit like a bill of materials. An example of a WBS is shown in Exhibit 8-22, but note that for brevity some of the categories are left unexploded. For example, project management would include all of the various project plans such as assembly team staffing plans or installation plans.

Exhibit 8-22: Work Breakdown Structure (Conveyor Belt Example)



- **Project schedule.** The project manager first defines activities that are needed to create each item on the WBS. Once all activities are defined, they can be placed in sequence. The project manager may arrange for activities to be done concurrently if they don't depend on the completion of other activities or have resource conflicts. Others must be done sequentially. For each activity, the project manager estimates the resources required (human and other), including required skill levels. Next, the project manager calculates activity durations. The total project duration is then how long it will take to do the longest string of activities that need to be done sequentially. This is the shortest possible project duration and is called the critical path. The schedule is perhaps subdivided for important deliverables or milestones that have go/no-go decision points. If approved, the schedule can be revised during the course of the project. Schedules can be represented using Gantt charts or various types of diagrams that show which activities can be done sequentially versus which can be done in parallel. An example is shown in Exhibit 8-23.

Exhibit 8-23: Project Schedule (Gantt Chart View) for Conveyor Belt Project



- **Project budget.** Costs are estimated from the bottom up starting at the activity level. The cost of the materials and resources is estimated for each activity, and then these costs are rolled up (aggregated) to determine the budget. As with the schedule, often this results in costs that are unacceptable to cost constraints. At that point, the project manager can work on the project budget from the top down, starting with the cost constraint or target budget and then determining whether it is feasible to get the same work done for less by using fewer resources (and likely a longer schedule) or if the project scope needs to be adjusted to fit within the available budget. The budget includes direct and indirect costs, project reserve funds the project manager can use for possible cost overruns, and separate management-allocated reserve funds that may be available to the project on management's approval. The budget may be allocated to stages reflective of the resources used in each stage.

The project manager will monitor and control the project against these baselines. Specific project management measurement tools exist and can be used to provide detailed information on performance relative to the schedule and budget baselines. Regular and reliable reports are vital for control. Control should be exercised daily, since a project gets off schedule a day at a time and off budget a dollar at a time.

When course corrections are needed, project managers may need to rearrange some additional activities to allow them to be done concurrently (called fast tracking) when possible or will add workers on activities to shorten their duration (called crashing) as is feasible from a cost and human resources perspective.

The project manager will reject or put off changes to the scope unless formally approved by a change control board and additional funds and schedule are provided. This is to help avoid scope creep (customer requests for extra work) or gold plating (team members do unasked-for work). The change control board reviews formal change requests to assess budget/schedule feasibility, technical merit, and potential for integration impact. Approved changes result in updated project baselines.

As needed and at the close of the project, the project manager will end team member assignments and close contracts with providers. This helps control project costs. The customer will review deliverables and accept or reject them. Additional work requested after formal approval will require new contractual arrangements and cost, so it is vital to carefully inspect deliverables prior to formal acceptance.

Agile Project Management (e.g., Scrum)

For technologies such as software or for new technologies that require prototypes, the customer requirements might need to have a high degree of variability and might change even late in the project. This helps such technologies to be responsive to competitor actions, to information learned from prototype feedback, and so on. For such projects, an agile project methodology is recommended. One type called scrum is used below as an example. Basically, the various agile methods use intense customer participation, regular iteration with planning just for that iteration, and incremental planning to enable rearranging the priority of work on a regular basis. A key benefit of agile methods is that they

can turn innovation into results much faster than traditional project management. For software, for example, a first release called a minimum viable product (MVP) is created to get the product functioning at a basic level quickly, and then future releases add functionality in stages. Some supply chain management functional areas even run their operations as a series of agile projects.

Scrum Example

Scrum is a rugby term that implies that the team needs to move forward as a unit by letting various members take the lead as needed. Scrum can be used to prioritize and reprioritize continuous improvement tasks or mini-projects (i.e., kaizen events) such as to alleviate a new bottleneck area.

The basic process is to create a visual board that has cards with all of the work to do (backlog) in the first column, all the work in process, perhaps in various stages, in one or more columns, and the work that is done in a final column. This is called a kanban board or scrumboard. (It was inspired by lean kanban boards.)

The team meets on a regular basis and plans tasks that can be done before the next regular meeting. Each fixed time period is called a sprint or iteration. In the meeting, the team can reprioritize the items in the backlog (moving the most important cards to the top) and update the status of tasks by moving a card to a new column. A goal is to keep the team focused on current work before starting too many new things.

The team also meets briefly on a daily basis (a daily standup) to discuss what they did, what they are doing, and any problems. At the end of the sprint, they review lessons learned and decide on ways to improve the process (a retrospective).

Rather than using a formal project manager, a scrum master is used. This person ensures that the scrum methodology is used and works to remove obstacles while letting various team members take the lead as needed. A product owner role represents the needs of the customer. (This could be an internal customer.)

Supply Chain Digital Transformation Using Change Management

A supply chain digital transformation is an umbrella term for a wide variety of supply chain improvements designed to upgrade supply chain maturity. This includes providing end-to-end visibility, supply chain agility and resilience, process or transaction automation, and better customer and supplier relationships. Change management is critical to making such changes happen; moreover, it is needed for any continuous or breakthrough improvement for an organization. The bigger the change, the more it will be resisted. Resistance sources include the organization's culture, persons who understand how to operate within the status quo, and suppliers and customers who do not want the expense or sustained effort required to make a change. Resistance will be especially strong if prior organizational

change initiatives have failed, perhaps because they were treated as projects that, once finished, were ignored in favor of familiar routines.

Change itself must be planned and executed, leaders need to inspire commitment and enthusiasm, and managers need to provide clear direction and monitor and control results long after any change projects are completed if the organization's strategic changes are to be realized over the long term.

Change Management Road Map

For change management to be effective, there needs to be two levels of implementation plans. Each plan should identify milestones, tasks, and resources.

- A road map (a high-level master plan that can be continuously reprioritized as needed) contains all improvements in sequence and delineates where projects end and use in operations begins.
- Project plans schedule all steps required to achieve the targets for each key performance indicator (KPI), set deadlines, and assign accountability for achieving results.

Note that change is usually difficult due to the high potential for unintended consequences. A change to one part of a system will affect the other parts. All companies and functional areas involved in the process must know what the improvement initiative involves so they can develop their own objectives and strategies to contribute to a synchronized effort.

When planning change across organizations, a successful pilot study with a limited number of companies may inspire confidence in other supply chain partners and make full implementation easier. In effect, the outcome of the pilot sets a benchmark for the rest of the partners.

Change can be enormously disruptive across a large organization if it isn't handled properly. To ease an organization, let alone several supply chain partners, into change, the team, along with executives, must prepare the ground carefully before the initiative and maintain communication during, and possibly long after, implementation. Some organizational and personal issues may hinder progress toward goals if they aren't addressed in the beginning:

- Some companies may need to change from a functional to a process-oriented structure—to get to a minimum level of supply chain maturity, in other words. Structural changes may be major and should be included in the plans.
- Leadership from the top ranks of the organization is crucial to success. The leaders in the affected partner companies must be brought into the process as full partners and passionate advocates to get the employees to commit to the change.
- Incentives should be adjusted to reflect a balanced scorecard. The measures of success must reflect the four quadrants of the scorecard, not only the success of the initiative in meeting its process improvement goals.

- Growth and learning will most likely have to be integral to the initiative. People must not be introduced to new roles and new expectations without being thoroughly prepared. Training can take different forms depending on roles and responsibilities. New skills may best be learned in a person-to-person or classroom context with follow-up on the job. New procedures may best be taught on the job with easy-to-use job aids for reinforcement. (If the processes are computer-based, the training should also be computer-based.)
- All companies involved in the revised process will have to work together in true partnership, sharing information and adjusting their strategies with an eye to the success of the overall supply chain and the positive impact on the end customer. Information sharing may have to be approached diplomatically, with an emphasis on what can be gained in terms of enhanced value for the customer and smoother operation of the supply chain.

Periodic targets for KPIs from the balanced scorecard should be set, being sure to meet financial goals as well as other scorecard goals.

Prerequisites for Change

According to Stephen Covey's *The Seven Habits of Highly Effective People*, three things are needed for any change to succeed in becoming a long-term practice, on either a personal or organizational level:

- **Desire:** You need to want to change.
- **Knowledge:** You need to know why the change is beneficial and what the end results look like.
- **Skill:** You need to acquire and apply the right tools and techniques to achieve your goals.

If any of these elements are missing, the change will fail. Change management processes address all of these things methodically.

Change Processes

One example of a change process is a model developed by John P. Kotter, author of several books on change management. In Kotter's book *Accelerate*, he outlines eight accelerators, a set of principles that relate to a change driver he calls "the big opportunity." A big opportunity is a new idea. It could be an agile reaction to an emerging threat, orchestrating visibility technology among partners, a new business model or methodology, a new product, and so on. What distinguishes a big opportunity from other potential changes or improvements is that it is a solution or opportunity that will create lasting benefits into the future rather than just addressing present problems, it would be difficult to achieve the change without a sustained impetus, and it is something that people can get excited about. It has to be an idea that top management agrees makes great sense and aligns with the organization's mission, vision, and core values, but it is not just a reiteration of those ideals. It may be aligned with the current strategy or may be the impetus to change the strategy.

Kotter's eight accelerators form the process that turns the big opportunity into action more rapidly than an established hierarchical system can because a key element is the establishment of a network organizational structure intended to mimic the creative thinking of an entrepreneurial start-up. The existing hierarchical organizational structure remains in place to address ongoing operations and business administration. The two structures share people. The network is more informal and is driven by the current or next big opportunity. The eight accelerators are paraphrased here:

- **Big opportunity and urgency.** Determine a big opportunity and create a sense of urgency around it, getting buy-in and enthusiasm from as many people as possible. People who feel this urgency will be thinking continually about how to advance the goal and how to sustain its urgency.
- **Guiding coalition as change agents.** The first big opportunity helps form the core of the network, as a guiding coalition forms to help win this opportunity. These core members will be change agents who want to lead, feel passionately about the big opportunity, and have something to contribute. As the team forms, it will need guidance to understand how a network needs to differ from a hierarchy, so they keep the entrepreneurial spirit rather than starting to build a hierarchy within the network (e.g., a focus on budgets, project management, roles).
- **Vision and inspiration.** The network forms a vision for the big opportunity and develops related strategic initiatives. The initiatives worked on first are those that most inspire the guiding coalition.
- **Legion of volunteers.** The network grows by creating an army of volunteers who can devote a portion of their time either on an ongoing basis or just for a temporary period. They help create buy-in and get things done. Kotter's research indicates that a network made up of five to ten percent of the total workforce is sufficient to make a well-functioning network. Volunteers need to be vetted for both the necessary level of commitment and the ability to help. The ability to help could take the form of relevant knowledge or expertise, relationship-building skills and a network of relationships, or possession of influence and credibility.
- **Obstacle and duplication avoidance.** The network's members focus on removing obstacles to ensure rapid progress on the big opportunity. They also pay close attention to initiatives on the hierarchical side to avoid duplications of effort.
- **Credibility through wins.** The network proves its worth by creating quick wins as well as bigger wins that have strategic relevance. These wins are highlighted and celebrated to help the network gain credibility, even starting to win over managers who either did not support the dual network concept or did not volunteer to help.
- **Self-sustaining network.** The network sustains itself by recognizing and supporting numerous sub-initiatives, which provide the quick wins described in the prior principle. It also continues to look for the next big opportunity and continues to recruit new members based on the needs.

