The construction industry, like so many basic American industries, is being transformed to meet the new demands of the twenty-first century. Project delivery concepts are changing—design-bid-build, in both the private and public sectors is, now recognized as less than efficient when it comes to both time and money, often promoting litigation and restricting innovation. New documents—ConsensusDOCS®, created by the Associated General Contractors of America (AGC), and the Integrated Project Delivery Agreement, prepared by the American Institute of Architects (AIA)—are further contractual efforts to enhance the “team” approach to project development. Relationships between owners, design consultants, and contractors are changing as well, given how the emphasis on design-build has reinforced the positive effects of team collaboration. Technological advances have produced 3-D, 4-D, and beyond, building-information modeling, resulting in the potential to construct a building, step-by-step, virtually within a computer before a shovel is ever placed in the ground.

These new building delivery systems and technologies place more responsibility on the project managers who, as before, are charged with “getting it built.” The construction industry in the United States, which exceeded $1.1 trillion in 2005, began to decline in 2007 to $1.065 trillion due to the worldwide recession and continued falling to $964 billion in 2009 and to $802.3 billion as of October 2010. However, according to a U.S. Bureau of Labor Statistics 2010–2011 Occupational Handbook, for the period 2008–2018 employment in the construction industry is expected to rise by 19 percent and to remain a vital part of the economy, providing jobs for more than 7.3 million construction employees and 2.4
million architects and engineers, along with untold millions in revenue to those industries dependent on construction activities. We are a unique business, incorporating everything from small residential remodeling contractors to giant multinational constructors.

The construction industry can also be characterized as being highly fragmented, and although there were approximately 884,300 construction establishments in the United States in 2008, according to the Bureau of Labor Statistics, 269,700 were building contractors, 57,600 were heavy and civil engineering or highway contractors, and 557,000 were specialty contractors (subcontractors). Most of these establishments were small; 68 percent employed fewer than five workers in the United States, and slightly more than 63 percent are specialty contractors (subcontractors). There were 1.8 million self-employed and unpaid family members as of 2008 who worked directly for property owners or acted as contractors on small jobs such as remodeling and maintenance projects. A highly competitive business, it is one in which profit margins are slim. Statistics compiled by the Construction Finance Management Association in Princeton, New Jersey, reveal that over the past several years, net profit, after taxes, for industrial and non-residential contractors ranged from 1.2 percent to 1.5 percent, which is slightly more than the current interest on a bank certificate of deposit.

Like so many other businesses and institutions, the new century holds untold opportunities and challenges, as well as plenty of detours for the unwary. The paperless workplace predicted by computer gurus decades ago is now gradually unfolding. With the lowered cost of building information modeling (BIM) software and the increase in its use by architects and engineers, many of the problems relating to constructability and conflicts between building systems have been significantly reduced, and in some cases eliminated.

The Bureau of Labor Statistics in its Career Guide to Industries: 2010–2011 Edition paints a bright picture of the construction industry in years to come. It expects the number of wage and salary jobs in the construction industry to grow 19 percent through the year 2018, compared with 11 percent projected for all industries combined.

Demand will come from the need for more medical treatment centers and long-term care facilities to meet the demands of our growing elderly population. Employment in heavy and civil engineering construction, such as roads, bridges, and tunnels, will be necessary to repair and upgrade our infrastructure, which is likely to require $2.2 trillion to bring it back to “good” condition.

And employment of managers of construction projects is expected to grow due to the increased complexity of projects and the retrofitting of existing structures to make them more energy efficient.
Critical Issues Facing Contractors in This New Millennium

As the first decade of the new century unfolds, some demanding issues in the construction industry have become apparent, while others remain more subtle. Both institutional perception and resource changes are taking place, affecting all facets of the industry, such as the following, which will act as the headings of upcoming sections in this chapter:

- How our industry is perceived
- Information technology
- Human resources—the changing workforce
- Productivity
- Quality control
- Project delivery systems
- The organization
- Construction technology
- Safety

How our industry is perceived

In 2010, the Construction Management Association of America (CMAA), in collaboration with FMI (the management consulting firm headquartered in Denver), conducted the 11th Annual Survey of Owners to obtain their views on the design and construction industry.

