

every organization. Firms will be more willing to hire managers who can accomplish that.

The security of computer networks will continue to increase in importance as more business is conducted over the Internet. Organizations need to understand how their systems are vulnerable and how to protect their infrastructure and Internet sites from hackers, viruses, and other acts of cyber-terrorism. As a result, there will be a high demand for managers proficient in computer security issues.

Due to the explosive growth of electronic commerce and the ability of the Internet to create new relationships with customers, the role of computer and information systems managers will continue to evolve in the future. They will continue to become more vital to their companies and the environments in which they work. The expansion of e-commerce will spur the need for computer and information systems managers with both business savvy and technical proficiency.

Opportunities for those who wish to become computer and information systems managers should be closely related to the growth of the occupations they supervise and the industries in which they are found. (See the statements on computer programmers; computer software engineers; computer support specialists and systems administrators; and systems analysts, computer scientists, and database administrators elsewhere in the *Handbook*.)

Earnings

Earnings for computer and information systems managers vary by specialty and level of responsibility. Median annual earnings of these managers in 2000 were \$78,830. The middle 50 percent earned between \$59,640 and \$100,820. The lowest 10 percent earned less than \$44,090, and the highest 10 percent earned more than \$127,460. Median annual earnings in the industries employing the largest numbers of computer and information systems managers in 2000 were:

Professional and commercial equipment	\$92,270
Computer and data processing services	88,410
Commercial banks	82,490
Management and public relations	73,930
Colleges and universities	64,460

According to Robert Half International Consulting, average starting salaries in 2001 for high-level information technology managers ranged from \$92,250 to \$152,500. According to a 2001 survey by the National Association of Colleges and Employers, starting salary offers for those with an MBA, a technical undergraduate degree, and 1 year or less of experience averaged \$61,196; for those with a master’s degree in management information systems/business data processing, \$57,225.

In addition, computer and information systems managers, especially those at higher levels, often receive more benefits—such as expense accounts, stock option plans, and bonuses—than do non-managerial workers in their organizations.

Related Occupations

The work of computer and information systems managers is closely related to that of computer programmers, computer software engineers; systems analysts, computer scientists, and database administrators; and computer support specialists and systems administrators. Computer and information systems managers also have some high-level responsibilities similar to those of top executives.

Sources of Additional Information

For information about a career as a computer and information systems manager, contact the sources of additional information for the various computer occupations discussed elsewhere in the *Handbook*.

Construction Managers

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Significant Points

- Construction managers must be available—often 24 hours a day—to deal with delays, bad weather, or emergencies at the jobsite.
- Employers prefer individuals who combine construction industry work experience with a bachelor’s degree in construction science, construction management, or civil engineering.
- Excellent opportunities are expected for qualified managers.
- Employment can be sensitive to the short-term nature of many construction projects and cyclical fluctuations in construction activity.

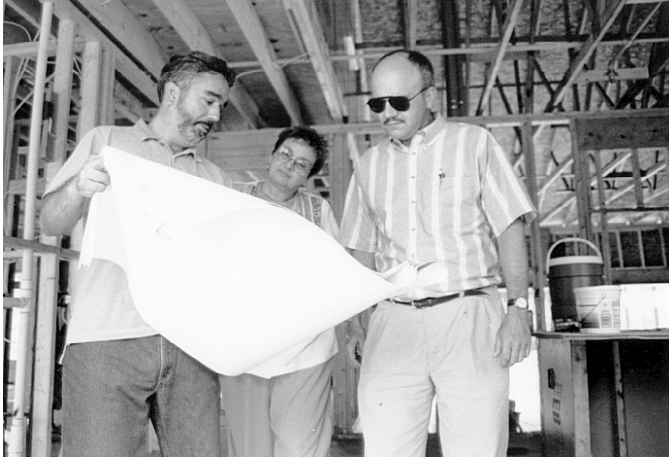
Nature of the Work

Construction managers plan and direct construction projects. They may have job titles such as constructor, construction superintendent, general superintendent, project engineer, project manager, general construction manager, or executive construction manager. Construction managers may be owners or salaried employees of a construction management or contracting firm, or may work under contract or as a salaried employee of the owner, developer, contractor, or management firm overseeing the construction project. The *Handbook* uses the term “construction manager” to describe salaried or self-employed managers who oversee construction supervisors and workers.

