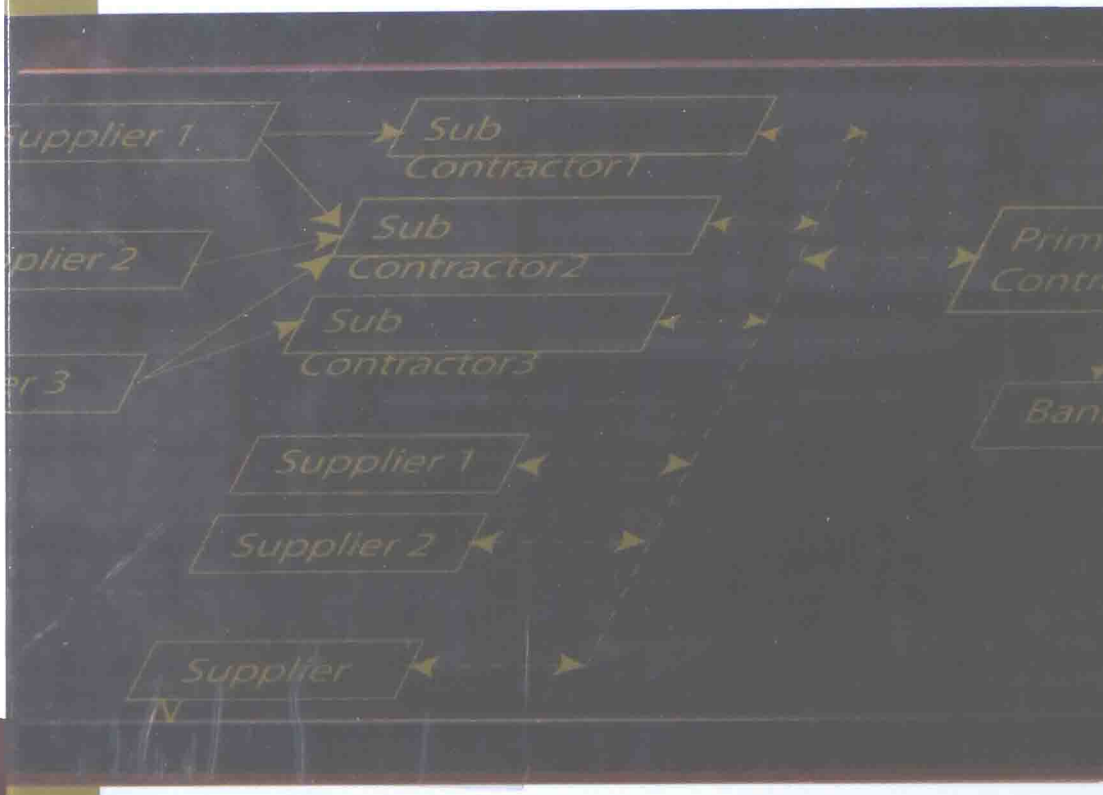
Construction Purchasing & Supply Chain Management



W.C. Benton, Jr. and Linda F. McHenry

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Preface

Construction Purchasing & Supply Chain Management is an authoritative guide that provides proven strategies for the construction supply chain management (CSCM) function. The material in this book explains how to achieve maximum integration with upstream and downstream supply chain members using the latest methodologies and technologies. It is also a comprehensive step-by-step guide to CSCM that is intended to help project owners, design engineers, architects, prime contractors, subcontractors, suppliers, and construction managers involved in construction projects throughout the world establish a strategic framework to meet the budgetary and scheduling goals of any project. This book can be used to teach the fundamentals of construction purchasing and supply management in a logical, simple, and concise format in construction management courses designed for undergraduate business and civil engineering students or for construction management graduate students. CSCM focuses on strategies for Lean construction including just-in-time purchasing, supplier evaluation, subcontractor selection, subcontractor relationship management, equipment acquisition, information sharing, and project quality management. The treatment of CSCM in this book is extensive and complete. There are more than 70 illustrations and ready-to-use forms.