This new study by both FMI and CMAA did not include any of the 2004 contractor-related ethical issues expressed by owners. This 2010 report revealed a number of responses that bear attention:

- Owners have reduced staff by layoffs, attrition, and early retirement. Nearly half of the 300 surveyed indicated that they will probably not resume hiring until 2012 or 2013. Twenty-eight percent said they do not plan to rehire at any time in the future. This means that any construction projects initiated by owners with reduced staff will undoubtedly place more burden on the contractor’s staff.

- Owners, as they have in past surveys, commented on the poor quality of design documents—34 percent reported a reduction in design document quality, and 33 percent reported a decline in construction drawing quality.

- Builders were not immune from criticism. Sixteen percent of respondents reported a decline in performance of construction management services, and 18 percent reported worsening construction execution.
Fully 55 percent of owners used design-bid-build as the predominant construction vehicle system, while 28 percent looked at a “blended approach,” which can possibly be interpreted as working with the architect and contractor to arrive at a negotiated contract. Sixteen percent used the design-build approach, which was up from 10 percent as registered in the 2005 survey.

The use of program managers has doubled since 2007 and accounts for about 10 percent of capital spent. This should send another message to contractors to gain more knowledge and experience in program management, which is most often applied to only large, complex projects, but which also reflects the owner’s desire to place more responsibility on the contractor, perhaps due to reduced staff.

And project managers and construction managers should take note. Owners described several forms of waste within their capital construction program, some of which relate to the management of their construction project:

- Waiting for material and/or equipment orders
- Frequent rework during construction and commissioning
- Weak transportation of materials and equipment to the jobsite
- Lean construction techniques and practices are gaining favor among owners. Lean construction, as we discuss more fully later in this book, places a great deal of emphasis on planning and scheduling and collaboration between owner, designer, construction manager or general contractor (CM/GC), subcontractors, and suppliers to shorten the construction cycle and increase quality.

**Information technology**

The ability to communicate more rapidly and more accurately has transformed both the design and construction segments of the industry. Wireless mobility has freed the project manager and their field supervisors from their copper umbilical cord so they can now instantaneously transmit and receive verbal and written directives at the touch of a button from their office, from the field, or traveling in between. Architects and engineers have already advanced computer-assisted design in 3-D and 4-D modeling (the addition of time) and 5-D (the addition of a materials list generated as design progresses) to the point where it promises to produce a seamless flow of design that will reduce systems interference issues to zero.

A 2010 Information Technology Survey for the construction industry conducted by the Construction Finance Management Association found a decrease of 55 to 43 percent of those contractors planning technology
infrastructure upgrades. Estimating and project management systems, according to the survey, revealed a significant uptick adoption rate for those types of software. Even further advances integrating design and construction are on the way.

**Human resources—the changing workforce**

In 2009, union membership overall was 12.3 percent of the nation’s workforce, essentially unchanged from 12.4 percent in the previous year. But these statistics are deceiving because the number of wage and salary workers belonging to unions had declined by 771,000 to 15.3 million. In 1983, the first year comparable data was available from the Bureau of Labor Statistics, union membership was 20.1 percent of the workforce, and there were 17.6 million union workers. The mix has also changed from blue-collar union members to public sector employees. Union workers in education, training, and library occupations increased 38.1 percent, and public sector employees increased by 7.9 million. Union membership in the construction trades has been in decline for several years. In 2009, there were 958,000 union members in the private U.S. construction workforce, its lowest point since 1995. This is compared to 1.195 million members in 2008. To attract people to this industry, we must work hard to change the public’s perception of construction as the industry of the four Ds: dull, dirty, demanding, and dangerous. An aging workforce, the absence of apparent technological advances, and the lure of more attractive vocations have all contributed to this image.

The demographics of our population sounded the warning bell several decades ago, but we failed to recognize it. Each year more than 3.5 million baby boomers turn 55—and the first wave of boomers reaches full retirement age in 2011.

According to the Sloan Center on Aging & Work at Boston College, construction is a young man’s game.

- 10.8 percent are under 25 years of age.
- 40 percent of all construction workers are in the 25–39 age group.
- 36 percent are between the age of 40 and 54.
- 11.5 percent are between 55 and 64.
- 1.4 percent are over 65.

And construction is a male-dominated industry.

- In 2000, males represented 89.9 percent of the workforce; females, 10.1 percent.
- In 2007, males represented 90 percent of the workforce; females 9.5 percent.
This compares industry-wide as follows:

- In all industries in 2000, males represented 52.9 percent; females, 47.1 percent.
- In all industries in 2007, males represented 53 percent; females, 47 percent.

