CONSTRUCTION PROJECT MANAGEMENT

A Complete Introduction

Third Edition

Alison Dykstra

with Linda V. Kade

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Editorial Director: Andrew Schulman
Lead Editor: Linda V. Kade
Copy Editor: Stephanie Marohn
Design: Lauren Woodrow
Research Assistant: Rosemarie Tarantino
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CHAPTER

3

Construction and Technology

As we learned in the last chapter, one of the biggest trends in construction is the volume of new technologies, which enter the workplace almost daily and continually become more sophisticated. The construction industry can now use previously unimaginable technology such as lasers, robotics, drones, large-scale prefabrication, virtual reality models, futuristic materials, and innovative construction systems as part of its work. These developments are ongoing and rapid. New technology and materials that have not even been conceived of at this time may be in common usage in just a few years. Similarly, technologies we use today may become outdated in just a few years. The days are fast disappearing when all the contractor needed to work was just a tool belt and a pickup truck (and a dog).

In this chapter, we'll explore how new technology is coming into use on several fronts. These include, but are not limited to:

- Computer software
- Computer hardware
- Construction tools
- Construction materials
- Construction methods

Although a large part of the developments in this chapter are not strictly new, they may be considered as such because they are increasingly more affordable, making them accessible to a larger portion of the construction industry.

New technologies affect the roles of everyone involved with the construction process. Architects, project owners, and contractors are increasingly dependent on computer software and new tools to make their work more efficient (and profitable), more thorough (fewer losses), and better coordinated with other team members through improved communication and increased collaboration. Construction project managers and others are increasingly required to work with new software and other tools as a part of their job description. Even if not directly affected, all of us will want to be generally aware of the developing technology available to use. Because of these rapid developments, continuing education is increasingly important for all members of the design, development, and construction teams.

Computer software

As a designer, developer or contractor, you will be expected to be computer literate and ready to learn new programs as they are adopted by your company and the industry. In particular, **construction project management software** is becoming ever more sophisticated and interconnected and it may be challenging to keep up with it all. Programs mentioned in earlier editions of this textbook, for example, such as Meridian System's Prolog, Newforma, and Primavera6 from Oracle are no longer in use; similarly, the programs mentioned in this chapter may soon be eclipsed by newer programs or updated with substantially newer features. Because of rapid changes, Marianne Sims of Graphisoft sees many in the profession and trades as "struggling with technology overload."[1]

Software has made it possible to manage the design, development, and building processes more efficiently than in the past. For the contractor, new construction-specific project management software provides improved ways to manage tasks during both the preconstruction as well as construction phases. Technology is now available to assist the contractor in the preparation of estimates, to schedule work and labor procurement, to purchase materials, and monitor costs and workflows. A contractor can also process requests for information (RFIs), submittals, change orders (COs), requests for payment (RFP), manage the team, as well as many other tasks noted in more detail in future chapters.

Software programs also enable better, more thorough, and more standardized record keeping. The ability to track and analyze critical information is what can give designers, owners, and contractors a better understanding and control of their business. This ability allows the contractor to project future project performance, thus potentially minimizing losses and increasing profits.

There are three major types of software and we'll look at some examples of each and how they might be used by the contractor:

- Limited task software
- Integrated software
- Advanced software

Limited task software

Some construction management software is geared to **limited tasks**, such as scheduling or estimating. Microsoft Project,[2] for example, is a platform used to schedule and manage projects. It has preformatted task lists, filters, views, and settings to schedule quickly and efficiently without sophisticated software experience, thus reducing what could be a long learning curve. STACK[3] and Houzz Pro Takeoff[4] are two options for estimating costs and doing take-offs (the process of pulling information from the plans and specifications to calculate the materials and labor needed to perform a specific task). As with most software, these platforms are fully cloud-based, storing data over the Internet instead of on individual hard drives. (Cloud-based data storage offers multiple advantages: it saves on computer storage demands for the data-intensive task of estimating, data can be regularly updated, and it provides contractors with the ability to access large amounts of information anytime and from anywhere with an internet connection.) There are software products such as Dropbox, Google Drive, Google Docs, and Box that enable secure team communications, and there is even customer relationship management software (CRM) available to help keep your clients well informed.