The construction industry has changed in its complexity over time. However, the primary objective of the industry is basically the same as it was 100 years ago: to build communities, roads, schools, homes, businesses, and hospitals. In 2007 approximately $2 trillion was spent in the construction industry. A unique project-delivery system is the cornerstone of the construction industry. The industry is fragmented and distinguished by a collection of large and small firms, related bulk material suppliers, and many other support professionals. The typical supply chain for any given construction project could include architects and engineers, prime contractors, specialty subcontractors, and material suppliers that come together one time to build a single project for a specific owner. This complex supply chain is characterized by adversarial short-term relationships driven by the competitive bidding process. Except for the architect, support engineer, or other

construction professional whose fees are negotiated, the low bid win is the pricing model that repeats itself in each link of the supply chain. The project owner selects a prime contractor who is the low bidder. In turn, the prime contractor uses price as the basis for selecting subcontractors and suppliers. This approach continues even if a subcontractor hires his or her own subcontractor; again, the low bid wins. In most private and some public markets it is an industry practice after the contract is awarded and the overall project price is known, for the prime contractor to "shop" the prices of subcontractors before deciding which to use. Likewise, prime contractors may receive unsolicited quotes from subcontractors who aggressively pedal their low prices after the contract award. This adversarial behavior causes dissatisfaction throughout the supply chain and results in arms-length, one-time, project-focused relationships.

Time is one of the most critical factors in construction operations and has significant legal consequences. The project owner sets rigid beginning and ending dates for the construction process. Delays are costly and are specifically addressed in contract documents in anticipation of liquidated and other damages. Pricing in construction can be lump sum, cost plus, negotiated, or unit price. All pricing in construction depends on the time that the contractor determines it will take to complete a job. Barring any circumstances caused by the project owner and outside of the control of the contractor, the contractor must meet the time set by the project owner or lose money. Time factors are even more complicated in construction because the working environment may be outside for part or all of a project, which means that progress is influenced by weather conditions.

The labor-intensive construction operation is characterized by decentralization. A prime contractor may self-perform a portion of the work as other specialty subcontractors move in and out of the project as their sections of work are ready. Over time, the jobsite is transformed from a temporary production facility with materials and heavy equipment to the actual completed project, a school or a hospital. Projects are typically located near the project owner who is either hands-on or represented by an architect or construction manager. There is limited coordination and collaboration between the design professionals, prime contractors, subcontractors, and suppliers involved during the life-cycle aspects of the project. Information generated by various sources, at many levels of abstraction and detail, contributes to the fragmentation. Traditionally, the project information exchanged between architects/engineers and a prime contractor is compliant and has been mainly based on paper documents. These documents come in the form of architectural and engineering drawings, specifications, bills of quantities, and materials and change orders. This lack of communication and implementation leads to significant negative impacts—low productivity, cost and time overruns, change orders, inadequate design specifications, liability claims, and

generally, conflicts and disputes—which directly impact the customer by increasing project-completion time and cost.

As flawed as the individual entities of a construction supply chain may be, they are even more troublesome because a new supply chain or operations component must be developed each time a new project begins. The reality is that the learning that takes place in manufacturing is circumvented in construction by the changes from one project to the next. Construction supply chain management poses an excellent opportunity to at least mitigate some risks by partially integrating some of the lessons learned from the manufacturing sector. A systematic step-by-step approach to operating a value-driven construction company must be adopted.

The topical coverage includes an introduction to construction purchasing and supply chain management; construction supply sourcing process and procedures; construction supply chain relationship management; construction supplier selection and evaluation; purchasing subcontracting services; equipment purchasing, planning, and leasing; supply chain complexity, profitability, and information sharing; and construction supply chain management business models.

Chapter 1 establishes construction supply chain management's potential for contributing to profitability. The fragmentation and adversarial relationships between owners, prime contractors, subcontractors, and suppliers in public and private, and vertical and horizontal sectors of the construction industry are a harsh reality. Construction sourcing risks involve not only the project owner, but all entities in the supply chain. At the same time, the construction industry faces new levels of complexity as it moves forward and tries to keep pace with increasing energy, materials, and labor costs. Construction supply chain management poses an excellent opportunity to mitigate risks by partially integrating the lessons of continuous improvement learned from the manufacturing sector.