**Undocumented immigrant problem**

The influx of immigrant workers that began in the late 1980s has accelerated, and today more and more jobsites require supervisors who are bilingual. The Pew Center in Washington, D.C., estimated that in 2007, 14.7 percent of Hispanic workers were employed in the construction industry, compared to 8.1 percent of the overall labor force. By February 2010, as construction activity in general declined, only 11.6 percent of Hispanic workers were employed, a decline of 27.8 percent, about the same percentage as the overall decline in construction. If, on the return to a more robust construction industry, these workers cannot be brought back into the labor force, another source of lower skilled workers must be found—but where? This presents a twofold problem for construction managers: a logistical one—the need to fill the labor pool with unskilled workers—and a legal one—attempting not to run afoul of the law in doing so.

**Productivity**

A U.S. Bureau of Labor Statistics study showed that productivity in the construction industry has decreased since 1964 while productivity in other nonfarm industries has increased significantly. The National Institute of Standards and Testing (NIST) concurs that productivity has declined, but the magnitude of the productivity problem is largely unknown because of a lack of means to measure productivity. It sees the need to develop ways to measure and evaluate tasks at the jobsite, project, and industry levels. A 2003 *Construction Industry Productivity Survey Report*, prepared by FMI, revealed that 47 percent of respondents, primarily general contractors, and secondarily, specialty contractors, indicated that productivity had remained the same or actually decreased in some areas. Of note to project managers, 81 percent of those answering the survey believed they could save 5 percent or more on field labor costs through better management practices.

A report by Scott Kimpland and Phil Warner in a 2009 issue of FMI’s quarterly journal indicated that 14 percent of respondents had improved their productivity by 5 percent over the past several years. These same respondents stated that they could save at least 5 percent of their field labor costs by enacting better management practices.
Only 56 percent of those contractors replying to the survey indicated that they had a formal strategy in place to deal with improving their productivity.

Possibly more related to the human resources category above, the survey indicated that 74 percent of their field managers were under the age of 36, and senior management expressed their concern that these younger managers needed much more experience to replace the 45-year-old and older managers who were likely to retire in the next 10 to 15 years. This points to the need for senior management to spend more time grooming and educating the current younger group of supervisors to provide them with some of the knowledge that could replace that acquired by osmosis.

Senior managers need to spend more time devoted to training and educating their field and project managers in dealing with the nine factors and challenges that impact productivity and increase the planning skills required to enhance productivity, which, in turn, should enhance profits.

Five items impacting productivity
- Lack of planning skills at the management level
- Lack of communication skills at the management level
- Poor communication between project manager and field management team
- Lack of technical training at the craft level
- Cultural resistance to change (This can be interpreted as “I’ve always done it this way and it worked—so why change?”)

Four greatest external challenges to improve productivity
- Poor quality of plans and specifications
- Poor coordination by owners, general contractors, and/or construction managers
- Slow responses from other members of the team: architects, engineers, customers, general contractors, and/or construction managers
- Lack of available and qualified craft personnel

A 2004 Construction Industry Institute/Lean Construction Institute study revealed that as much as 57 percent of time, effort, and material investment in construction projects does not add value to the final product. This figure does not compare favorably with the 26 percent in the manufacturing world.

However, there are many differences between manufacturing a repetitive product in a closed environment and building a one-off product exposed to the elements. But there is an obvious need to improve construction productivity.
Quality control

“Do it right, and do it right the first time” is a concept that will take on more importance in this and future decades. The shortage of skilled workers and experienced managers should increase the pressure placed on project managers from owners demanding, among other things, less call backs and less rework—in effect, higher quality.

In this competitive age, if your firm can’t produce a quality product and produce it both quickly and at a competitive price, owners will look elsewhere. Organizations such as The International Organization for Standardization in Switzerland has developed two generic standards for the worldwide construction industry in order to drive the construction industry quality control engine. ISO Standard 9000 applies to quality management systems, while ISO deals with environmental management systems—but we don’t have to look that far to see what else is being done to embrace quality.

The man who is most associated as being “the father of quality control” is W. Edwards Deming, whose ideas on quality control were rejected by Detroit’s automakers in the 1950s. Deming traveled to Japan where its new auto manufacturing industry fully embraced his ideas to improve quality—and the rest is history.

The Deming business philosophy embraced 14 points, some that apply to the construction industry are:

- Strive to improve every process.
- Institute training on the job.
- Demand zero defects.
- Encourage education.
- Permit and display pride in one’s work.