In contrast with the *Handbook* definition, “construction manager” is defined more narrowly within the construction industry to denote a management firm, or an individual employed by such a firm, involved in managerial oversight of a construction project. Under this definition, construction managers usually represent the owner or developer with other participants throughout the project. Although they usually play no direct role in the actual construction of a structure, they typically schedule and coordinate all design and construction processes, including the selection, hiring, and oversight of specialty trade contractors.

Managers who work in the construction industry, such as general managers, project engineers, and others, increasingly are called *constructors*. Through education and past work experience, this broad group of managers manages, coordinates, and supervises the construction process from the conceptual development stage through final construction on a timely and economical basis. Given designs for buildings, roads, bridges, or other projects, constructors oversee the organization, scheduling, and implementation of the project to execute those designs. They are responsible for coordinating and managing people, materials, and equipment; budgets, schedules, and contracts; and safety of employees and the general public.

On large projects, construction managers may work for a *general contractor*—the firm with overall responsibility for all activities. There, they oversee the completion of all construction in accordance with the engineer’s and architect’s drawings and specifications and prevailing building codes. They arrange for *trade contractors* to perform specialized craftwork or other specified construction work. On small projects, such as remodeling a home, a self-employed construction manager or skilled trades worker who directs and oversees employees often is referred to as the construction “contractor.”



Construction managers direct and monitor the progress of construction activities.

Large construction projects, such as an office building or industrial complex, are too complicated for one person to manage. These projects are divided into many segments: Site preparation, including land clearing and earth moving; sewage systems; landscaping and road construction; building construction, including excavation and laying foundations, erection of structural framework, floors, walls, and roofs; and building systems, including fire-protection, electrical, plumbing, air-conditioning, and heating. Construction managers may be in charge of one or more of these activities. Construction managers often team with workers in other occupations, such as engineers and architects.

Construction managers evaluate various construction methods and determine the most cost-effective plan and schedule. They determine the appropriate construction methods and schedule all required construction site activities into logical, specific steps, budgeting the time required to meet established deadlines. This may require sophisticated estimating and scheduling techniques and use of computers with specialized software. (See the statement on cost estimators elsewhere in the *Handbook*.) This also involves the selection and coordination of trade contractors hired to complete specific pieces of the project—which could include everything from structural metalworking and plumbing to painting and carpet installation. Construction managers determine the labor requirements and, in some cases, supervise or monitor the hiring and dismissal of workers. They oversee the performance of all trade contractors and are responsible for ensuring that all work is completed on schedule.

Construction managers direct and monitor the progress of construction activities, at times through other construction supervisors. They oversee the delivery and use of materials, tools, and equipment; and the quality of construction, worker productivity, and safety. They are responsible for obtaining all necessary permits and licenses and, depending upon the contractual arrangements, direct or monitor compliance with building and safety codes and other regulations. They may have several subordinates, such as assistant managers or superintendents, field engineers, or crew supervisors, reporting to them.

Construction managers regularly review engineering and architectural drawings and specifications to monitor progress and ensure compliance with plans and schedules. They track and control construction costs against the project budget to avoid cost overruns. Based upon direct observation and reports by subordinate supervisors, managers may prepare daily reports of progress and requirements for labor, material, machinery, and equipment at the construction site. They meet regularly with owners, trade contractors, architects, and others to monitor and coordinate all phases of the construction project.