- **Institutionalize.** Successful initiatives are incorporated into the organization's hierarchical organizational structure so they can be sustained and institutionalized. This includes integration into the organization's policies and procedures, metrics and enforcement, and eventually the culture, as the culture becomes one that supports change as a necessary element of thriving in a rapidly changing world.

Many of the concepts expressed in Kotter's change methods are also captured in the following generic change management process. (How these steps address the desire, knowledge, and skill prerequisites for change is also described.)

- **Prepare for change:** Identify the need to change (knowledge), set forth a compelling vision of the future (desire and knowledge), explore the costs and benefits of change and the organization's strengths and weaknesses that can complement or deter change (knowledge), and build consensus and enthusiasm for change (desire).
- **Plan for change:** Determine success criteria (knowledge), discover what areas (e.g., business units, roles) need to change (knowledge), develop detailed plans for each area including formal projects, training, and focused events (skill), develop ongoing management, monitoring, and controlling plans (skill), and gain approval and funding (desire and skill).
- **Execute change:** Execute projects, training, and events (skill).
- **Monitor change:** Lead and manage using the new operational policies, procedures, and processes (skill), and monitor and control against new metrics that align incentives to strategic goals (skill).

These generic change management steps are discussed in more detail next.

Prepare for Change

Preparing for change needs to involve everyone. When more people see the need to change because they are involved in identifying that need, more people will support the change. Executives need to initiate and champion change but cannot simply hand it down from above. They need to get people involved at all stages so that they all "own" the change. The steps that lead to this buy-in from all parties follow.

Identify Need for Change

Rather than changing simply because a new method exists, the right reasons for change usually involve the realization that the status quo will no longer suffice to achieve organizational goals.

Identifying the need for change starts with taking stock of the current state of the organization. This information is then compared to the new methodologies being contemplated as well as to what competitors are doing. The process could involve a formal project or a series of meetings, depending

on the scope of the change. The idea is to use careful investigation to arrive at a frank understanding of the as-is state and to envision whether continuing to operate in this fashion will work in the future.

Create Change Vision

If some type of change is needed to continue growing and prospering, then the next step is to determine what the end results of the change will look like. Beginning with the end in mind involves understanding what the organization wants to accomplish with the change. This involves executives first determining strategic goals such as becoming agile, then building this into a high-level concept of the end results, and then communicating this vision to everyone in the organization in a compelling manner.

Once executives settle on a strategy that will help the organization achieve its long-term goals, the next step is to develop a big-picture view of what the change will look like. This requires developing an understanding of not only what needs to be accomplished and its scope but also who will be accountable for success and when the results are to be achieved. This effort cannot be an executives-only process. As many people as is feasible should be involved in conceptual design, not only to gather unique perspectives from managers and functional staff but also to give people a chance to make this their change program rather than being handed one. More perspectives can be contentious but also can bring a wealth of new ideas.

Setting a compelling vision is the essence of leadership. This is where top management shows that it is fully invested in the change, that they are going to champion it, and that they are going to enlist the help of everyone in getting it right. Top management support sounds almost like a given, but many change initiatives fail because executives don't get involved, their involvement trails off, or they fail to keep reinforcing how important the initiative is to the organization's future.

Top-level support also needs to be active. This includes executive- or board-level governance, monitoring of key milestones and progress, and periodic recognition of program achievements.

Determine Costs and Benefits of Change

Participants in a change program can help brainstorm the costs and benefits of the change. Costs may include monetary costs, technical or external barriers, or anticipated resistance to change in its many forms (e.g., ignoring, complaining, actively resisting). Persons or areas who would be more resistant than others might be identified so they could be handled specially. Benefits of the change are also enumerated and communicated to everyone.

Assess Organization's Strengths and Weaknesses

Exploring the strengths and weaknesses of the organization is where the organization's culture is explicitly considered. A given methodology will have many standardized features, but some elements will work better with the organization's culture than others. Determining the organization's

organizational and cultural strengths can help show where these will reinforce the change and make it uniquely this organization's initiative. Similarly, developing an understanding of organizational and cultural weaknesses will show which areas of a program will meet the most resistance. Some of these program areas might be modified to better fit the organization. Others will require changing the culture when the weakness would otherwise endanger the success of the strategy.

Build Consensus

Getting buy-in from people cannot be overemphasized in a change management initiative. People like to feel that they have a say in matters. People are naturally resistant to any decision that they feel they have had no input in. It goes against a desire for autonomy and personal growth. Even when people's ideas are not eventually adopted, giving them a chance to express them from the outset of an initiative will give a sense of buy-in.

Buy-in can be accomplished in many ways, including brainstorming sessions, distributing surveys, asking for people's reactions to ideas, and formally involving representatives from affected business functions on project teams and in change planning meetings. Some persons will need to have full-time involvement, while others can have part-time or small roles.

Another essential element of consensus building is to emphasize that the only way to achieve these goals is to work together. Tools and techniques to facilitate coordination, cooperation, and collaboration might include new types of supplier contracts, measurements that emphasize common goals over individual goals, or information systems such as collaborative planning, forecasting, and replenishment (CPFR).

Build Enthusiasm

Building enthusiasm is an ongoing task for leaders at the executive and project management levels. While this is especially important right from the start, leaders need to sustain excitement for change in multiple ways, such as expressing excitement during large team meetings, by networking with individuals, by publishing a newsletter, or by advertising with short marketing messages that encapsulate the goals of the program, such as, "Supply chain resilience will allow us to seamlessly and rapidly shift to alternate supply sources when supply disruptions occur."

Planning for Change

Planning for change involves developing formal plans to provide everyone who is affected with the tools and skills they will need to succeed. This starts by determining specific, measurable, attainable, relevant, and time-bound (SMART) success criteria.

Setting baselines will help an organization determine whether the initiative is succeeding or failing and will help with continuous improvement after any related projects are complete. The organization can use the SCOR Digital Standard to help determine key performance indicators to use.

Supply chain change initiatives may affect more business units than just the obvious ones. For example, marketing might need to change its focus from a make-and-sell philosophy to a sense-and-respond philosophy, purchasing may need to move from a low-cost emphasis to a relationship-building emphasis, manufacturing may need to retool whole plants and retrain staff to perform quick changeovers, distribution may need to have new information systems to select better modes of transportation on the fly and track inventory movements closely, and finance and accounting may need a new set of measurements that can show the financial benefits of the new operating methods rather than making them seem like purely negative costs.

Last but not least, the organization's culture may need to change, and doing so requires finesse. Changing an organization's culture requires knowing human nature and how to develop incentives that will lead people to change their ways.

Change Plans

Change plans for each area of the organization might involve formal projects with all of the detailed initiating, planning, executing, monitoring and controlling, and closing that this entails, or it might involve planning various types of training for individuals such as formal classroom training, or it could involve brief continuous improvement events.

Regardless of the method of planning for change, from a change management perspective the most vital aspect of these plans is on people and relationships. While a new technology will have many challenges and costs, it is critical to invest significant time training people on how to use the new tool. People and relationships will also be a top concern when changes involve moving from a transactional to a partnering relationship with suppliers. These paradigm shifts are difficult to achieve and so require serious attention and planning.

Plans to improve relationship building may need to include talent acquisition and development, executive training and support, and leveraging new collaborative tools and communication channels that are implemented across multiple organizations.

Plans also need to include specific and detailed relationship-building activities for each area. For example, executives might need to initiate contact with specific supplier and customer counterparts regarding collaboration. Marketing might need to define what additional information they need to collect on customers and how to determine customers' actual wants and needs. Purchasing may need to develop a mentoring program to help other business units develop supplier relationships. Operations may need to work on empowering employees by providing them with more autonomy and cross-training. Distribution may need to determine how to share order information with suppliers and customers. And finance and accounting may need to collaborate with other organizations to develop total cost of ownership or other total supply chain metrics.

Culture change is also about people and relationships. Plans for changing culture may involve getting expert consultants to help design new metrics and incentives that pull people toward desired behavior rather than pushing them.

Organizational change plans cannot stop with projects, training, and events. These things are temporary endeavors, while the changes will be part of ongoing operations. Therefore, plans will necessarily also involve aligning business rules to institutionalize the changes. Enforcement needs to be consistent and vigilant so that people aren't allowed to slip back into their old ways or develop workarounds.

Organizational structures may also need changes. Often, this means that the organization becomes flatter to allow faster communications (more allowed direct communication channels) and fewer organizational silos.

Approval and funding for change plans and projects is mandatory. Sufficient funding for change management is a signal on top management's part that they want the changes to succeed.

Executing Change

If the plans for physical and social change are well developed, they can be implemented smoothly in a step-by-step fashion. Usually the physical changes, like configuring a new information system, receive a lot of time and attention. Communication flows need to precede and follow these physical changes, first preparing individuals for the change, then guiding them through the change, then providing training, and then reinforcing the training through practice, certification as applicable, mentoring, and so on. The cultural changes are also initiated from the start, but these will take the longest to complete, since culture changes slowly. Realizing the glacial pace of culture change is the key to successful culture change. The effort to change culture—to help people see the world in a different way—needs sustained effort that is built into an operations mentality rather than treating it as a temporary project.

New business goals may require the following:

- **New business vision and mission statement.** A new vision and mission statement is an opportunity to define the values of the new culture. Those values may involve a greater focus on the customer, meeting customer needs, and delivering complete satisfaction. It may mean abandoning traditional interdepartmental and/or intercompany boundaries in favor of open, cooperative, and collaborative relationships. Involving as many people as possible in crafting these statements makes the drafting process itself into a culture change tool.
- **New business organization.** In the past, organizational structures focused primarily on individual profit centers. The information moved up the organization's hierarchy where decisions were made and then moved down the channels where the decisions were carried out. In contrast, many types of reorganizations may require pushing decisions down the organizational structure from upper

management to those involved in the actual processes. Traditional hierarchical organizations may flatten and move toward interdisciplinary teams or add a parallel network structure for big opportunities.

- **New job definitions and organizational structures.** The skills needed may require redefining job descriptions or organizational structures. Employees and management need to understand different perspectives in their new teams. They may need to provide support and backup for other employees. Many members of the organization will need to acquire knowledge and develop new skills. The criteria for job success will change as well. Managers may need to migrate from being taskmasters and scorekeepers to being process owners and mentors who are responsible for identifying resources as well as coaching and providing problem-solving facilitation for their employees.

Monitoring Change

When people resist change—and they will—the goal is to listen first, because people need to feel understood before they will attempt to understand. Showing that you are willing to listen and are taking complaints seriously will help people feel more comfortable sharing their issues and fears. The more people share, the better idea the organization will have of the current level of acceptance of the change.

The organization needs to take individuals' fears seriously, address them by listening and carefully considering how these fears can be alleviated, and then provide the response not only to the individuals who brought them up but to everyone affected by the change, since many persons who are remaining silent will likely have similar fears.

Monitoring change also involves leading and managing using the new methods and monitoring and controlling using the new metrics.

Leading and managing using the new operational policies, procedures, and processes will institutionalize the change. Projects and events cannot sustain a change effort. They are limited in duration and funding. The change has to become the new way of doing business—the new normal. This requires both leadership and management. Leadership is used to continue refining strategy based on feedback from management and to set the tone and the vision for fully realizing the benefits envisioned by the change. When top management lives by the new methods, the change becomes something that cannot be ignored. Management provides clear direction as to policy, procedure, and process and makes organizational changes as needed, such as by replacing staff members who refuse to learn or apply the new ways.