Integrated software

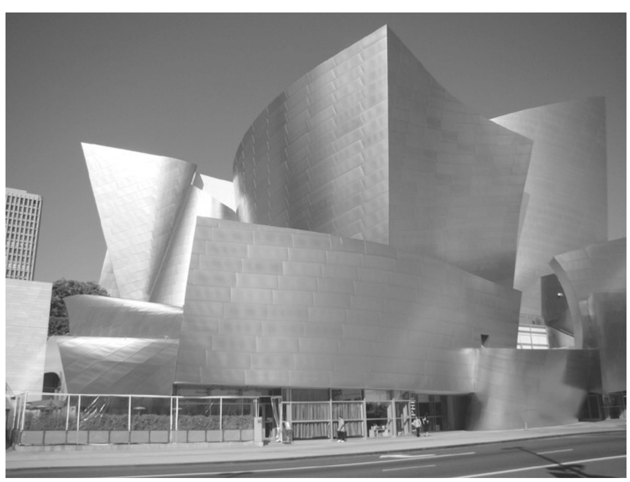
When software is “integrated,” information entered into the database once can automatically be used for multiple functions. **Integrated software** means various programs such as design, estimating, scheduling, and communications share the same database. Changing a single number can immediately modify the drawings, schedule, and cost estimate, for example. Trimble ProjectSight (formerly Prolog)[5] is a powerful and versatile construction management tool. It features project management capabilities such as contract management, change orders, equipment management, document management, punch lists, RFIs, submittals, and project scheduling. For estimating management, it offers BIM integration (see later section), cost database, item list, and data import and export. The software also offers accounting services of accounts payable and receivable management, inventory management, and purchase order management. Other capabilities include **vendor** management, bid packages and analysis, attachment control, file management, field administration, cash-flow forecasting, distribution management, and other functions. Trimble ProjectSight integrates with Microsoft Office, Outlook, and Project and offers over 400 standard reports. There are many other construction-specific programs with various characteristics: Aconex[6] and Viewpoint[7] are just two of them. Aconex is part of Oracle’s common data environment, a single, central platform that connects teams, processes, and project data. Viewpoint helps the contractor create customized systems for tracking projects.

Most integrated software programs allow many functions to be carried out in the field, instead of back at the office. These include being able to reference current plans, specifications, and other documents on tablets or smartphones in the field. They also help document issues and conditions with photos and notes and voice recordings. Software is now available that converts voice to text, allowing notes to be dictated in the field. All this information could be electronically embedded on the plans and available to team members. Of interest to many contractors are software programs that can send small files to team members in the field and at various office locations.

Advanced sophisticated software

In general, **advanced sophisticated software** such as AutoDesk's Build Construction Cloud (which now includes Plangrid) and Procore's[8] construction management software aim to document and understand the project and its integral systems in three dimensions (3D). These tools reduce the risk of errors or omissions, identify issues that need to be addressed, streamline workflow from preconstruction to close-out, connect the team, integrate software, and maximize profits for the contractor. These programs allow 3D modeling in two dimensions, including fly-through animations, and can even produce 3D-printed models using special printers. Related to this, see the discussion of BIM technology that follows.

In addition, these advanced programs allow architects and engineers to design complex irregular buildings that, until recently, would have been nearly impossible to design and convey via drawings alone. Massive curvilinear and irregular buildings, such as the Lucas Museum of Narrative Art in Los Angeles, by Ma Yansong,[9] and the Walt Disney Concert Hall, also in Los Angeles, by Frank Gehry (shown here), are defined by innovative forms and materials that would not have been possible to utilize in the pre-computer world. The Disney Concert Hall General Contractor (Mortenson) is proud of how the company turned what was then thought to be an "unbuildable" design into an actual structure.[10]



Andrew Schulman photograph

Walt Disney Concert Hall

Building information modeling (BIM)

Building information modeling (BIM) is a computer-based system that shows building spaces, systems, and products in relative scale to each other and in three dimensions. BIM can be used to illustrate an entire building. It uses a process of gathering geometric and product data into virtual models as a tool for design, construction, and, when construction is finished, facilities management. Building information modeling platforms include Graphisoft's Archicad for residential projects,[11] Autodesk's Revit,[12] and BIM 360,[13] which are now part of the Autodesk Construction Cloud. The use of BIM has been a growing trend and is no longer relegated to the larger construction firms.

