CHAPTER

15

Accounting for change orders

Introduction

Addenda modify the scope of the project before it is bid and change orders accomplish the same thing but after contract award. In addition to modifying the scope and terms and conditions of the agreement, a change order usually impacts cost and/or schedule. Change orders may be additive, if they add scope of work, or deductive, if they delete work items. Since they occur on most construction contracts, managing change orders is an important project management and cost engineering function. This chapter discusses change order management and pricing and the interplay of change orders between the jobsite and home office accounting operations.

Change order sources

Change orders arise from a variety of sources or causes. Four of the most common are elaborated on in this section. Most change orders originate due to *design errors*. These can arise for a variety of reasons, including:

- Architects and engineers may not have sufficient funds, resources, or time to do a complete design;
- Clients may contract with the engineers (such as mechanical or electrical engineers) directly and not through the architect. This may result in multi-discipline documents that are not fully coordinated;
- A complex project such as a hospital; and/or
- People make mistakes, including architects, engineers, and project owners.

Client-requested *scope* or *programming changes* are among the most expensive change orders but are relatively easy to process and gain approval for as this is something the project owner

wants to add or change. Additional scope changes are usually accompanied with an architect-generated construction change authorization or construction change directive (CCA or CCD) with new or revised drawings and specifications.

Change orders which occur due to *uncovering unknown site conditions* can be among the most difficult type of change order for a client to accept as they were unforeseen or unanticipated. These generally result from inadequate site exploration prior to starting design. Hidden or latent conflicts or conditions are common in site work (for example, wet or contaminated soil) or remodeling (for example, mold or insect infestation) and may use up the client's contingency funds early in the project. When the contractor encounters hidden site conditions that adversely impact construction, the general contractor's (GC's) jobsite project team must 'promptly' notify the architect and client and provide the designer an opportunity to make an inspection; this is often through the use of a request for information (RFI).

Materials and equipment supplied by the project owner for installation by the contractor, or *not-in-contract (NIC) equipment*, result in a fourth category of change order if the products are not fully coordinated. Some construction consumers believe that by contracting direct with sub-contractors and suppliers they save the general contractor's fee. This is common with items such as kitchen equipment, swimming pool subcontractors, exercise equipment, furnishings, custom casework, and landscaping on commercial projects. Problems may surface and the project can be disrupted due to the lack of coordination of client-furnished materials. These conflicts are unfortunately often not discovered until the materials first arrive on site. Conflicts may have been mitigated if the construction team had reviewed the client's purchase orders and vendor submittals and identified potential issues through the use of requests for information. Project owners may pay much more to resolve conflicts associated with NIC materials then they would have originally paid the general contractor to manage the work.

There are several other ways change orders may occur such as weather, changes initiated by the City when issuing the building permit, contractor and supplier requested material changes, and others. Most of the processes to develop and account and manage change orders will follow the same path as discussed in the balance of this chapter. The change order process begins with preparation and pricing of change order proposals (COPs). After the proposals have been approved, they are incorporated into the contract through formal change orders. Cost accounting and cost control systems must be continually modified to reflect approved change orders. If the contractor and the project owner cannot agree on change order pricing and time impacts, then the general contractor and its subcontractors may process claims which require a formal dispute resolution process to resolve.

Change order proposal process

The change order process can begin in a variety of fashions as indicated earlier. One common route is to start with a request for information due to a discrepancy discovered by the construction team, resulting in a cost proposal or request for proposal of subcontractors. The other route is through a project owner or architect-generated request for a change. In both cases the general contractor gathers all of the costs and backup, and forwards a change order proposal to the client or architect, and, if accepted, results in a contract change order (CO). The steps associated with processing COPs are discussed in this section. Claims are also briefly introduced later in this chapter. Claims are often the result of unresolved COPs.

A change order is a formal contract-revising vehicle whereas a change order proposal is a softer and more negotiable document. An owner-initiated COP request provides a description of the proposed change in the scope of work and requests that the contractor provides an estimate of additional or deductive costs. If the proposed change extends the project duration, the contractor also requests additional time. A contractor-initiated COP generally results either from a differing site condition or from a response to a request for information. The contractor's proposal describes the change to the scope of work and provides any proposed adjustments to contract price and time. Figure 15.1 reflects a COP from Evergreen Construction Company for changing the level three, gypsum wall board (GWB) taping finish, to a level four finish throughout the hotel case study project. COPs do not modify the construction contract; only a formal contract change order accomplishes this. An additional COP example is included on the eResource for a change in the concrete foundation walls, including quantity take-off (QTO) and direct work pricing recap sheets.