Monitoring and controlling to a new paradigm requires new metrics that create the proper incentives. A new metric that measures whether or not the entire supply chain benefits will deter suboptimization. A

procurement executive who is rewarded for establishing collaborative supplier contracts will work to get such contracts signed.

Once the new strategically aligned metrics are in place, systems and individuals need to be monitored against those metrics. Control of significant variances and trends then enforces the change process. Finally, analysis of actual results can be used as feedback to show which metrics need modification. Since it is difficult to predict some of the side effects of incentives, continually improving these metrics will help to get the organization closer and closer to its desired strategy.

Maintaining Technologies

Maintaining technologies involves designating responsibility for maintenance to specific parties and individuals, setting maintenance policies and procedures, performing maintenance according to a schedule, and regularly reassessing maintenance requirements,

It is important to determine who will be providing maintenance for a given technology as part of the contracting discussions with vendors, since this will impact ongoing costs and staffing requirements. If the vendor will maintain the system, the organization may not need certain job positions at all. Some technologies will be purchased and maintained by the organization, while others may be leased and possibly maintained by the vendor via cloud computing and software as a service (SaaS). In general, leasing can drastically reduce the initial investment and implementation time but will increase the ongoing cost relative to a purchase. The cost of upgrades and maintenance will usually be the vendor's responsibility, and this may partially offset the higher ongoing cost of the lease. Ending a lease will end the provision of the service, however.

For technologies that will be maintained in house, these roles need to be explicit, including by ensuring that the maintenance role is listed in the job description.

Once who will be maintaining technology is clear, it is important to set maintenance policies and procedures for the technology so that it will remain useful over its expected life cycle. To monitor and control technology maintenance, policies and procedures should

- Emphasize the necessity of developing and using testing protocols such as testing samples for quality using specific sampling and testing procedures.
- Enforce restrictions on who can use existing technologies, their acceptable parameters for use (e.g., for equipment longevity, worker safety, or customer privacy), and specific checks and balances or controls on their use such as required approvals for changes.
- Specify a process for assessing usage impacts and tradeoffs related to the current state of machine wear, the maintenance impact of different configurations or rates of throughput, and so on to minimize risks to existing technologies.

- Develop priority planning techniques and communication skills for technology maintenance so that critical technology for ongoing operations (e.g., for a bottleneck area) is maintained and any emergency situations get an immediate response. Predictive analytics can help determine maintenance needs.
- Determine maintenance schedules that minimize conflict with ongoing operations, including by scheduling maintenance after operation hours or in conjunction with changeovers. These policies will require a communication element between the person doing the maintenance and the operators.
- Include a process for carrying some replacement parts in stock, ordering some replacement parts in advance of scheduled maintenance, and ordering other parts only on demand. The process should have an approval step for parts above a certain value. Predictive analytics can help with this as well.

Assuming that the policies and procedures are well designed, maintenance scheduling and execution will be straightforward. There still needs to be a system and process for expediting emergency maintenance and repairs. Advanced training in troubleshooting is important, since the cause of an unexpected breakdown will not necessarily be obvious.

As technologies age, their maintenance requirements may change. Maintenance managers can compile data on part breakdown rates and revise what parts are kept in stock, for example. The expected remaining useful life of a technology can also be updated. This information should be provided not only to managers responsible for considering when and what technologies to upgrade but also to the organization's accounting function, who can update depreciation rates.

Cumulative Course Bibliography

The following materials were used during the development and revision of the APICS CSCP Learning System.

“2017 Aon Risk Maturity Index Insight Report Uncovers New Insights on Relationship of Risk Maturity and Financial Success.” Aon, www.aon.com/risk-services/thought-leadership/report-rmi-insight-nov-2017.jsp.

“About the UN Global Compact.” United Nations Global Compact, www.unglobalcompact.org/about.

“Adapto.” Vanderlande, www.vanderlande.com/systems/storage-as-rs/adapto/.

Amazon Web Services. “What Is Pub/Sub Messaging?” aws.amazon.com/pub-sub-messaging/.

American Society for Quality, www.asq.org.

Andersen, Mette. “Corporate Social Responsibility in Global Supply Chains.” *Supply Chain Management: An International Journal*, Volume 14, Issue 2, 2009.

APICS. *Advanced Supply Chain Management* (CD-ROM). Chicago, Illinois: APICS.

APICS. *Advanced Supply Chain Management Reprints*. Chicago, Illinois: APICS, 2000.

APICS. *APICS Certified Supply Chain Professional (CSCP) Learning System*, Version 3.3. Chicago, Illinois: APICS, 2015.

APICS. *APICS CPIM Basics of Supply Chain Management*. Chicago, Illinois: APICS.

APICS. *APICS Dictionary*, 16th edition. Chicago, Illinois: APICS, 2019.

APICS. *APICS Global Sourcing Workshop Series*. Chicago, Illinois: APICS.

APICS. *APICS Master Planning of Resources*, Version 3.1. Chicago, Illinois: APICS.

APICS. *APICS Operations Management Now*, July 2, 2010, edition. Chicago, Illinois: APICS, 2010.

APICS. *CPIM Workbook*. Chicago, Illinois: APICS.

APICS. *Introduction to ERP: Enterprise Resources Planning, Facilitator Guide*. Chicago, Illinois: APICS, 2002.

APICS. *Introduction to ERP: Enterprise Resources Planning Reprints*. Chicago, Illinois: APICS, 2002.

APICS. *Lean Enterprise Workshop Series*, Version 1.0. Chicago, Illinois: APICS, 2008.

“Application Programming Interface (API).” IBM, www.ibm.com/cloud/learn/api, August 19, 2020.

Arnold, J. R. Tony, Stephen N. Chapman, and Lloyd M. Clive. *Introduction to Materials Management*, sixth edition. Upper Saddle River, New Jersey: Pearson Prentice Hall, 2008.

ASCET. *Achieving Supply Chain Excellence Through Technology*, Volume 6. San Francisco: Montgomery Research, Inc., 2004.

Ashkenas, Ron, Martha Craumer, Anthony K. Tjan, Gina Trapani, David Silverman, Jane Heifetz, June Delano, Jodi Glickman, and Melissa Raffoni. “HBR Guide to Making Every Meeting Matter.” *Harvard Business Review*, April 11, 2011.

“AS/NZS ISO 31000:2009 Risk Management—Principles and Guidelines.” Standards Australia/Standards New Zealand.

Association for Financial Professionals. *AFP Financial Planning and Analysis Learning System, Version 2.0*. Bethesda, Maryland: AFP, 2014.

“ATA Truck Tonnage Index Increased 1.4% In January.” American Trucking Associations, www.trucking.org/news-insights/ata-truck-tonnage-index-increased-14-january, February 23, 2021.

Aurelie, Charles, Matthieu Luras, and Luk Van Wassenhove. “A Model to Define and Assess the Agility of Supply Chains: Building on Humanitarian Experience.” *International Journal of Physical Distribution & Logistics Management*, Volume 40, Number 8/9, 2010.

Ayers, James B. *Handbook of Supply Chain Management*. Boca Raton, Florida: St. Lucie Press, 2001.

Ayres, Ian. “Paying People to Quit: What Law Schools Can Learn From Zappos.” freakonomics.com/2011/11/21/paying-people-to-quit-what-law-schools-can-learn-from-zappos/.

Banker, Steve. “20 Things to Know About Digital Supply Chain Transformations.” *Forbes*, www.forbes.com/sites/stevebanker/2019/09/18/20-things-to-know-about-digital-supply-chain-transformations/?sh=23e59bd945b1, September 18, 2019.

Banker, Steve. “Top Takeaways from the State of Logistics Report 2019.” *Forbes*, www.forbes.com/sites/stevebanker/2019/06/18/top-takeaways-from-the-state-of-logistics-report-2019/#5dec6c765b2c, June 18, 2019.

“Barge Transport Wins on Fuel Efficiency.” *The Maritime Executive*, www.maritime-executive.com/article/barge-transport-wins-on-fuel-efficiency, March 29, 2017.

Barnes, Jim. “To Hear the Voice of the Customer, Listen Outside the Box.” customerthink.com/hear_voice_of_customer_listen_outside_box/.

Basu, S., and R. G. Schroeder. “Incorporating Judgments in Sales Forecasts: Application of the Delphi Method at American Hoist and Derrick.” *Interfaces*, Vol. 7, No. 3, 1977.

Bauer, Michael J., et al. *E-Business: The Strategic Impact on Supply Chain and Logistics*. Oak Brook, Illinois: Council of Logistics Management, 2001.

Baumer, D. L., and R. B. Handfield. “Managing Conflict of Interest in Purchasing.” *Journal of Supply Chain Management*, 42(3), 2006.

Begley Bloom, Laura. “35 Countries Where Americans Are Most Likely to Get Kidnapped.” *Forbes*, www.forbes.com/sites/laurabegleybloom/2019/04/25/35-countries-where-americans-are-most-likely-to-get-kidnapped/?sh=1c7f1095bdf1, April 25, 2019.

Bhasin, Kim, and Patrick Clark. “How Amazon Triggered a Robot Arms Race, Revolutionizing the World’s Warehouses and Putting Human Jobs at Risk.” *Financial Post*, business.financialpost.com/fp-tech-desk/how-amazon-triggered-a-robot-arms-race, July 1, 2016.

Bhattacharya, Ananya. “Amazon Is Just Beginning to Use Robots in Its Warehouses and They’re Already Making a Huge Difference.” *Quartz*, qz.com/709541/amazon-is-just-beginning-to-use-robots-in-its-warehouses-and-theyre-already-making-a-huge-difference/, June 17, 2016.

Big Picture Small World, www.bigpicturesmallworld.com.

Black, Thomas, and Matt Day. “Amazon’s Air Fleet Grows to Meet Need for Delivery Speed.” *Bloomberg*, www.bloomberg.com/news/newsletters/2021-01-21/supply-chains-latest-amazon-s-air-fleet-grows-to-meet-need-for-speed, January 21, 2021.

Blascovich, John. “How Procurement Excellence Creates Value.” *Supply Chain Management, Review*, July 2005.

Bohmer, Richard M. J., Gary P. Pisano, Raffaella Sadun, and Thomas C. Tsai. "How Hospitals Can Manage Supply Shortages as Demand Surges." *Harvard Business Review*, hbr.org/2020/04/how-hospitals-can-manage-supply-shortages-as-demand-surges, April 3, 2020.

Bonini, Sheila. "The Business of Sustainability." McKinsey & Company, www.mckinsey.com/~media/mckinsey/dotcom/client_service/Sustainability/PDFs/McK%20on%20SRP/SRP_11_Biz%20sustainability.ashx, 2012.

Bossert, James L. *The Supplier Management Handbook*, sixth edition. Milwaukee, Wisconsin: ASQ Quality Press, 2004.

Bowersox, Donald J., and David J. Closs. *Logistical Management: The Integrated Supply Chain Process*. New York: McGraw-Hill, 1996.

Bowersox, Donald J., David J. Closs, M. Bixby Cooper, and John C. Bowersox. *Supply Chain Logistics Management*, fourth edition. Boston: McGraw-Hill, 2013.

Bowersox, Donald J., David J. Closs, M. Bixby Cooper, and John C. Bowersox. *Supply Chain Logistics Management*, fifth edition. New York: McGraw-Hill, 2020.