Current building practice generally relies on two-dimensional (2D) drawings, either computer generated or even hand drawn, for the dozens or even hundreds of separate, sometimes inconsistent documents required for pricing and construction. However, these documents usually exclude the very information necessary for effective design, cost, and construction evaluation, such as bid and contract documents, timelines, specifications, price lists, installation recommendations, maintenance guides, and more. Revisions are costly and time consuming and changes may not be adequately communicated between the parties. The application of BIM enables all team members to easily access information. The information provided by BIM means that team members can make smart design decisions early in the process, identify problems before construction starts, schedule efficiencies into construction sequencing, and get accurate cost estimates up front. This reduces the possibilities for discrepancies, mistakes, and cost overruns during the work.

One of the values of BIM is that, when changes or adjustments are made, the model and the accompanying data change too. For example, if the team decides to substitute a more costly radiant floor heating system for the direct-vent furnace specified, BIM has the capabilities to identify the full impact of this change, including the cost and time as well as spatial changes.

Drawings can be produced quickly and accurately, and embedded data lets designers and contractors analyze code and installation requirements (including the optimum sequence for installing building components), as well

Screen shot reprinted courtesy of Autodesk, Inc.

BIM graphic using Autodesk Revit

as manufacturers' specifications, materials and cost data, work sequence, and scheduling information. BIM can sequence project time (4D models) and costs (5D models) into renderings in various levels of detail, from high-level design to detailed installation sequencing for subcontractors. BIM can help contractors with takeoffs and materials ordering. BIM is even being used to drive some factory-based construction practices, such as modular housing.

☑ Some BIM vocabulary

Building information model: A digital representative of the physical and functional characteristics of a facility.

3D BIM: A building information model that includes 3D shape information but not time and cost data.

4D BIM: 3D BIM with objects and assemblies that have schedule and time constraints added to them.

5D BIM: 4D BIM with objects and assemblies that have a cost dimension added to them.[14]

Scanning and BIM Building information modeling is only as accurate and useful as the data entered. Laser scanning, as well as infrared scanning and photogrammetry, which captures 3D measurements from 2D documents, has emerged as a tool for capturing increasingly accurate and detailed information for use during the BIM process. A scan is a powerful laser recording of an object's shape and appearance, and converts thousands of data points that can be imported into a BIM model. The accuracy made possible through the use of laser scanning is unparalleled by manual measurement and traditional field surveying techniques.[15]

For additional information on BIM, the reader is directed to the U.S. General Services Administration's Guides (www.gsa.gov/bim), a free download of ASHRAE's BIM guide (http://cms.ashrae.biz/bim/), and *The Business Value of BIM* from McGraw Hill (https://vdocuments.net/mcgraw-hill-the-business-value-of-bim.html).

Subsurface information modeling (SIM)

Similar to BIM, **subsurface information modeling (SIM)** is the process of creating digital replicas of below-ground structures like utilities, tanks, voids and bedrock. With utility locating and modeling, accuracy is essential. Some call SIM "underground" BIM, which completes the information modeling process and generates a total asset model of all the planned construction, both above and below ground.

Virtual design and construction (VDC)

Virtual design and construction (VDC), like BIM, is a process and a way of working that involves the management of integrated multidisciplinary performance models.[16] It can be considered integrated software. VDC and BIM technology are related but differ in purpose. While BIM technology creates a digital representation of a physical building, VDC technology uses 3D BIM models and other information to digitally plan all aspects of a construction project—from estimating costs to scheduling and risk management. VDC emphasizes collaboration and integrated working, and BIM is frequently a valuable part of VDC. BIM is a much more specific process than VDC, but both are essentially methods of planning and managing a project collaboratively.