Dr. Demings’ 14 points apply today as well as they did 50 years ago. Project managers can exert control over quality by close communication with their superintendents, conducting periodic quality control meetings with small groups of specialty trade contractors, rejecting sub-standard work, and making it very clear that quality is job one.

Project delivery systems

Although guaranteed maximum price (GMP) type contracts and CM contracts continue to dominate project delivery systems, the search goes on for a better approach. As always, the cost of design and construction is a key concern of all parties; meeting schedules, often tightly compressed, keeps the pressure on. Avoidance of disputes between owners, design consultants, and contractors continues to be a prime objective of all parties,
and a method to promote more accurate and error-free design documents is another goal pursued by the industry.

For the moment, design-build seems to address speed of delivery when including both design and construction time, lessening disputes due to the collaborative process it creates, and even results in lower overall costs in many cases because it generates fewer change orders. Design-build has been growing rapidly. According to a design-build study conducted by RS Means Reed Construction Data Market Intelligence reported by the Design-Build Institute in June 2011, 80 percent of military construction projects are design-build, 40 percent of medical and commercial projects exceeded 40 percent of market share. Each party to the construction process continues to look for a better, more equitable project delivery system. Although no contract can be deemed successful unless all parties to that contract deal with each other in good faith and are willing to share some risk, the search goes on. We will discuss three recent endeavors—AGC’s ConsensusDOCS, AIA’s Integrated Project Delivery Agreement, and Lean Construction—in Chapter 2.

The organization

Of the reported 880,000-plus general contractors operating in the United States according to the 2004 Census, the overwhelming majority remain small businesses with modest annual volumes, operating in a limited geographic area.

The number one contractor in the United States in 2009 was Bechtel Corporation, posting $30.8 billion in sales. It was followed by Fluor Corporation, KBR, Kiewit, and Turner. That leaves about 799,999 other contractors with a significantly smaller annual sales volume. Most establishments have fewer than five employees and annual revenue between $100,000 and $250,000.

Construction technology

In the 1990s, spurred on by their concerns over an aging population and the potential lack of skilled workers in their construction industry, the Japanese began to develop a whole series of construction robots including excavation and real-time compaction robots, as well as rebar bending, concrete placement, and floor-finishing robots. Second- and third-generation models emerged in the mid-1990s and it appeared that the robots’ commercial production was just around the corner when the Japanese economy spiraled downward at the end of that decade putting most of these expensive programs on hold. Nevertheless, they showed what could be done.

Global Positioning System (GPS) satellites have been used for years by survey parties. Combined with 3-D modeling, it is now possible to
create a 3-D site plan on a remote console and, similar to a video game, grip two joysticks and actually direct an unmanned bulldozer to work the site. GPS technology utilized for grading has reduced set-up time by 30 percent, according to one excavating contractor, and John Deere, which began equipping its dozers with GPS units several years ago, was predicting that 20 percent of its bulldozers would have automatic grade controls.

Robotic demolition machines, automated pile placement using programmed coordinates, and robotic drilling and cutting systems are in current use.

Safety
Once again, the scarcity of skilled workers places added importance on maintaining a safe working environment, not only to polish the industry's image, but to retain the integrity of productive work teams.

More owners, aware of safety from both a moral and cost standpoint, are requiring that contractors provide them with a history of safe working conditions as part of the project bid criteria. The Census of Fatal Occupational Injuries compiled by the Bureau of Labor Statistics, modified on August 19, 2010, revealed that fatal work injuries in construction declined 16 percent from 2008 to 2009, in real numbers from 726 to 607. This was in addition to a 17 percent decline from 2007. Higher fatal work injuries during this 2008–2009 period, however, were reported for three trades: electricians, plumbers, and carpenters. Project managers and project superintendents will need to concentrate their safety program on these trades.

The changing marketplace
Tomorrow's managers will have to become more astute and selective in defining their markets in the face of stiffer competition, and more general contractors are looking to specialization, or niche marketing, to do so.