Boyle, Robert D. "Achieving Your Supply Chain Goals: Conquering the 'First Mile' Hurdle of Data Capture." *APICS—The Performance Advantage*, July/August 2004.

Brigham, E., and M. Ehrhardt. *Financial Management—Theory and Practice*, 10th edition. Fort Worth, Texas: Harcourt College Publishers, 2002.

Brown, Scott A., and Don Hess. "Activity-Based Management of Supply Chain Methodologies." International Conference Proceedings. Chicago, Illinois: APICS, 2003.

Brown, Stanley A. *Customer Relationship Management: A Strategic Imperative in the World of e-Business*. Etobicoke, Ontario: John Wiley & Sons Canada, 2000.

Bugler, Will. "Extreme Weather Events Blow a Hole in Lloyd's of London's Balance Sheet." *Acclimatise News*, www.acclimatise.uk.com/2019/04/18/extreme-weather-events-blow-hole-in-lloyds-of-londons-balance-sheet/, April 18, 2019.

Bureau of Industry and Security. "Guidelines for Preparing Export License Applications Involving Foreign Nationals." www.bis.doc.gov/index.php/documents/deemed-exports/709-guidelines-for-foreign-national-license-applications/file.

Burnson, Patrick. "Improving Reverse Logistics with a Returns Management Strategy." *Logistics Management*, www.logisticsmgmt.com/article/improving_reverse_logistics_with_a_returns_management_strategy.

"Business to Business to Consumer (B2B2C)." *Techopedia*, www.techopedia.com/definition/23169/business-to-business-to-consumer-b2b2c.

Byrne, Robert. "What's Ahead in Transportation Forecasting?" *Inbound Logistics*, www.inboundlogistics.com/cms/article/whats-ahead-in-transportation-forecasting/, July 15, 2010.

Byrnes, Jonathan. "You Only Have One Supply Chain?" *Working Knowledge*, August 1, 2005.

Calculated Risk—Finance and Economics, www.calculatedriskblog.com.

Caldwell, Bruce. "Reverse Logistics." *Information Week*, April 12, 1999.

Callioni, Gianpaolo, et al. "Inventory-Driven Costs." *Harvard Business Review*, March 2005

Canales, Katie. "Amazon Reportedly Hopes to to [sic] Double Its Delivery Fleet This Year by Investing in Smaller Trucking Companies that Would Exclusively Serve the E-commerce Giant." *Business Insider*, www.businessinsider.com/amazon-double-delivery-fleet-exclusive-incubator-freight-2021-2, February 5, 2021.

"Capacity of Oil Tankers in Seaborne Trade 1980-2020." Statista, www.statista.com/statistics/267605/capacity-of-oil-tankers-in-the-world-maritime-trade-since-1980/, April 14, 2021.

Carlson, Andy. "SCEM: Help or Hype?" *InTech*, November 2002.

Carlson, Scott. "Target Hits While Wal-Mart Misses." *St. Paul Pioneer Press*, May 13, 2005.

Cartin, Thomas J. *Principles and Practices of TQM*. Milwaukee, Wisconsin: ASQ Quality Press, 1993.

Caruso, David. "Get a Backbone." *Intelligent Enterprise*, Volume 1, Number 3, December 1998.

Cash, Raheem, and Taylor Wilkerson. "GreenSCOR: Developing a Green Supply Chain Analytical Tool." Report LG101T4. McLean, Virginia: Logistics Management Institute, March 2003.

"CCPA vs. GDPR: Compliance with Cookiebot CMP." Cookiebot, www.cookiebot.com/en/ccpa-vs-gdpr/.

"CertainT Platform." Applieddnasciences, adnas.com/certaint-supply-chain-platform/.

Chaturvedi, Nitin, Mirko Martich, Brian Ruwadi, and Nursen Ulker. "The Future of Retail Supply Chains." www.mckinsey.com/~media/mckinsey/dotcom/client_service/retail/articles/future_of_retail_supply_chains.ashx.

Chaudhry, Peggy, et al. "Preserving Intellectual Property Rights: Managerial Insight into the Escalating Counterfeit Market Quandary." *Business Horizons*, Volume 52, Issue 1, 2009.

Choi, Thomas Y., and Tom Linton. "Don't Let Your Supply Chain Control Your Business." *Harvard Business Review*, December 2011, hbr.org/2011/12/dont-let-your-supply-chain-control-your-business/ar/1.

Chopra, Sunil, and Peter Meindl. *Supply Chain Management, Planning, and Operations*. Upper Saddle River, New Jersey: Prentice-Hall, 2001.

Chorafas, Dimitris N. *Integrating ERP, CRM, Supply Chain Management, and Smart Materials*. Boca Raton, Florida: Auerbach, 2001.

Clark, Don. "Continuous Process Improvement." www.nwlink.com/~donclark/perform/process.html.

Clark, Don, and Yoshio Takahashi. "Quake Disrupts Key Supply Chains." *Wall Street Journal*, online.wsj.com/article/SB10001424052748703597804576194101663283550.html, March 12, 2011.

Clauer, Gary T., and Gerald L. Kilty. "The Other Side of VMI." International Conference Proceedings. Chicago, Illinois: APICS, 2004.

Clearly Cultural, www.clearlycultural.com.

"CMR Convention." Wikipedia, en.wikipedia.org/wiki/CMR_Convention.

"CMR Convention, Scope, Responsibilities, Liabilities, Claims, Compensation." Transportify, www.transportify.co.uk/what-is-the-cmr-convention-and-what-are-your-responsibilities/.

"CMR: What Does CMR Stand for in Logistics?" Saloodo, www.saloodo.com/logistics-dictionary/cmr/.

Cohen, Shoshanah, and Joseph Roussel. *Strategic Supply Chain Management: The Five Core Disciplines for Top Performance*, second edition. New York: McGraw-Hill Education, 2013.

Cohn, Carolyn. "LLoyd's of London Sees 'Large Loss' Due to Suez Canal Blockage." Reuters, www.reuters.com/article/us-lloyd-s-of-london-results/lloyds-of-london-sees-large-loss-due-to-suez-canal-blockage-idUSKBN2BN0MF, March 31, 2021.

Colehower, Jonathan. "Achieving Supply Chain Visibility." International Conference Proceedings. Chicago, Illinois: APICS, 2003.

Colley, John L., Jr., Jacqueline L. Doyle, and Robert D. Hardie. *Corporate Strategy*. New York: McGraw-Hill, 2002.

Common Controls Hub, commoncontrolshub.com/overview/unified-compliance-framework/.

"A Complete Breakdown of the 26th State of Logistics Report." www.globaltranz.com/state-of-logistics-report/, July 10, 2015.

"Container Facts." Costamare Inc., www.costamare.com/industry_containerisation.

"Container Shipping—Statistics & Facts." Statista, www.statista.com/topics/1367/container-shipping/, April 1, 2021.

Corner, Stuart. "Cloud Computing Is Now Mainstream and Australia Is Ahead, Say New Reports." The Age, www.theage.com.au/it-pro/cloud/cloud-computing-is-now-mainstream-and-australia-is-ahead-say-new-reports-20141103-11fze9.html, November 32, 2014.

"Corporate Sustainability in the World Economy." United Nations Global Compact, www.unglobalcompact.org/docs/news_events/8.1/GC_brochure_FINAL.pdf, 2014.

Council of Supply Chain Management Professionals (CSCMP), cscmp.org.

Covey, Stephen R. *The Seven Habits of Highly Effective People*. New York: Simon & Schuster, 1989.

"Covisint." Wikipedia, en.wikipedia.org/wiki/Covisint.

Cox, Wendell. "China's Ascent in World Transport." The Heartland Institute, www.heartland.org/news-opinion/news/chinas-ascent-in-world-transport?source=policybot, May 21, 2014.

Coyle, John J., Edward J. Bardi, and C. John Langley, Jr. *The Management of Business Logistics*, sixth edition. St. Paul, Minnesota: West Publishing Company, 1996.

"CPFR: An Overview." Voluntary Interindustry Commerce Standards Association, www.gs1us.org/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=492, May 18, 2004.

Crandall, Richard E., William R. Crandall, and Charlie C. Chen. *Principles of Supply Chain Management*, second edition. Boca Raton, Florida: CRC Press, 2015.

Creating Value through Strategic Supply Management. Chicago, Illinois: A. T. Kearney, 2005.

Crum, Colleen, and George E. Palmatier. *Demand Management Best Practices: Process, Principles, and Collaboration*. Boca Raton, Florida: J. Ross Publishing, Inc., 2003.

Davenport, Thomas H., and Thomas C. Redman. "Digital Transformation Comes Down to Talent in 4 Key Areas." *Harvard Business Review*, hbr.org/2020/05/digital-transformation-comes-down-to-talent-in-4-key-areas, May 21, 2020.

"Demand Driven Material Requirements Planning," www.demanddrivenmrp.com/.

Derrick, Doug, and Robert Jacoby. "The Forgotten Supply Chain: How OEMs Can Optimize the Aftermarket Business." *APICS—The Performance Advantage*, February 2003.

“Design for Supply Chain: Spreading the Word Across HP.” *Supply Chain Management: An International Journal*, 2006.

Diebel, Anne. “How the Kidnapping of Executives Made the Insurance Industry Boom.” *Financial Review*, www.afr.com/companies/financial-services/how-the-kidnapping-of-executives-has-made-the-insurance-industry-boom-20190423-p51gbv, April 23, 2019.

Dinning, Mark, and Edmund W. Schuster. “Getting on Board: Building a Business Case for Auto-ID at Dell.” *APICS—The Performance Advantage*, October 2004.

Dinsmore, Paul, and Jeannette Cabanis-Brewin. *AMA Handbook of Project Management*, second edition. New York: AMACOM, 2006.

“Disaster Puts Kink in World Supply Chain.” *Los Angeles Times*, March 16, 2011. Reprinted in Minneapolis *StarTribune*, March 16, 2011.

“Doing Business 2020.” World Bank, documents1.worldbank.org/curated/en/688761571934946384/pdf/Doing-Business-2020-Comparing-Business-Regulation-in-190-Economies.pdf.

Dolan, Kerry A. “America’s Greenest Companies 2011.” *Forbes*, forbes.com/2011/04/18/americas-greenest-companies.html, April 18, 2011.

Dubner, Stephen J. “Customer Service Heaven.” freakonomics.com/2007/05/17/customer-service-heaven/.

Egan, Matt. “Jack Ma Wishes Alibaba Never Went Public.” CNN, money.cnn.com/2015/06/09/investing/jack-ma-alibaba-ipo-china/, June 9, 2015.

Eisenhardt, Kathleen M. “Time Pacing: Competing in Markets That Won’t Stand Still.” *Harvard Business Review*, March 1998.

“Electronic TIR Framework Enters Into Force Across Globe in Huge Boost to Trade Facilitation.” United Nations Economic Commission for Europe, unece.org/media/Transport/TIR/press/356719, May 25, 2021.

Elkington, John. *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. Stony Creek, Connecticut: New Society Publishers, 1998.

Ellram, Lisa M., and Thomas Y. Choi. *Supply Management for Value Enhancement: Best Practices in Supply Management*. Tempe, Arizona: National Association of Purchasing Management, 2000.

Engel, Douglas A. “Overcoming the Challenge of Innovation: Synchronizing Your Supply Chain and Improving Product Lifecycle Management.” *International Conference Proceedings*. Chicago, Illinois: APICS, 2004.

Enslow, Beth. “Supplier Performance Management for Manufacturers.” *International Conference Proceedings*. Chicago, Illinois: APICS, 2004.