New computer hardware

Smartphones and tablets

Over the last few decades, as printed construction plans became increasingly bulky, expensive, and difficult to reference in the field, technology has worked to put plans in the palm of the contractor's hand, literally. Construction teams can now view full sets of plans and send updated drawings, site condition photos, schedules, estimates, and more on easily portable smartphones or tablets. Construction plans are now widely electronically shared using various software systems. These allow many functions to be carried out in the field, including creating and documenting field issues with photos and notes electronically embedded on the plans and communicating with team members.

"Smart" buildings

The technology incorporated into buildings themselves is increasingly sophisticated. There is a trend toward **"smart" buildings** that use information technology to operate and to connect subsystems to maximize performance. Buildings that incorporate smart technology produce lower emissions and are more sustainable. They use automation to control building functions automatically and/or remotely, track resource usage, and reduce costs. For example, lighting, heating, and cooling systems can be matched with occupancy patterns, analysis algorithms can detect problems for proactive maintenance, and signals from the electricity market can maximize energy use by altering usage in response. Computers can control access, lighting, and communication and make it possible to access and control the systems remotely. Constructing a smart building is more intensive for the electrical, HVAC, and security system trades than a conventional building because they require special controls and equipment, which generally require additional wiring for interconnectivity.

Virtual-reality skilled-trades training

Technology is playing a role in workforce development. Using virtual reality equipment and technology taken straight from gaming, it's now possible to participate in online **virtual-reality skilled-trades training**. This helps contractors avoid the time, effort, and expense of sustaining an in-house trades training program. Personnel can be jobsite ready in weeks, not months. Some companies offering this technology are Interplay Learning,[17] VRSim,[18] and Serious Labs.[19]

New construction tools

New tools available to contractors include drones, lasers, robots, autonomous vehicles, infrared scanners, and more.

Drones

An increasing number of construction companies are using **drones**, remote-controlled miniature helicopters, to carry cameras and other equipment to capture construction conditions and data. Drones are used for aerial imaging, scanning (including for BIM), topographical mapping, video documentation, and more. Drones with cameras are especially useful for road construction and repair and other large civil engineering projects because they allow birds-eye views of large-scale projects in real time. Also, drones are mobile and can easily move from one location on a large jobsite to another.

Another developing use for drones is tall-building facade visual inspections and visual condition documentation, which can now be performed using drones instead of in-person from a swing stage or bosun chair. Another frequent use of drones is for time lapse photography/videography. Edited together, it can show the "growth" of a project similar to an animation. Construction companies can hire drones, although with equipment cost reductions many now have in-house drone capability.

Laser scanning systems

Use of laser scanning systems is increasingly popular for a variety of construction related uses. The systems, also known as terrestrial light detection and ranging (LiDAR), are called aerial laser scanners (ALS) when carried by drones. In this technology, lasers are beamed out and the reflected light is used to create imagery. Laser scanning records physical conditions in three dimensions. The technology used literally scans three-dimensional conditions such as topography, buildings, and rooms. Laser scanners process the data and assign reflectance value, color, and X, Y, Z plane coordinates to every point, forming a detailed 3D model of complex environments. These scans allow fully three-dimensional documentation of landscapes as well as existing and new construction. This technology also allows for accurate documentation of conditions too complex or large for conventional measurements. Of note, geologists in Guatemala recently discovered a Mayan site that stretches for approximately 650 square miles, hidden for centuries under the jungle canopy. The findings were the result of an aerial survey that was conducted via airplane using LiDAR.

Contractors and designers are gaining access to laser scanning technology, which has recently come down in price and complexity. The equipment is much less bulky and more mobile than before and its operation simpler. A personal laser scanning system that can be carried in a backpack is offered by numerous companies, including GIM International. Laser scanning has many applications. This technology is used often by general contractors who work in historic restoration, building repair, and adaptive reuse projects to document existing conditions. The system can document existing conditions of historic properties to have accurate plans of conditions prior to design or construction. The technology replaces time consuming and expensive surveys and measuring/drafting "as-builts." For construction in high-density urban sites, some construction companies need to document the conditions at adjacent neighboring properties prior to the construction. This allows monitoring of conditions during the construction and documents any changes that may occur to adjacent properties during a construction project.