Niche marketing will become more important as each company seeks to exploit its experience and expertise in the field of its choice and thus narrow the field of competition. The growth in green building technology and the use of BIM is expected to increase dramatically in the years to come, and contractors and their project managers need to become familiar with not only new green technology, but retrofitting as well. This may become one of the dominant “niche” markets in the next decade. Marketing or sales development, long ignored by many contractors who depended on word-of-mouth in a defined geographic marketing area, has now become not only essential, but sophisticated, as witnessed by the proliferation of contractor Internet web sites.
The state of infrastructure in the United States has gotten much attention within the past two years—all of it disheartening. The American Society of Civil Engineers publishes a periodic Report Card on America’s road, bridges, tunnels, and other infrastructure. The 2009 Report Card revealed a “D” overall rating of our infrastructure and suggested that a five-year investment of $2.2 trillion is required to bring it back to good condition. When funding becomes available via public or private money, infrastructure rebuilding—roads, bridges, water, wastewater, schools, railroads, dams, and power plant projects—will provide lots of jobs for many years.

The changing role of the general contractor. The character and role of the general contractor has changed dramatically over the past 50 years or so. The time when the general contractor employed crews of laborers, carpenters, masons, and operating engineers, and owned substantial numbers of excavating equipment (“iron”), performing significant amounts of work with their own forces, is largely over. Construction projects became more sophisticated in design, and as competition intensified, the reliance on specialty contractors, subcontractors, soon became the order of the day. As early as 1991, subcontractors accounted for 75 percent of all construction company establishments, and that number has been growing ever since. Change is nothing new to contractors. When activity in new construction lessens, contractors pursue renovation, rehabilitation, and interior tenant fit-up work. When private sector work decreases, the contractor looks to the public sector for projects. But in the coming years, along with the usual concerns over costs and getting the job done on time, other factors will occupy the thoughts and actions of progressive contractors. The electronic age is here to stay and those contractors that fail to embrace the advantages it has to offer will find themselves at a disadvantage. Old ideas must give way to the new, presenting yet further challenges that must be surmounted, just as the problems of the past were.

The project manager’s role. With all of the changes taking place in the industry, the project manager’s role remains constant: control over both the work process and the costs associated with that work. Management of a construction project can be divided into four components:

- **Construction engineering**  The proper technique of assembling materials, components, equipment and systems, and the selection and utilization of the best construction technology to do so.

- **Management of the construction process**  Establishing the most effective way to implement the construction process, including proper
scheduling and the coordination and control of the flow of labor, materials, and equipment to the jobsite.

- **Human resources management** Since labor productivity and a harmonious working environment are essential elements of a successful project, control over human resources becomes important, more so than ever these days where shortages of both skilled workers and experienced managers exist.

- **Financial management** Construction is a high-risk business with historically low profit margins. Control over costs, cash flow, and adequate project funding is critical to the success of any business endeavor, and construction is certainly no exception.

Program management is expected to grow, and while generally confined to large, complex projects, depending on the owner’s needs, may gravitate toward smaller projects where staff reductions by owners place more responsibilities on the contractor and their project managers. More involvement in the planning, scheduling, conceptual estimating, and interface with public agencies during the permitting process will provide more growth potential and opportunities for the project manager willing to learn and assume more responsibilities.

All of these key management functions, to some degree or other, will fall upon that most visible member of the construction team, the project manager, who must not forget the seven criteria essential to the successful completion of a project.

- The project was completed on time.
- The complete project cost remained within budget.
- The quality levels expected were achieved.
- The project was completed with no unresolved disputes and no outstanding claims.
- The contractor maintained a professional relationship with the designers—the architect and engineers.
- The contractor maintained a mutually beneficial relationship with all subcontractors and vendors.
- The contractor-client relationship was a good one.

To accomplish these goals, keep the following guidelines in mind:

1. Build a project team. Although you may be working with an entirely new group of designers, subcontractors, and suppliers, instill the concept of collaboration and teamwork from day one and practice it.
2. Develop relationships with the owners. Let them know that you are working in their best interests.

3. Protect your team. If anyone is unjustly criticized, stand up for your team member.

4. A promise made is a promise kept whether to the owner, architect, subcontractor, or your own team members.

5. Keep track of things that went well and those that didn’t. Develop a lessons-learned mentality.

6. Coordination is an ongoing activity. Share opinions, concerns, and suggestions that will benefit the project.

7. Collaborate. Discuss plans with all members of the team, seek suggestions, and accept constructive criticism.

8. Listen. Really listen to what others have to say and avoid “tuning out.”

9. Look at each project as a new learning experience, one that will help you achieve higher professional goals.

10. Expect the unexpected, and consider alternatives as the project reaches critical stages even though everything is going along okay. Think contingency plan.

Project management means managing the construction project—and that is what this book is all about.