Eskew, Michael. “Profiting Through Environmental Supply Chain Management.” *Executive Speeches™*, August/September 1999.

European Agency for Railways. “European Rail Traffic Management System (ERTMS),” www.era.europa.eu/activities/european-rail-traffic-management-system-ertms_en.

Ewert, Donald E. *IBT Guide to Incoterms 2000*. Eagan, Minnesota: International Business Training, 2005.

Executive Office of the President. “Patent Assertion and U.S. Innovation.” obamawhitehouse.archives.gov/sites/default/files/docs/patent_report.pdf.

“Expert Names Five Main Achievements in China in Development of Inland Waterways.” Port News, en.portnews.ru/news/306589/, December 21, 2020.

Eyring, Matthew J. “New Business Models in Emerging Markets.” *Harvard Business Review*, hbr.org/2011/01/new-business-models-in-emerging-markets/ar/1, January 2011.

Ferguson, Brad R. “Implementing Supply Chain Management.” Chicago, Illinois: APICS, 2000.

Fisher, Marshall L. “What Is the Right Supply Chain for Your Product?” *Harvard Business Review*, March-April 1997.

Fisher, Roger, and William Ury. *Getting to Yes: Negotiating Agreement Without Giving In*. New York: Penguin Books, 1991.

Forde, Morgan. “USMCA Takes Effect. How Does It Affect Supply Chains?” Supply Chain Dive, www.supplychaindive.com/news/usmca-shippers-uncertain-changes-sourcing-operations, July 1, 2020.

Forman, Marianne, and Michael Søgaaard Jørgensen. “Organising Environmental Supply Chain Management. Experience from a Sector with Frequent Product Shifts and Complex Product Chains: The Case of the Danish Textile Sector.” *GMI*, Spring 2004.

Frazelle, Edward H. *Supply Chain Strategy, The Logistics of Supply Chain Management*. New York: McGraw-Hill, 2002.

Frazelle, Edward H. *World-Class Warehousing and Material Handling*. New York: McGraw-Hill, 2002.

“Freight Rail: Moving Miles Ahead on Sustainability.” Association of American Railroads, www.aar.org/article/freight-rail-moving-miles-ahead-on-sustainability/.

“Freight Transport Statistics—Modal Split.” Eurostat, ec.europa.eu/eurostat/statistics-explained/index.php?title=Freight_transport_statistics_-_modal_split.

French, Ewan. “Green by Design.” *Logistics & Transport Focus*, June 2007.

Friedman, Thomas L. *The World Is Flat*. New York: Picador/Farrar, Straus, and Giroux, 2007.

Gardner, Daniel L. *Supply Chain Vector: Methods for Linking Execution of Global Business Models with Financial Performance*. Boca Raton, Florida: J. Ross, 2004.

“Gartner Announces Rankings of the 2021 Supply Chain Top 25.” Gartner, www.gartner.com/en/newsroom/press-releases/2021-05-19-gartner-announces-rankings-of-the-2021-supply-chain-top-25.

Gates, Bill. *Business @ the Speed of Thought*. New York: Warner Books, 1999.

“Geert Hofstede Cultural Dimensions.” www.clearlycultural.com/geert-hofstede-cultural-dimensions.

Gerken, Arno, Olivier Plantefève, and Xavier Veillard, “Managing Industrials’ Commodity-Price Risk.” McKinsey & Company, www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/managing-industrials-commodity-price-risk, October 28, 2019.

Gettinger, Marilyn. “Letting Your Supplier Mind the Store.” *APICS—The Performance Advantage*, March 2001.

Ghemawat, Pankaj. “Finding Your Strategy in the New Landscape.” *Harvard Business Review*, hbr.org/2010/03/finding-your-strategy-in-the-new-landscape/ar/1.

Giguere, Michael, and Glen Goldbach. “Segment Your Suppliers to Reduce Risk.” *CSCMP’s Supply Chain Quarterly*, Quarter 3, 2012, www.supplychainquarterly.com/topics/Global/20121001-segment-your-suppliers-to-reduce-risk/.

Gladstone, Rick, and Megan Specia. "What to Know About the Suez Canal and the Cargo Ship That Was Stuck There." *New York Times*, www.nytimes.com/2021/03/25/world/middleeast/suez-canal-container-ship.html, March 25, 2021 (updated March 29, 2021).

Global Reporting Initiative (GRI), www.globalreporting.org.

Global Sustainability Standards Board (GSSB). "Consolidated Set of GRI Sustainability Reporting Standards 2020." GSSB: Amsterdam, 2020.

"Goal: A Green Supply Chain: 2009 Green Supplier Directory." *Purchasing*, February 2009.

Godsell, Janet, and Remko van Hoek. "Fudging the Supply Chain to Hit the Number: Five Common Practices That Sacrifice the Supply Chain and What Financial Analysts Should Ask About Them." *Supply Chain Management: An International Journal*, Volume 14, Issue 3, 2009.

Goff, John. "Dude, Where's My Printer?, RFID Technology May Well Revolutionize How Companies Track Their Products." *CFO Asia*, October 2004.

Goldstein, Jacob, and Zoe Chace. "Episode 517: The Fastest Growing, Least Popular Airline in America." NPR, www.npr.org/templates/transcript/transcript.php?storyId=276973956, February 14, 2014.

Gorbach, Greg. "Digital Transformation in the Supply Chain." ARC Advisory Group, www.arcweb.com/blog/digital-transformation-supply-chain, May 6, 2020.

Government of Luxembourg. "TIR Carnet." logistics.public.lu/en/formalities-procedures/required-documents/tir-carnet.html.

Gramling, Kathy, Jeff Orschell, and Joshua Chernoff. "How E-Commerce Fits in Retail's Post-Pandemic Future." *Harvard Business Review*, hbr.org/2021/05/how-e-commerce-fits-into-retails-post-pandemic-future, May 11, 2021.

"'Green' Supply Chain Movement Hits a Speed Bump." *Industry Week*, April 2009.

Greve-Davis. "A Global Overview of Reverse Logistics." www.supplychain247.com/paper/a_global_overview_of_reverse_logistics.ain M

Griffis, Stanley E., Thomas J. Goldsby, Martha Cooper, and David J. Closs. "Aligning Logistics Performance Measures to the Information Needs of the Firm." *Journal of Business Logistics*, Autumn 2007, Volume 28, Issue 2.

Gupta, Katyayan, Ellen Daley, Bryan Wang, Dane Anderson, Michael Barnes, and Abhinav Druwa. "The Future of TD-LTE Lies in Asia Pacific." Forrester, www.forrester.com/report/The-Future-of-TDLTE-Lies-In-Asia-Pacific/RES6112, May 7, 2012.

Haenlein, Michael. "Unprofitable Customers and Their Management." *Business Horizons*, 52(1), January-February 2009.

Hall, Jeremy. "Environmental Supply-Chain Innovation." *GMI*, Autumn 2001.

Handfield, R. B., and D. L. Baumer. "Conflict of Interest in Purchasing Management." *Journal of Supply Chain Management*, 42(3), 2006.

"Harmonized Tariff Schedule." hts.usitc.gov/current.

Harrison, Terry P., Hau L. Lee, and John J. Neale, editors. *The Practice of Supply Chain Management: Where Theory and Application Converge*. Norwell, Massachusetts: Kluwer Academic Publishers Group, 2003.

Harvard Business Essentials. *Power, Influence and Persuasion*. Boston: Harvard Business School Press, 2005.

Harvard Business Review. *Harvard Business Review on Communicating Effectively*. Boston: Harvard Business School Publishing Corporation, 2011.

Harvard Business Review School Press. *Harvard Business Review School Press on Business Communication*. Boston: Harvard Business School Publishing Corporation, 2003.

Hauser, Lisa. "The Risk-Adjusted Supply Chain Management Approach." International Conference Proceedings. Chicago, Illinois: APICS, 2004.

He, Hao. "What Is Service-Oriented Architecture?" O'Reilly Webservices, www.xml.com/pub/a/ws/2003/09/30/soa.html, September 30, 2003.

Health and Safety Executive (U.K.), www.hse.gov.uk.

Heizer, Jay, and Barry Render. *Principles of Operations Management*, fourth edition. Upper Saddle River, New Jersey: Prentice-Hall, 2001.

Helmers, Lori R. "The Elastic Green: Protecting the Environment and the Bottom Line." Global Trade Services at JPMorgan Chase, BNP Media, 2008.

Hirano, Hiroyuki. *Five Pillars of the Visual Workplace*. Portland, Oregon: Productivity Press, 1995.

Hitchcock, Darcy E., and Marsha L. Willard. *The Business Guide to Sustainability: Practical Strategies and Tools for Organizations*. London Sterling, Virginia: 2009.

HM Treasury. "VAT Rates." www.gov.uk/vat-rates.

Hofstede, Geert H. *Cultures and Organizations: Software of the Mind*, revised second edition. New York: McGraw-Hill, 2005.

Holmes Corporation. *The Learning System for PMP® Exam Preparation*, Version 1.0. Eagan, Minnesota: Holmes Corporation, 2015.

Hoppe, Richard M., and James B. Rice. "Supply Chain vs. Supply Chain—The Hype and the Reality." *Supply Chain Management Review*, September/October 2001.

"How to Determine the Supplier Relationship Management Model." *Supplier Selection and Management Report*, July 2003.

Huey, John, and Sam Walton. *Made in America: My Story*. New York: Doubleday, 1992.

Icenhour, Melissa R., "Reverse Logistics Planning: A Strategic Way to Address Environmental Sustainability While Creating a Competitive Advantage." University of Tennessee Honors Thesis Projects, 2014. trace.tennessee.edu/utk_chanhonoproj/1760.

"Imagine Warehouse Management Software." www.imaginewms.com/wms.htm.

Immelt, Jeffrey, et al. "How GE Is Disrupting Itself." *Harvard Business Review*, October 2009, hbr.org/2009/10/how-ge-is-disrupting-itself/ar/1.

"Import Licensing." World Trade Organization, www.wto.org/english/tratop_e/implic_e/implic_e.htm.

Institute of Management Accounts. *CMA Learning System*, Book 2a: Management Accounting and Reporting. Montvale, New Jersey: Institute of Management Accountants, 2004.

"Integrity in the Data LifeCycle." Dataworks, www.dataworks.ie/5-stages-in-the-data-management-lifecycle-process/.

International Chamber of Commerce, www.iccwbo.org.

International Labour Organization. "Tripartite Declaration of Principles Concerning Multinational Enterprises and Social Policy," 5th edition. [www.ilo.org/empent/Publications/WCMS_094386/lang--en/index.htm](http://www.ilo.org/empent/Publications/WCMS_094386/lang-en/index.htm).

International Organization for Standardization. "IEC 31010: 2009—Risk Management—Risk Assessment Techniques." www.iso.org/iso/catalogue_detail?csnumber=51073.

International Organization for Standardization. "ISO 9000 Family—Quality Management." www.iso.org/iso/home/standards/management-standards/iso_9000.htm.

International Organization for Standardization. "ISO 9001: What Does It Mean in the Supply Chain?" www.iso.org/iso/PUB100304.pdf.

International Organization for Standardization. "ISO 14000 Family—Environmental Management." www.iso.org/iso/iso14000.

International Organization for Standardization. "ISO 26000—Social Responsibility." www.iso.org/iso/social_responsibility.

International Organization for Standardization. "ISO/IEC 17788:2014, Information Technology—Cloud Computing—Overview and Vocabulary." www.iso.org/standard/60544.html.