Robots

Robotics has long been a part of automobile manufacturing but is now coming into use in the construction industry. Contractors are using robotics to improve productivity: to do tasks faster, with heightened quality control and consistency, and to supplement labor shortages. Robotics are currently best used for repetitive tasks in standardized conditions. This technology is also used for dangerous tasks such as setting explosives or cleaning toxic spills.

There are multiple companies developing robotics that are, or will likely soon be, integrated into the construction process. Among them: Dusty Robotics[20] has a robot that performs construction layout work significantly faster than it could otherwise be done; Boston Dynamics' "Spot" is a customizable quadruped (four-legged) robot[21] that specializes in capturing data by photographing a jobsite; San Francisco-based firm Canvas has developed a robot to do drywall finishing.[22] According to a survey commissioned by ABB Robotics, 55% of large construction companies across the U.S, Europe, and China say they use robotics, compared to 84% of automotive companies and 79% of manufacturing companies.[23]

Robotics are costly and smaller firms are still on the sidelines with the incorporation of this technology. Nonetheless, robotics are on the horizon and workers will need to be prepared. Not surprisingly, a recent study has correlated both wage and job declines with the adoption of robots.

Autonomous equipment

Autonomous equipment is considered a part of the robotics revolution. For example, in the past, surveyors and specialized workers would note site elevations, calculate soils that needed to be brought in or moved. Human operated excavators and graders then move soils on the building site to achieve the final site contours and elevations.[24] Today, drones can capture grade information and automated equipment can deliver the layout, using sensors and artificial intelligence (AI) software to navigate the terrain and complete tasks such as moving earth. Autonomous vehicles are also used for transporting resources from point A to point B on jobsites. Semi-autonomous wheel loaders and other vehicles don't have complete self-driving capabilities and still require operation or remote control. These vehicles, such as CAT Command by Caterpillar, remove operators from hazardous jobsite conditions.

Exoskeletons

One extreme fantastical piece of technology is the human-robot combination that is coming into limited construction use: the **exoskeleton**. This suit or exterior body frame allows a human operator to strap into it and lift and carry heavy and bulky objects. The exoskeleton is still more likely to be seen in science fiction movies than in real life.

Infrared scanners and photography

Infrared scanners and photography can help detect leaks inside of walls, ceilings, or floors. By showing comparative temperatures, the images can show a trained user wet spots or cooler/hotter air. This technology allows for initial nondestructive evaluation of assemblies for water or air intrusion sources within them. It is often used by repair or litigation related construction companies. Infrared imaging is also used looking at whole buildings from the exterior to determine heat loss sources, such as through single-pane windows and uninsulated assemblies, which then could be corrected to maximize energy efficiency.

Ground penetrating radar (GPR)

Ground penetrating radar (GPR) equipment is a nondestructive detection and imaging tool. It can be used to identify subsurface elements either underground or within a material such as concrete.

Borescopes

Another useful tool for repair and litigation-support contractors to inspect construction assemblies with minimal destruction is the **borescope**. This tool is a flexible cable with a fiber optic light and camera mounted on the end. The camera end is inserted through a small hole in a construction assembly in order to observe what is going on inside. The camera can be guided through a cavity to observe hidden conditions for signs of decay or other construction failures. Construction repair companies and litigation-support construction companies often use this tool to look for areas of water damage, decay, or other construction failures. Increasingly, cities are mandating periodic cantilevered deck inspections and this is the tool used to do them when a finished soffit is installed. Borescopes allow these inspections without removal of the soffit finish.

There is a never-ending list of cool new tools and gadgets for contractors, as is evident in the myriad construction magazines and newsletters.

All this new technology may feel like a threat, but it can also provide opportunities as new jobs emerge. The new mantra in the industry: adapt and become adept!