Working Conditions

Construction managers work out of a main office from which the overall construction project is monitored, or out of a field office at the construction site. Management decisions regarding daily construction activities generally are made at the jobsite. Managers usually travel when the construction site is in another State or when they are responsible for activities at two or more sites. Management of overseas construction projects usually entails temporary residence in another country.

Construction managers may be “on call”—often 24 hours a day—to deal with delays, bad weather, or emergencies at the site. Most work more than a standard 40-hour week because construction may proceed around-the-clock. They may have to work this type of schedule for days, even weeks, to meet special project deadlines, especially if there are delays.

Although the work usually is not considered inherently dangerous, construction managers must be careful while touring construction sites. Managers must establish priorities and assign duties. They need to observe job conditions and be alert to changes and potential problems, particularly those involving safety on the jobsite and adherence to regulations.

Employment

Construction managers held about 308,000 jobs in 2000. Around 75,000 were self-employed. About 59 percent of construction managers were employed in the construction industry, about 24 percent by specialty trade contractors—for example, plumbing, heating and air-conditioning, and electrical contractors—and about 28 percent by general building contractors. Engineering, architectural, and construction management services firms, as well as local governments, educational institutions, and real estate developers employed others.

Training, Other Qualifications, and Advancement

Persons interested in becoming a construction manager need a solid background in building science, business, and management, as well as related work experience within the construction industry. They need to understand contracts, plans, and specifications, and to be knowledgeable about construction methods, materials, and regulations. Familiarity with computers and software programs for job costing, scheduling, and estimating also is important.

Traditionally, persons advance to construction management positions after having substantial experience as construction craftworkers—carpenters, masons, plumbers, or electricians, for example—or after having worked as construction supervisors or as owners of independent specialty contracting firms overseeing workers in one or more construction trades. However, employers—particularly large construction firms—increasingly prefer individuals who combine industry work experience with a bachelor’s degree in construction science, construction management, or civil engineering. Practical industry experience also is very important, whether it is acquired through internships, cooperative education programs, or work experience in the industry.

Construction managers should be flexible and work effectively in a fast-paced environment. They should be decisive and work well under pressure, particularly when faced with unexpected occurrences or delays. The ability to coordinate several major activities at once, while analyzing and resolving specific problems, is essential, as is an understanding of engineering, architectural, and other construction drawings. Good oral and written communication skills also are important, as are leadership skills. Managers must be able to establish a good working relationship with many different people, including owners, other managers, designers, supervisors, and craftworkers.

Advancement opportunities for construction managers vary depending upon an individual’s performance and the size and type of company for which they work. Within large firms, managers

may eventually become top-level managers or executives. Highly experienced individuals may become independent consultants; some serve as expert witnesses in court or as arbitrators in disputes. Those with the required capital may establish their own construction management services, specialty contracting, or general contracting firm.

In 2000, more than 100 colleges and universities offered 4-year degree programs in construction management or construction science. These programs include courses in project control and development, site planning, design, construction methods, construction materials, value analysis, cost estimating, scheduling, contract administration, accounting, business and financial management, building codes and standards, inspection procedures, engineering and architectural sciences, mathematics, statistics, and information technology. Graduates from 4-year degree programs usually are hired as assistants to project managers, field engineers, schedulers, or cost estimators. An increasing number of graduates in related fields—engineering or architecture, for example—also enter construction management, often after having had substantial experience on construction projects or after completing graduate studies in construction management or building science.

Around 20 colleges and universities offer a master’s degree program in construction management or construction science. Master’s degree recipients, especially those with work experience in construction, typically become construction managers in very large construction or construction management companies. Often, individuals who hold a bachelor’s degree in an unrelated field seek a master’s degree in order to work in the construction industry. Some construction managers obtain a master’s degree in business administration or finance to further their career prospects. Doctoral degree recipients usually become college professors or conduct research.

Many individuals also attend training and educational programs sponsored by industry associations, often in collaboration with post-secondary institutions. A number of 2-year colleges throughout the country offer construction management or construction technology programs.