In **Chap. 2**, the construction supply sourcing process and procedures have historically been among the most arbitrary elements in the construction process. Only when the cost of materials and subcontracting services increased did management attempt to solve sourcing problems. The focus on labor was logical simply because the construction process is labor intensive. Recently, some construction market segments have investigated new technologies and invested in a technology-driven construction purchasing systems. Although these new systems are up and running, too frequently they are being operated just like the old construction business models, thus defeating the very purpose the system was designed to achieve. The reality is that technology and advanced management systems are rapidly displacing labor.

Construction supply chain relationship management is addressed in **Chap. 3**. Construction organizations cannot afford to ignore subcontractor/supplier relationship management. Competitive advantages

can be gained through superior subcontractor/supplier management. Given the competitive nature of the current business environment, a firm could potentially go out of business if it neglects proper management of strategic subcontractor/supplier relationships. The supply chain management approach encourages a prime contractor to compete by adding supply chain value and eliminating waste. Establishing long-term relationships with strategic subcontractors and suppliers is one of the most important principles of the supply chain paradigm. True information sharing can only be accomplished with both upstream and downstream information technology. Finally, the theme of continuous improvement must permeate all relationships and activities throughout the supply chain.

Construction supplier selection and evaluation is the focus of **Chap. 4**. Construction organizations are not proficient at identifying the capabilities of their suppliers and sometimes rationalize decisions for the selection of materials suppliers based on convenience. This integral function—materials supplier selection process—should be integrated into the supply chain management environment so that the availability of bulk materials is ensured. The mistakes made by many organizations in supplier selection can be avoided with three factors for success. Prime contractors should assess the core competencies and capabilities of each supplier and then ask if that supplier could be replaced. Since firms exit the market for various reasons, prime contractors should be prepared to establish alternative partnerships. Lastly, the prime contractor should share information with all team members and request their input.

In **Chap. 5** purchasing subcontracting services is presented. Planning the use of subcontractor services can account for improved supply chain performance, thereby substantially increasing the probability of a successful project. Prime contractors should not wait until they receive bid proposals to evaluate subcontracting expertise. The dollar magnitude of subcontracting is motivation for the supply chain management-oriented construction organization to ensure that the appropriate subcontractor is selected. The subcontractor selection process involves many important factors including the evaluation of a subcontractor's capacity and performing a SWOT (strengths, weaknesses, opportunities, and threats) analysis. An equitable bid submission and evaluation process, along with mutually satisfactory negotiations set the tone for sound relationships with subcontractors once the project begins.

Equipment purchasing, planning, and leasing are presented in **Chap. 6**. The capital equipment acquisition is a specialized function for the purchasing department. A step-by-step capital acquisition process includes (1) requisition, (2) company objectives, (3) new product ideas, (4) cash-flow analysis, (5) economic evaluation, (6) financial plan analysis, and (7) expenditure control. The decision to lease or buy capital equipment requires both analytical analysis and normative judgments.

When does it make more sense to invest in construction capital equipment instead of leasing it? Another element of the capital acquisition process is whether to purchase new or used equipment. But, whatever the reason for the purchase or lease, technology-driven equipment acquisitions can be a formidable competitive weapon.

Construction supply chain complexity, profitability, and information sharing are presented in **Chap. 7**. The concept of construction supply chain has gained significance because of the increasing number of potential complex private and public sector construction projects. In the short run, contractors may be able to survive with losses; however, in the long run, *every* construction business *must* generate a profit. Niche marketing, decreasing total costs, and decreasing overhead are traditional means of increasing profits. In the construction process costly delays in materials, equipments, and services erode profits. Construction supply chain management through the integration and coordination of materials, information, and money flows between the various project partners resolves delays and offers a new means of increasing profitability. CSCM's emphasis on information sharing and communications fosters cooperation and collaboration among supply chain members. Contract arrangements that promote core values across all levels of the supply chain depart from traditional practices by advancing successful project outcomes instead of individual firm successes. Project management and execution are the final tests of how well the supply chain is working. Tracking progress in the field ensures that a project will be on-time and under-budget and within specifications. Sharing field measurements with all members in accordance with supply chain values is the final predictor of a profitable project.