International Trade Administration. "Protecting Intellectual Property Rights (IPR) Abroad." 2016.export.gov/tradeproblems/eg_main_018580.asp.

Irving, Dan, Gary Kilponen, Raffi Markarian, and Mark Klitgaard. "Innovations: A Tax-Aligned Approach to SCM." *Supply Chain Management Review*, April 2005.

iSixSigma, www.isixsigma.com.

Johnson, Mark. "New Business Models In Emerging Markets." *Harvard Business Review*, 2011.

Johnson, Matt. "Collaboration: A New Paradigm for Partnership Across the Supply Chain." Chicago, Illinois: APICS, 2002.

Jordan, Lewis D. *Partnerships for Profit: Structuring and Managing Strategic Alliances*. New York: The Free Press, Simon & Schuster, Inc., 1990.

"Just-In-Time Made the World Tardy: COVID-19 Revealed Manufacturing Cost Cutting Strategies May Have Gone Too Far, According to Pricefx." Business Wire, www.businesswire.com/news/home/20210628005038/en/Just-In-Time-Made-the-World-Tardy-COVID-19-Revealed-Manufacturing-Cost-Cutting-Strategies-May-Have-Gone-Too-Far-According-to-Pricefx, June 28, 2021.

Kamensky, John. "Disasters Are Inevitable; Government's Inadequate Response Is Not." *Government Executive*, www.govexec.com/management/2020/11/disasters-are-inevitable-governments-inadequate-response-not/170243/, November 20, 2020.

Kaplan, Robert S., and David P. Norton. *The Balanced Scorecard: Translating Strategy into Action*. Boston: Harvard Business School Press, 1996.

Ketchen, David Jr., William Rebarick, G. Thomas M. Hult, and David Meyer. "Best Value Supply Chains: A Key Competitive Weapon for the 21st Century." hbr.org/product/best-value-supply-chains-a-key-competitive-weapon-/an/BH279-PDF-ENG, May 15, 2008.

Khoo, Hsien H., Trevor A. Spedding, Ian Bainbridge, and David M. R. Taplin. "Creating a Green Supply Chain." *GMI*, Autumn 2001.

Kilcarr, Sean. "Changing Shipping Patterns May Shrink Logistics Industry." *FleetOwner*, fleetowner.com/fleet-management/changing-shipping-patterns-may-shrink-logistics-industry, June 6, 2014.

Kilponen, Gary, and Mark Hardison. "Integrated Approaches to Global Supply Chain Transformation." Chicago, Illinois: APICS, 2004.

King, Anna. "Northwest Hay Exports Getting Squeezed in Down Economy." *OPB News*, Northwest Public Radio, July 13, 2009.

Kiser, James, and G. Cantrell. "Six Steps to Managing Risk." *Supply Chain Management Review*, 10(3), 2006.

Kohan, Shelley E. "Amazon's Net Profit Soars 84% with Sales Hitting \$386 Billion." *Forbes*, www.forbes.com/sites/shelleykohan/2021/02/02/amazons-net-profit-soars-84-with-sales-hitting-386-billion/?sh=6b84ed9b1334, February 2, 2021.

Kotter, John P. *Accelerate: Building Strategic Agility for a Faster-Moving World*. Boston: Harvard Business Review Press, 2014.

Kroll, Karen. "The USMCA's Impact on Supply Chain Compliance." Society of Corporate Compliance and Ethics (SCCE), www.jdsupra.com/legalnews/the-usmca-s-impact-on-supply-chain-51787/, August 25, 2020.

Kuglin, Fred A. *Customer-Centered Supply Chain Management: A Link-by-Link Guide*. New York: AMACOM, 1998.

Kuglin, Fred A., and Barbara A. Rosenbaum. *The Supply Chain Network @ Internet Speed: Preparing Your Company for the E-Commerce Revolution*. New York: AMACOM, 2001.

Kwak, James. "The Importance of Excel." baselinescenario.com/2013/02/09/the-importance-of-excel/.

Landvater, Darryl. "What Is Time-Phased Planning?" *Supply Chain Management Review*, November/December 2001.

Lee, Hau L. "Don't Tweak Your Supply Chain—Rethink it End to End." *Harvard Business Review*, hbr.org/2010/10/dont-tweak-your-supply-chain-rethink-it-end-to-end/ar/1, October 2010.

Lee, Hau L. "Triple-A Supply Chain." *Harvard Business Review*, hbr.org/product/the-triple-a-supply-chain-harvard-business-review/an/R0410F-PDF-ENG, October 2004.

Li, Ling. *Supply Chain Management: Concepts, Techniques, and Practices—Enhancing Value through Collaboration*. Hackensack, New Jersey: World Scientific Publishing Co. Pte. Ltd., 2007.

Light, Elizabeth. "A Green Supply Chain." *NZ Business*, April 2002.

Ling, Richard. "Sales and Operations Planning—The Journey." Chicago, Illinois: APICS, 2002.

"List of Free-Trade Zones in the United Arab Emirates." Wikipedia, en.wikipedia.org/wiki/List_of_free-trade_zones_in_the_United_Arab_Emirates.

Long, Douglas. *International Logistics: Global Supply Chain Management*. Norwell, Massachusetts: Kluwer Academic Publishers, 2003.

Lovorn, Randall. "Building a Solid Foundation for Supply Chain Optimization." International Conference Proceedings. Chicago, Illinois: APICS, 2003.

Lowe, Hunter. "How Cloud Supply Chain Software Revolutionizes Operations." Select Hub, www.selecthub.com/supply-chain-management/10-ways-cloud-computing-revolutionizing-supply-chain-management/.

Lubin, David A., and Daniel C. Esty. "The Sustainability Imperative." *Harvard Business Review*, hbr.org/2010/05/the-sustainability-imperative/ar/1, May 2010.

Lummus, Rhonda R., and Terry Lunn. "Competing through Networks, Part II: Vocalize the Plan; Visualize Performance." International Conference Proceedings. Chicago, Illinois: APICS, 2004.

"Main Changes in Revised ISO 31000 Standard—Keep Risk Management Simple." Wolters Kluwer, www.cgerisk.com/2018/07/main-changes-in-revised-iso-31000-standard-keep-risk-management-simple/.

Malone, Robert. "Closing the Supply Chain Loop: Reverse Logistics and the SCOR Model." Inbound Logistics, www.inboundlogistics.com/cms/article/closing-the-supply-chain-loop-reverse-logistics-and-the-scor-model/, January 1, 2004.

Mansfield, Edward D., and Milner, Helen V. *The Political Economy of Regionalism*. New York: Columbia University Press, 1997.

Marabotti, Deb. "Supply Chain Event Management: Category, Function, or Just Another Buzzword?" Westmont, Illinois: Silvon Software, Inc., 2002.

Marketing Charts, www.marketingcharts.com.

Martin, Andre J. "Capacity Planning: The Antidote to Supply Chain Constraints." *Supply Chain Management Review*, November/December 2001.

"Master Data Management—What, Why, How & Who." Profisee, profisee.com/master-data-management-what-why-how-who/.

Mathis, Robert L., John H. Hackson. *Human Resource Management*, 12th edition. Mason, Ohio: Thomson/South-Western, 2008.

Mazareanu, E. "Global Size of the Courier, Express and Parcel (CEP) Market 2009-2024." Statista, www.statista.com/statistics/723986/cep-market-total-revenue-worldwide/, June 11, 2021.

McConnell, Campbell R., Stanley L. Brue, and Sean M. Flynn. *Macroeconomics: Principles, Problems, and Policies*. New York: McGraw-Hill/Irwin, 2012.

McCormack, Kevin P., William Johnson, and William T. Walker. *Supply Chain Networks and Business Process Orientation: Advanced Strategies and Best Practices*. Boca Raton, Florida: St. Lucie Press, 2002.

McCrea, Bridget. "The Continuing Convergence of the Public Cloud and Supply Chain Management Software." Supply Chain 247, www.supplychain247.com/article/the_continuing_convergence_of_the_cloud_and_supply_chain_software, September 4, 2020.

"McDonald's Supply Chain Management Is the Secret to Their Success." Box Around the World, boxaroundtheworld.com/mcdonalds-supply-chain-management/.

Melnyk, Steven A., et al. "Supply Chain Management 2010 and Beyond: Mapping the Future of the Strategic Supply Chain." APICS Educational & Research, Inc., November 2006.

Melnyk, Steven, and R. T. Christensen. "Risk Management: Is Your Supply Chain Too Lean?" *APICS—The Performance Advantage*, June 2004.

Merrifield, Ric, Jack Calhoun, and Dennis Stevens. "The Next Revolution in Productivity." *Harvard Business Review*, June 1, 2008.

Metzger, Michael. "The Ten Commandments of Legal Risk Management." *Business Horizons*, January 2008.

Microsoft Business Solutions. *Training 8019A: CRM Applications Professional*. Fargo, North Dakota: Microsoft Corporation, 2004.

Miller, Roger Le Roy, and Gaylord A. Jentz. *Business Law Today*, sixth edition. Mason, Ohio: Thomson-South-Western West, 2003.

Monczka, Robert M., Robert B. Handfield, Larry C. Giunipero, and James L. Patterson. *Purchasing and Supply Chain Management*, 7th edition. Boston: Cengage, 2021.

Mongelluzzo, Bill. "Green for 'Green'—Investment 'Angels' Put Up Money for Environmental Technology at Ports." *The Journal of Commerce*, June 16, 2008.

Moore, John. "RFID's Positive Identification." FCW, fcw.com/articles/2005/04/18/rfids-positive-identification.aspx, April 18, 2005.

Morningstar, www.morningstar.com.

Munter, Mary. *Guide to Managerial Communication: Effective Business Writing and Speaking*, ninth edition. Boston: Prentice Hall, 2012.

Muzumdar, Maha, and Narayan Balachandran. "The Supply Chain Evolution: Roles, Responsibilities and Implications for Management." *APICS—The Performance Advantage*, October 2001.

Needle, Flori. "75 Essential Social Media Marketing Statistics for 2021." Hubspot, blog.hubspot.com/blog/tabid/6307/bid/23865/13-mind-bending-social-media-marketing-statistics.aspx.

Noah, David. "Incoterms 2020 FCA: Spotlight on Free Carrier." Shipping Solutions, www.shippingsolutions.com/blog/incoterms-2020-fca-spotlight-on-free-carrier.

Nokia, www.nokia.com.

OASIS (Organization for the Advancement of Structured Information Standards), www.oasis-open.org.

Oliver Wight, www.oliverwight.com.

"Online Barcode Generator." TEC-IT Datenverarbeitung GmbH, barcode.tec-it.com.

Open Systems, Inc., www.osas.com. Oracle, www.oracle.com.

Organisation for Economic Co-operation and Development, www.oecd.org/about/.

Organisation for Economic Co-operation and Development. "OECD Guidelines for Multinational Enterprises." OECD Publishing, www.oecd-ilibrary.org/governance/oecd-guidelines-for-multinational-enterprises_9789264115415-en, 2011.

Ort, Ed. "Service-Oriented Architecture and Web Services: Concepts, Technologies, and Tools." Sun Developer Network, www.oracle.com/technical-resources/articles/javase/soa2.html, April 2005.

Osawa, Juro. "How To Understand Alibaba's Business Model." MarketWatch, www.marketwatch.com/story/how-to-understand-alibabas-business-model-2014-03-15-94855847, March 15, 2014.