Both the American Institute of Constructors (AIC) and the Construction Management Association of America (CMAA) have established voluntary certification programs for construction managers. Requirements combine written examinations with verification of professional experience. AIC awards the Associate Constructor (AC) and Certified Professional Constructor (CPC) designations to candidates who meet the requirements and pass appropriate construction examinations. CMAA awards the Certified Construction Manager (CCM) designation to practitioners who meet the requirements in a construction management firm and pass a technical examination. Applicants for the CMAA certification also must complete a self-study course that covers a broad range of topics central to construction management, including the professional role of a construction manager, legal issues, and allocation of risk. Although certification is not required to work in the construction industry, voluntary certification can be valuable because it provides evidence of competence and experience.

Job Outlook

Excellent employment opportunities for construction managers are expected through 2010 because the number of job openings arising from job growth and replacement needs is expected to exceed the number of qualified managers seeking to enter the occupation. Because the construction industry often is seen as having dirty, strenuous, and hazardous working conditions, even for managers, many potential managers choose other types of careers.

Employment of construction managers is expected to increase about as fast as the average for all occupations through 2010, as the level and complexity of construction activity continues to grow. Prospects in construction management, engineering and architec-

tural services, and construction contracting firms should be best for persons who have a bachelor’s or higher degree in construction science, construction management, or construction engineering, as well as practical experience working in construction. Employers prefer applicants with previous construction work experience who can combine a strong background in building technology with proven supervisory or managerial skills. In addition to job growth, many openings should result annually from the need to replace workers who transfer to other occupations or leave the labor force.

The increasing complexity of construction projects should boost demand for management-level personnel within the construction industry, as sophisticated technology and the proliferation of laws setting standards for buildings and construction materials, worker safety, energy efficiency, and environmental protection have further complicated the construction process. Advances in building materials and construction methods; the need to replace much of the Nation’s infrastructure; and the growing number of multipurpose buildings, electronically operated “smart” buildings, and energy-efficient structures will further add to the demand for more construction managers. However, employment of construction managers can be sensitive to the short-term nature of many projects and to cyclical fluctuations in construction activity.

Earnings

Earnings of salaried construction managers and self-employed independent construction contractors vary depending upon the size and nature of the construction project, its geographic location, and economic conditions. In addition to typical benefits, many salaried construction managers receive benefits such as bonuses and use of company motor vehicles.

Median annual earnings of construction managers in 2000 were \$58,250. The middle 50 percent earned between \$44,710 and \$76,510. The lowest 10 percent earned less than \$34,820, and the highest 10 percent earned more than \$102,860. Median annual earnings in the industries employing the largest numbers of managers in 2000 were:

Electrical work	\$60,300
Nonresidential building construction	59,470
Plumbing, heating, and air-conditioning	58,500
Heavy construction, except highway	57,280
Residential building construction	53,510

According to a 2001 salary survey by the National Association of Colleges and Employers, candidates with a bachelor’s degree in construction science/management received job offers averaging \$40,740 a year.

Related Occupations

Construction managers participate in the conceptual development of a construction project and oversee its organization, scheduling, and implementation. Occupations in which similar functions are performed include architects, except landscape and naval; civil engineers; cost estimators; landscape architects; and engineering and natural sciences managers.

Sources of Information

For information about constructor certification, contact:

- ▶ American Institute of Constructors, 466 94th Ave. North, St. Petersburg, FL 33702. Internet: <http://www.aicnet.org>

For information about construction management and construction manager certification, contact:

- ▶ Construction Management Association of America, 7918 Jones Branch Dr., Suite 540, McLean, VA 22102-3307. Internet: <http://www.cmaanet.org>

Information on accredited construction science and management programs and accreditation requirements is available from:

- ▶ American Council for Construction Education, 1300 Hudson Lane, Suite 3, Monroe, LA 71201. Internet: <http://www.acce-hq.org>