New construction materials

Technology and environmental necessity have driven the development of thousands of new products and materials. More designers incorporate sustainable components, including recycled products, into structures every day. Sustainability is discussed in more detail in Chapter 4. Contractors are being asked to construct buildings from materials produced using less energy, less waste, and fewer harmful chemicals. This trend has been accelerated by rising energy prices and concerns over the impact of greenhouse gasses.

Today's contractors are training to become familiar with a new generation of innovative materials and products. Some of these new materials are futuristic: a concrete product that reportedly traps carbon dioxide, zero-carbon drywall, energy-harvesting glass, panels made from sorghum stalks, wall panels made from fast-growing grasses, and paint that helps clean the air.

Re-thinkingthefuture.com lists some recent construction material innovations: self-healing concrete, modular bamboo, transparent aluminum, translucent wood, light-generating concrete, microbial cellulose, 3D graphene, aerographite, and spider silk.

Many new materials have unique qualities and installation standards. When contractors are asked to use unfamiliar new products or systems, the first course of action recommended is to contact the product's technical representative. This person is usually a great (free) resource for the contractor to learn about the material, including its compatibility with other materials. If the new construction component is part of a **proprietary system**, the manufacturer has ownership or control of the installation process. The installation contractors may need to be approved by the manufacturer. Some systems, such as Sika's Sarnifil roofing, actually have their own select, certified contractors trained in the installation process.[25] These subcontractors have exclusive agreements with the manufacturer to purchase and install the products, which are not available to others.

New construction methods

Technology is also creating new ways of building using familiar materials and the development of new construction systems such as off-site modular construction, mass timber construction, and 3D-printed buildings.

Prefabrication, including mass timber and modular construction, has moved construction to the factory assembly line. Under these controlled circumstances, inconsistent execution and weather delays are eliminated. The completed building components are delivered to and installed at the jobsite.

Modular construction

Off-site **modular construction** is used to prefabricate everything from wall framing sections to entire apartments in a controlled factory setting, unaffected by weather. Modular construction still mostly uses conventional building materials (i.e., wood framing) and meets conventional construction codes, but the construction takes place in a factory and the components are then placed on-site for integration into a construction project. Construction time savings and consistent workmanship quality are a part of the lure of this construction technique.

Because the modules are self-contained and are meant to be assembled like building blocks, the system is characterized by double walls and double floor/ceiling assemblies. The double walls and ceilings are considered to be superior sound insulators, thus ideal for multi-family uses. One such modular construction company is Factory OS, in Vallejo, California, where it occupies a former naval submarine assembly building. The winches and ceiling-mounted tracks that used to carry submarines now carry the building modules from one workstation to the next. At Factory OS[26] and similar modular housing manufacturing facilities, the construction workers and their tools remain in one place and the module under construction is brought to them.

Factory OS

Modular housing production floor with BIM overlay showing framing

Modular construction is not to be confused with **prefabricated construction,** such as mobile homes and similar trailers. These construction types often use very light framing and some less-durable materials, which do not always meet conventional building codes but do conform with other national codes.

Mass timber construction

In **mass timber (or laminated timber) construction**, walls, floors, and ceilings consist of wood sections, such as 2×4s, glued together to form strong panels. This is considered green construction because it is a low-carbon alternative to steel and concrete construction, where the wood is (ideally) sourced from sustainably managed forestry companies. Mass timber has excellent fire resistance, dimensional stability, and sound attenuation qualities. Like modular construction, mass timber modules are constructed in controlled factory environments and delivered to the jobsite, where they are assembled.