The book concludes with a focus on construction supply chain management business models in **Chap. 8**. Two construction supply chain models encompass the variety of specific project types discussed in Chap. 1. Horizontal projects are usually publicly funded and characterized by government agencies in the role of the project owner. In addition to the project owner's own in-house technical capabilities, the supply chain members have substantial engineering expertise. Vertical projects may have public or private funding. Construction managers are a key supply chain entity in the vertical model. Because of private ownership issues there can be vulnerability to bankruptcy in some variations of the vertical model. The CSCM models and methods described in this chapter and throughout this book can be customized to meet specific project requirements. A systematic CSCM approach will lead to increased integration and profitability.

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CHAPTER 1

Introduction to Construction Purchasing and Supply Chain Management

The Future Is Now

The essential ingredients in any business are mental, not physical. The methodologies and processes used to organize the labor, materials, equipment, and financial resources needed to produce a product are at the core of a successful business model, more so than the physical tasks required to make the individual product itself. The reason for acquiring knowledge of methodologies is to prevent mistakes from being repeated. To this end, the primary purpose of business schools and business education is to teach the minimization of risks and improve the probability of success.

Knowledge, whether gained through experience or education, is both conceptual and analytical. *Conceptual knowledge* comes from years of experience: "We know how to build a sports arena because we have done it time and time again." On the other hand, *analytical knowledge* encompasses technology: "We use the Critical Path Method to track actual to budgeted production performance." Even with an increased knowledge base and cumulative learning, however, there will still be risks. The challenge for business owners is to be willing to take *reasonable* risks.

Manufacturing Risks versus Construction Risks

Knight[2] defined the difference between risk and uncertainty: Risk is measurable, but uncertainty cannot be measured. Therefore, supplier and contractor risks can be defined as SCR = PA × NC, where SCR = supplier and contractor risks, PA = the probability that an adverse event will occur, and NC = negative consequences if the adverse event occurs, assuming that each of the adverse events is independent.

The notion of risk versus reward in the construction industry is counterintuitive because the expected risk reward curve in the manufacturing industry is positively correlated, meaning that for each unit of risk an approximate reward follows (Ceteris paribus). See Fig. 1.1. On the other hand, the risk reward curve for the construction industry is negatively correlated. See Fig. 1.2.

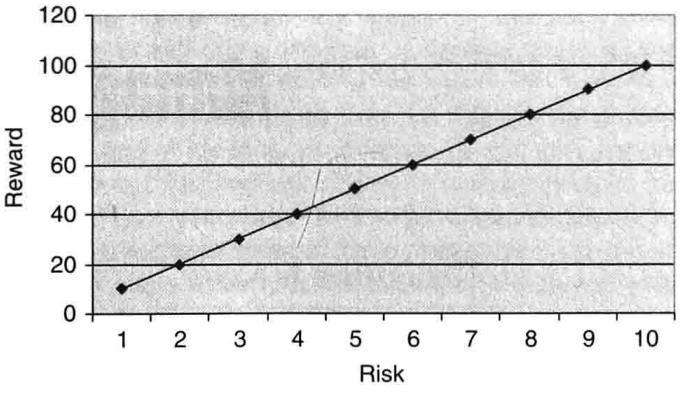

Figure 1.1 Risk versus reward for the manufacturing sector.

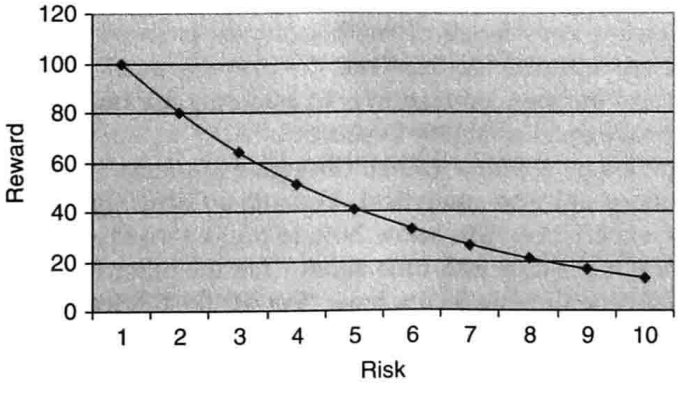

Figure 1.2 Risk versus reward for the construction sector.