O'Sullivan, Denis. "What Is the Reality of Environmentally Friendly Supply Chains?" *Logistics & Transport Focus*, October 2008.

Oxford Economics. "The Economic Impact of Express Carriers in Europe." www.euroexpress.org/uploads/ELibrary/EEA_RA2011_LR.pdf, November 2011

Pagano, Anthony M., and Matthew Liotine. *Technology in Supply Chain Management and Logistics*. Elsevier: Cambridge, Massachusetts, 2020.

Parker, Andrew, and Daniel Schafer. "Multinationals Warn over Japanese Supplies." *Financial Times*, March 17, 2011.

Pennic, Jasmine. "4 Best Practices for Streamlining Hospital Supply Chain Management." HIT Consultant, hitconsultant.net/2013/08/05/4-best-practices-for-streamlining-hospital-supply-chain-management/, August 5, 2013.

Peppers, Don, and Martha Rogers. *One to One, B2B: Customer Development Strategies for the Business-to-Business World*. New York: Doubleday, 2001.

Petersen, Catherine J., and Brent W. M. Primus. *Incoterms® 2010 and the UCC: A Guide to International and Domestic Terms of Sale, Version 3*. Global Training Center, 2010.

Poirier, Charles C. *Advanced Supply Chain Management: How to Build a Sustained Competitive Advantage*. San Francisco: Berrett-Koehler Publishers, 1999.

Poirier, Charles, et al. *The Networked Supply Chain: Applying Breakthrough BPM Technology to Meet Relentless Customer Demand*. Boca Raton, Florida: J. Ross Publishing, 2004.

Poirier, Charles C., and Michael J. Bauer. *E-Supply Chain: Using the Internet to Revolutionize Your Business (How Market Leaders Focus Their Entire Organization on Driving Value to Customers)*. San Francisco: Berrett-Koehler Publishers, 2000.

Poirier, Charles C., and Stephen Reiter. *Supply Chain Optimization: Building the Strongest Total Business Network*. San Francisco: Berrett-Koehler Publishers, 1996.

Pojasek, Robert B. "Using Leading Indicators to Drive Sustainability Performance." Wiley Periodicals, Inc., Summer 2009.

Porter, Michael. *The Competitive Advantage: Creating and Sustaining Superior Performance*. New York: Free Press, 1985.

Prashantham, Shameen, and Julian Birkinshaw. "Dancing with Gorillas: How Small Companies Can Partner Effectively with MNCs." *California Management Review*, November 2008.

Prescod, Paul. "REST and the Real World." O'Reilly Webservices, www.xml.com/pub/a/ws/2002/02/20/rest.html, February 20, 2002.

Project Management Institute, Inc. *A Guide to the Project Management Body of Knowledge (PMBOK Guide®)*, fifth edition. Newtown Square, Pennsylvania: Project Management Institute, Inc., 2013.

Ptak, Carol, and Chad Smith. *Demand Driven Material Requirements Planning, Version 3*. South Norwalk, Connecticut: Industrial Press, Inc., 2019.

Ptak, Carol A., Chad Smith, and Joseph Orlicky. *Orlicky's Material Requirements Planning*. New York: McGraw-Hill, 2011.

Ramakrishnan, V. S. Rama. "Web Services: OR's Newest Ally?" *Inform*, www.informs.org/ORMS-Today/Archived-Issues/2001/orms-12-01/Web-Services-OR-s-Newest-Ally, December 2001.

Randewich, Noel, and Chang-Ran Kim. "Asian Supply Lines Hit by West Coast Ports Dispute." Reuters, www.reuters.com/news/picture/asian-supply-lines-hit-by-west-coast-por-idUSKBN0LK0F620150217, February 16, 2015.

Reese, Andrew K. "Building the Green Supply Chain." *Supply/Demand Chain Executive*, www.sdcexec.com/article/10289678/building-the-green-supply-chain, October/November 2007.

Reeve, James M. "The Financial Advantages of the Lean Supply Chain." *Supply Chain Management Review*, March/April 2002.

Reingold, Jennifer. "Walking the Walk." *Fast Company*, November 2005.

Resilinc, “Our Products.” www.resilinc.com/products/. *RFID Journal*, www.rfidjournal.com.

Rice, James B., Jr., and Richard M. Hoppe. “Supply Chain vs. Supply Chain: The Hype and the Reality.” *Supply Chain Management Review*, September/October 2001.

Ritchie, Hannah. “3M and ForestEthics End Multi-Year Conflict Over Paper Sourcing Policy.” www.sustainablebrands.com/news_and_views/behavior_change/hannah_ritchie/3m_forestethics_end_multi-year_conflict_over_paper_sou.

Robinson, Sean. “What Are the Hidden Costs of Software Licensing?” TechRadar, www.techradar.com/news/software/what-are-the-hidden-costs-of-software-licensing-1280832, January 17, 2015.

Ronai, Bob. “Incoterms 2020—7 Key Changes You Need to Know [Update].” Trade Finance Global, www.tradefinanceglobal.com/posts/incoterms-2020-7-key-changes-you-need-to-know/, October 15, 2019.

Rosenfeld, Everett. “Major Asia-Pacific Trade Pact Enters Final Stages.” CNBC, www.cnbc.com/2015/03/20/tpp-trans-pacific-partnership-trade-pact-in-final-stages-china-set-to-join-later.html, April 16, 2015.

Rosenthal, Beth Ellyn. “An Attorney Outlines Some Outsourcing Challenges for Manufacturers.” Outsourcing Center, www.outsourcing-center.com/an-attorney-outlines-some-outsourcing-challenges-for-manufacturers-article/.

Ross, David F. *Distribution Planning and Control*, second edition. New York: Springer Science+Business Media, Inc., 2004.

Ross, David F. *Introduction to Supply Chain Management Technologies*, second edition. Boca Raton, Florida: CRC Press, 2011.

Roussel, Joseph. “How to Get More from Your Supply Chain.” *Industry Week*, www.industryweek.com/supply-chain/article/21965457/how-to-get-more-from-your-supply-chain, February 19, 2014.

Rowat, Christine. “Collaboration for Improved Product Availability.” *Logistics & Transport Focus*, April 2006.

Rutner, Stephen M., et al. “Longitudinal Study of Supply Chain Information Systems.” *Production and Inventory Management Journal*, second quarter, 2001.

Sanoussi, Bilal, and R. J. Barry Jones, editors. *Routledge Encyclopedia of International Political Economy*. New York: Routledge, 2001.

Saunders, Michael, and Alan Heger. “Centralizing the System: Solution Links Global Operations, Integrates End-to-End Supply Chain.” *APICS—The Performance Advantage*, September 2004.

Savitz, Andrew W. *The Triple Bottom Line: How Today’s Best Run Companies Are Achieving Economic, Social and Environmental Success—and How You Can Too*. San Francisco: Jossey-Bass, 2006.

“Scallog, The French Logistics Robotics Specialist, Sets Sail to Conquer the USA in Agreement with Bastian Solutions.” Global Trade, www.globaltrademag.com/scallog-the-french-logistics-robotics-specialist-sets-sail-to-conquer-the-usa-in-agreement-with-bastian-solutions/, June 2, 2021.

Schermerhorn, John R., James G. Hunt, and Richard N. Osborn. *Organizational Behavior*, 10th edition. Hoboken, New Jersey: 2008.

Schlegel, Gregory L., and Robert J. Trent. *Supply Chain Risk Management: An Emerging Discipline*. Boca Raton, Florida: CRC Press, 2014.

Schroder, Paul W., and David M. Powell. "Rules of Engagement: A Better Way to Interact With Suppliers." *Supply Chain Quarterly*, www.supplychainquarterly.com/articles/686-rules-of-engagement-a-better-way-to-interact-with-suppliers, December 17, 2012.

Schulz, John D. "31st Annual State of Logistics: Resilience Put to the Test." *Logistics Management*, www.logisticsmgmt.com/article/31st_annual_state_of_logistics_resilience_put_to_the_test#:~:text=The%20report%20states%20that%20U.S.,%2421.43%20trillion%20Gross%20Domestic%20Product, July 10, 2020.

"Securing Trade: The EU's Approach to Port and Maritime Container Security." *EU Insight*, Issue No. 21, July 2008.

Sen Gupta, Mark. "What Is Digitization, Digitalization, and Digital Transformation?" ARC Advisory Group, www.arcweb.com/blog/what-digitization-digitalization-digital-transformation, March 24, 2020.

Seuring, Stefan A. "Green Supply Chain Costing: Joint Cost Management in the Polyester Linings Supply Chain." *GMI*, Spring 2001.

Sharma, Ajay. "Good and Getting Better." Chicago, Illinois: APICS, 2001.

Shear, Michael D., Nicole Perloth, and Clifford Krauss. "Colonial Pipeline Paid Roughly \$5 million in Ransom to Hackers." *New York Times*, www.nytimes.com/2021/05/13/us/politics/biden-colonial-pipeline-ransomware.html, May 13, 2021.

Sheffi, Yossi. *The Resilient Enterprise*. Cambridge, Massachusetts: MIT Press, 2007.

Sheffi, Yossi, and Paul Michelman. "The Next Killer App? It's Your Supply Chain." *Supply Chain Strategy*, Volume 1, Number 2, 2005.

Sheffi, Yossi, and James B. Rice, Jr. "A Supply Chain View of the Resilient Enterprise." *MIT Sloan Management Review*, Fall 2005, web.mit.edu/scresponse/repository/Sheffi_Rice_SC_View_of_the_Resilient_Enterprise_Fall_2005.pdf.

Shih, Willy C. "Global Supply Chains in a Post-Pandemic World." *Harvard Business Review*, September-October 2020. hbr.org/2020/09/global-supply-chains-in-a-post-pandemic-world.

"Shipping During COVID-19: Why Container Freight Rates Have Surged." United Nations Conference on Trade and Development (UNCTAD), unctad.org/news/shipping-during-covid-19-why-container-freight-rates-have-surged, April 23, 2021.

Shobrys, Donald E. "Investing in the Chain: Mitigating Risk and Maximizing Return in Your Supply Chain Investments for 2003." *APICS—The Performance Advantage*, January 2003.

Shoemaker, Greg. "Supply Chain Overhaul: Driving Your Company's Future Strategy." *International Conference Proceedings*. Chicago, Illinois: APICS, 2004.

Siegel, Camille. "What Is an API?" Axway, blog.axway.com/amplify-products/api-management/what-is-an-api, October 28, 2020.

Simchi-Levi, David. "Seven Myths to Beat Before They Beat You." store.hbr.org/product/seven-myths-to-beat-before-they-beat-you/iir048?sku=IIR048-PDF-ENG.

Simchi-Levi, David, Philip Kaminsky, and Edith Simchi-Levi. *Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies*, third edition. Boston: McGraw-Hill Irwin, 2008.

Smith, Elliot. "Coronavirus Will Be the Largest Loss on Record for Insurers, Lloyd's of London Says." *CNBC*, www.cnbc.com/2020/05/14/lloyds-of-london-coronavirus-will-be-largest-loss-on-record-for-insurers.html, May 14, 2020.

Smith, Jacquelyn. "The World's Most Sustainable Companies of 2014." *Forbes*, www.forbes.com/sites/jacquelynsmith/2014/01/22/the-worlds-most-sustainable-companies-of-2014/.

"SOA vs. Microservices: What's the Difference?" IBM, www.ibm.com/cloud/blog/soa-vs-microservices.

Social Accountability International. *Social Accountability 8000: International Standard*, Version 2014. New York: Social Accountability International, 2014.