3D Printing

On-site use of **3D printing** for buildings is in its infancy and promises to be a useful tool as well. Buildings constructed using 3D-printing technology most often utilize a thick cementitious slurry which is placed in thin layers on a wall line using machines running on tracks and controlled by computer and, in some cases, linked to BIM. It is like a copier printing a plan, but instead of ink, it puts down layer upon layer of the fast-setting slurry to create the walls. 3D printing can build a home or building from the ground up in a matter of days. That's a significantly faster time frame than conventional construction. According to Marco Vonk, marketing manager at Saint-Gobain Weber Beamix, "You save about 60% of the time on the jobsite and 80% in labor."[27]

3D-building printing technology can also be used to meet sustainability requirements. Worldwide construction waste currently totals more than one billion tons each year, and according to Construction Dive, this number is expected to double by 2025. Waste reduction is a key element of sustainable construction techniques. This is because 3D printing is an additive manufacturing process that only uses as much material as is necessary for creating a structure. To further its "green" appeal, companies are working to develop materials to substitute the concrete-based slurry with alternate materials.

In this chapter, we explored how new technology is coming into use on several fronts. New computer software creates office and field efficiencies. New computer hardware puts information in your hands. New construction tools use technology to work for you. New construction materials help meet sustainability goals and requirements. And finally, new construction methods and systems increase your productivity.

New technology is not without its own problems, liabilities, and gotchas. For example, sophisticated cloud-based programs and communication tools are only as good as your internet connection, robots can get stymied by the smallest nonstandard conditions, and if the power goes off, the whole jobsite stops (at least until the generators come on). In addition, this technology is not cheap, although it is being made more affordable with passing time. Finally, technology gets outdated quickly and it is difficult for those of us in construction to deal with technology overload. However, don't fear technology, "embrace it." This is the present and future of the construction industry.

We will review other new directions in the industry in the next chapter on building for sustainability and climate resiliency.

Chapter vocabulary

3D BIM—a building information model that includes 3D shape information but not time and cost data.

3D-printed construction—buildings constructed using a thick cementitious slurry placed in small layers to build up walls using machines running on tracks and controlled by computer.

4D BIM—3D BIM with objects and assemblies that have schedule and time constraints added to them.

5D BIM—4D BIM with objects and assemblies that have a cost dimension added to them.

Autonomous equipment—certain equipment, including excavators and graders, that can be programmed to perform a specific task in a defined area of the jobsite.

Borescope—a flexible cable with a fiber optic light and camera mounted on the end used to observe conditions inside an enclosed construction cavity.

Cloud-based software—stores data over the internet instead of on individual hard drives.

Construction project management software—computer programs designed to assist with typical CPM tasks and record keeping.

Drones—remote-controlled miniature helicopters that can carry cameras and other equipment to capture data.

Exoskeleton—a suit or exterior frame worn by a person that removes the strain of lifting heavy objects or materials.

Ground penetrating radar (GPR)—a nondestructive detection and imaging tool that can be used to identify subsurface elements either underground or within a material such as concrete.

Infrared scanners—detect air/moisture leaks inside of walls, ceilings, or floors by showing comparative temperatures.

Laser scanning systems—scans three-dimensional conditions such as topography, buildings, and rooms, similar to the way a copying machine works.

Mass timber (or laminated timber) construction—a building system with walls, floors, and ceilings consisting of wood sections such as 2×4s glued together to form strong fire-resistant panels, which are assembled in the field.

Modular construction—a system that builds everything from wall sections to entire apartments in a controlled factory setting for shipping to a construction site, where they are assembled together.

Prefabricated construction—structures assembled using very light non-conventional construction, such as mobile homes and trailers.

Proprietary system—a system in which the manufacturer has ownership or control of the installation process and contractors.

Robotics—in the construction industry, robots are currently best used for repetitive tasks in standardized conditions.

Smart buildings—use information technology to operate and to connect subsystems such as HVAC and lighting to maximize performance.

Subsurface information modeling (SIM)—the process of creating digital replicas of below-ground structures.

Vendor (supplier)—a company that manufactures, distributes, or supplies products and services to a contractor.

Topics for discussion

1. What is meant by the term BIM? What advantages do you think this system gives the contractor?
2. Soils at a construction site are contaminated. What are some technologies you as a contractor could use to protect your workers from exposure to toxic dust?
3. Your apartment building project framing and drywall finishing is falling behind schedule. What technologies could you use to get back on schedule?
4. Discuss some advantages of new construction materials. Discuss potential disadvantages too.