Society for Human Resource Management. *SHRM Learning System for SHRM-CP/SHRM-SCP*. Alexandria, Virginia: Society for Human Resource Management, 2015.

Sohlberg, Marcus. "China Free Trade Zones: A Complete Guide." Export2Asia, www.export2asia.com/blog/china-free-trade-zones/, August 11, 2020.

Sommer, Tim. "The Licensing of Oracle Technology Products—Compliance, Metrics, Licensing Restrictions." omtco.eu/references/oracle/the-licensing-of-oracle-technology-products-compliance-metrics-licensing-restrictions/.

"Special Economic Zone." Wikipedia, en.wikipedia.org/wiki/Special_economic_zone.

"Special Economic Zones: Performance, Lessons Learned, and Implications for Zone Development." World Bank, documents.worldbank.org/en/publication/documents-reports/documentdetail/343901468330977533/special-economic-zone-performance-lessons-learned-and-implication-for-zone-development, 2008.

Springman, Brian, and Jack Rech. "Using Existing Tools for Sophisticated Supply Chain Analysis and Measurement." International Conference Proceedings. Chicago, Illinois: APICS, 2004.

Stephen, Mark. "A Guide to Six Sigma, Lean, and the Theory of Constraints." *Canadian Plastics*, January/February 2009, Volume 67, No. 1.

"Supply Chain 4.0: 6 Ways Digital Transformation Is Transforming the Supply Chain." BDO Digital, www.bdo.com/digital/insights/digital-transformation/6-ways-the-supply-chain-is-transforming, January 12, 2021.

Supply Chain Council. *SCOR: Supply Chain Operations Reference Model*, Revision 11.0. United States of America: Supply Chain Council, Inc., 2013.

"Target Canada Closing, Ending 2-Year Foray." CTVNews, www.ctvnews.ca/business/target-canada-closing-ending-2-year-foray-1.2323222, April 12, 2015.

Tate, Curtis. "How Railroads Came Back from the Brink and Got Ahead." *The Wichita Eagle*, www.kansas.com/news/politics-government/article1192920.html, March 1, 2012.

Taylor, David A. *Supply Chains: A Manager's Guide*. Boston: Addison-Wesley, 2004.

Taylor, Jessica. "Obama Says China Could Join Already Huge Asia Trade Deal." NPR, www.npr.org/sections/itsallpolitics/2015/06/03/411778624/obama-says-china-could-join-already-huge-asia-trade-deal, June 3, 2015.

"The 10 Keys to Global Logistics and Trade Management Excellence." *The Supply Chain Digest Letter*™, May 2008.

"THESIS Index." Walmart Sustainability Hub, www.walmartsustainabilityhub.com/sustainability-index.

Thompson, Andrea. "A Running List of Record-Breaking Natural Disasters in 2020." *Scientific American*, www.scientificamerican.com/article/a-running-list-of-record-breaking-natural-disasters-in-2020/, December 22, 2020.

"TIR." United Nations Economic Commission for Europe, unece.org/transport/tir.

Titze, Christian. "Gartner: What Supply Chain Managers Should Know About Control Towers." Supply Chain Dive, www.supplychaindive.com/news/gartner-what-supply-chain-managers-should-know-about-control-towers/574098/, March 13, 2020.

"Top 10 Largest Couriers." Supply Chain Digital, supplychaindigital.com/top10/top-10-largest-couriers, December 18, 2020.

"Tradelens Digital Shipping Platform Adoption Grows in China." TradeLens, www.tradelens.com/post/tradelens-adoption-grows-in-china, June 17, 2021.

"Transportation Management Software (TMS)." Imagine, www.imaginewms.com/tms.htm.

Trent, Robert J. "What Everyone Needs to Know about SCM." *Supply Chain Management Review*, March 2004.

Tritely, Peter. "Looking Left, Looking Right: The Critical Role of Supply Chain in Supporting Business Transformation." *Supply & Demand Chain Executive*, October/November 2004.

"Truck and Bus Regulation Compliance Requirement Overview." California Air Resources Board, ww3.arb.ca.gov/msprog/onrdiesel/documents/fsregsum.pdf, June 18, 2019.

Tyndall, Gene, Christopher Gopal, Wolfgang Partsch, and John Kamauff. *Supercharging Supply Chains: New Ways to Increase Value through Global Operational Excellence*. New York: John Wiley, 1998.

"UN Global Compact Management Model: Framework for Implementation." United Nations Global Compact, d306pr3pise04h.cloudfront.net/docs/news_events%2F9.1_news_archives%2F2010_06_17%2FUN_Global_Compact_Management_Model.pdf, 2010.

Unified Compliance Framework, ServiceNow. www.unifiedcompliance.com/partner/servicenow/.

"United States-Mexico-Canada Agreement." International Trade Administration, trade.gov/usmca.

"Unlocking the Promise of Demand Sensing and Shaping Through Big Data Analytics: How To Apply High-Performance Analytics in Your Supply Chain." SAS, resources.idgenterprise.com/original/AST-0112051_UnlockingPromise.pdf.

UPS, www.ups.com. U.S. Census Bureau, www.census.gov.

U.S. Census Bureau, "Economic Indicators." www.census.gov/cgi-bin/briefroom/briefrm.

U.S. Customs and Border Protection, www.cbp.gov.

U.S. Customs and Border Protection. "Customs-Trade Partnership Against Terrorism—Mutual Recognition." www.cbp.gov/border-security/ports-entry/cargo-security/c-tpat-customs-trade-partnership-against-terrorism/mutual-recognition.

"U.S. Postal Service Reports Fiscal Year 2020 Results." USPS, about.usps.com/newsroom/national-releases/2020/1113-usps-reports-fiscal-year-2020-results.htm, November 13, 2020.

U.S. Securities and Exchange Commission. "Fact Sheet—Disclosing the Use of Conflict Minerals." www.sec.gov/opa/Article/2012-2012-163htm---related-materials.html#.VSbp5_nF98E.

"Use of IFRS Around the World." IFRS Foundation, www.ifrs.org/content/dam/ifrs/around-the-world/adoption/use-of-ifrs-around-the-world-overview-sept-2018.pdf.

Uusitalo, Olavi H., and Maria S. Uuskoski. "Improving Supplier and Customer Relationship Management through Organizational Learning." Industrial Marketing and Purchasing Group, www.impgroup.org/uploads/papers/6737.pdf.

- Vachani, Sushil, and N. Craig Smith. "Socially Responsible Distribution: Distribution Strategies for Reaching the Bottom of the Pyramid." *California Management Review*, Winter 2008.
- Vachon, Stephan. "Green Supply Chain Practices and the Selection of Environmental Technologies." *International Journal of Production Research*, Vol. 45, Nos. 18–19, 15 September–1 October 2007.
- Valentine, Michael. "Seeing Into the Chain: Supply Chain Visibility—The Next Generation." *APICS—The Performance Advantage*, September 2003.
- Van der Meulen, Rob. "5 Stages of Logistics Maturity." Gartner, www.gartner.com/smarterwithgartner/5-stages-of-logistics-maturity/, August 28, 2017.
- Van Marle, Gavin. "The 'Staggering' Cost of Reverse Logistics to Supply Chains," theloadstar.com/the-staggering-cost-of-reverse-logistics-to-supply-chains/, January 23, 2020.
- Varshney, Rajiv, and Praveen Gupta. "Letting Your Supplier Mind the Store." *APICS—The Performance Advantage*, March 2001.
- Verwijmeren, Martin. "Three Types of Supply Chain Control Towers." MPO, blog.mpo.com/3-types-of-supply-chain-control-towers, August 17, 2017.
- Visioni, Laura. "Preparing a Successful Partnership." *B to B Magazine*, January 14, 2002.
- Vitasek, Kate. "A Matter of Time Before West Coast Port Labor Issues Recur." *Forbes*, www.forbes.com/sites/katevitasek/2015/02/23/a-matter-of-time-before-west-coast-port-labor-issues-recur/, February 23, 2015.
- Wakabayashi, Daisuke, and Lorraine Luk. *Wall Street Journal*, "Apple Watch: Faulty Taptic Engine Slows Rollout." www.wsj.com/articles/apple-watch-faulty-taptic-engine-slows-roll-out-1430339460, April 29, 2015.
- Walker, William T. "Change Your Partner." *APICS—The Performance Advantage*, April 2003.
- Wallace, Thomas F., and Robert A. Stahl. *Sales and Operations Planning: The How-to Handbook*, third edition. Cincinnati, Ohio: T. F. Wallace and Company, 2007.
- "Wal-Mart Expects 30% Rise in E-Commerce Revenues This Year." *Forbes*, www.forbes.com/sites/greatspeculations/2014/06/09/wal-mart-expects-30-rise-in-e-commerce-revenues-this-year/, June 9, 2014.
- "Walmart's Online Sales Grow 79% in Its Just-Ended Fiscal Year." Bloomberg News, www.digitalcommerce360.com/2021/02/18/walmarts-online-sales-grow-79-in-its-just%E2%80%91ended-fiscal-year/, Feb 18, 2021.
- "Warehouse Management Systems (WMS)." www.inventoryops.com/warehouse_management_systems.htm.
- Wee, H. M. "Lean Supply Chain and Its Effect on Product Cost and Quality: A Case Study on Ford Motor Company." *Supply Chain Management: An International Journal*, Volume 14, Issue 5, 2009.
- Wessner, David K. "Toyota's Efficiencies Can Benefit American Health Care." *Minneapolis Star Tribune*, June 13, 2005.
- Weygandt, Jerry J., Paul D. Kimmel, and Donald E. Kieso. *Accounting Principles*. Hoboken, New Jersey: J. Wiley & Sons, 2012.
- "What Does the Term 'Demand Driven' Really Mean?" Demand Driven Institute, www.demanddriveninstitute.com/demand-driven-basics.
- "What Is a Resilient Supply Chain?" SAP Insights, insights.sap.com/what-is-a-resilient-supply-chain/.

“What Is Quantum Computing?” IBM, www.ibm.com/quantum-computing/what-is-quantum-computing/.

“What is the MITRE ATT&CK Framework?” McAfee, www.mcafee.com/enterprise/en-us/security-awareness/cybersecurity/what-is-mitre-attack-framework.html.

Wheelwright, Steven C., and Kim B. Clark. *Revolutionizing Product Development: Quantum Leaps in Speed, Efficiency, and Quality*. New York: Free Press, 1992.

“Who Gains, Who Loses, from RFID’s Growing Presence in the Marketplace?” The Wharton School, knowledge.wharton.upenn.edu/article.cfm?articleid=1161, March 23, 2005.

Wight, Oliver. *Manufacturing Resource Planning: MRP II: Unlocking America’s Productivity Potential*. Chichester, New York: Wiley, 1984.

Wight, Oliver. *The Oliver Wight Class A Checklist for Business Excellence*, sixth edition. New York: John Wiley and Sons, 2005.

Womack, James P., and Daniel T. Jones. *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*. New York: Simon and Schuster, 1996.

Woollacott, Emma. “Electric Cars: What Will Happen to All the Dead Batteries?” BBC News, www.bbc.com/news/business-56574779, April 27, 2021.

World Wide Web Consortium (W3C), www.w3.org. X12, www.x12.org.

Zigiaris, Sotiris. “Supply Chain Management.” Report produced for the EC-funded InnoRegio Project, BPR Hellas, SA, ww.urenio.org/tools/en/supply_chain_management.pdf, January 2000.

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