Subcontractors account for 80–90% of the work on a typical commercial construction project. Subcontractors therefore initiate the majority of the change order proposals. Well-written requests for information and thorough and timely submittals are methods for surfacing discrepancies and therefore are part of the active quality control process. The project manager (PM) or project engineer/cost engineer should research a changed condition and forward the question or submittal to the architect. In this case the GWB subcontractor had processed its submittal indicating a level three taping finish, including a light texture, which was as specified, but the architect intended a level four finish and a smooth high-gloss paint which allows for easy cleaning. The architect changed the level of finish upon submittal return.

If the architect does not request a change order proposal from the contractor when responding to a request for information or submittal, the subcontractor must notify the general contractor regarding cost and schedule impacts from the architect's response. If the GC's team believes a change order is warranted, they will send a change order pricing request to the subcontractor. The project manager or jobsite cost engineer uses the subcontractor's response to the change order request to prepare the GC's COP similar to the one illustrated in Figure 15.1. COPs should include at least the following:

- The format of a COP cover page will be very similar to an estimate summary;
- Each COP is individually numbered;
- A detailed description of the work proposed is included;
- Direct labor hours, wage rates, and labor burden are itemized;
- Direct material and equipment costs should be backed up with detail;
- Subcontract costs are backed up with quotes from the individual subcontractors;
- Markups as established in the contract agreements are added; and
- The COP provides a line for the project owner to sign approval.

COPs should be prepared in a manner to facilitate expeditious approval from the project owner and architect. All relevant supporting documents should be attached. Subcontractors should provide the GC with the same level of detailed backup the owner asks of the GC. All COPs should be tracked with a log similar to an equipment ledger, value engineering, or an RFI log. Some of the types of COP backup documents which should accompany every change request include:

- RFIs and/or submittals which initiated the change;
- Relevant drawings, sketches, specifications, and/or photographs which depict the change;

- Estimating backup including quantity take-offs and pricing recap sheets;
- Subcontractor and supplier quotations; and
- Other supporting documents such as letters, phone memos, meeting notes, and/or daily diaries.

If COPs are properly prepared by the subcontractors and the GC, and the project owner accepts the COP, the formal change order process is relatively straight forward. Often, however, there will be questions related to the COP request and subsequent negotiations. This is to be expected and is part of working as a team. The cost proposal is usually negotiable. The project management team is not taking a hard line approach at this time. A weekly COP meeting outside of the regular owner-architect-contractor construction coordination meeting is a good way to discuss and resolve change issues. Following are two examples of subcontractors' approach to change orders; one successful and one not as successful.

Example One: Both of these subcontractors worked on the same biotechnology project. The electrical subcontractor had not done a lot of work in the high-technology arena, but they low-bid this project in hopes of negotiating future work. The project manager was a former superintendent and an electrician by trade. He filed requests for change orders for every minor issue, generating over 125 change order proposals, some of them for only $100. This frustrated the client who managed the project from out of town and visited the site only once monthly. The client fought with the subcontractor on almost every change and the subcontractor eventually filed a post-project claim. The electrical subcontractor did not break into the very tight-knit biotechnology construction market.

Example Two: The mechanical subcontractor also bid this project lump sum but had extensive biotechnology experience. Their project manager took a big picture approach. He did not charge for minor discrepancies. The client eventually generated a very major change in scope, adding and revising several pieces of mechanical equipment both on this project and in an adjacent facility. These changes amounted to over $600,000 worth of mechanical work. Many of the equipment changes were performed off-shift to minimize the impact to the client's employees and laboratory experiments. The client was very thankful. The mechanical subcontractor is still in the building doing time and materials (T&M) work years later.

Change order proposal pricing

Change order proposals cannot be processed for payment until they are approved and incorporated into the contract via formal contract change orders. The easiest way to obtain payment is to be realistic with respect to pricing on direct and subcontract cost estimates. Overly inflated prices will only delay the process. Quantity measurements generally are verifiable and should not be inflated. Wage rates paid to craft employees are verifiable and should not be inflated. Subcontractor quotes should be passed through as is without adjustment (unless incomplete) from

the general contractor to the client. The subcontractors and suppliers should practice the same procedures with their second- and third-tier firms. Labor productivity rates should be derived from pre-approved resources. Material prices should be actual and verified with invoices or quotations. Any deviations in the previous suggestions may damage team-build relationships and trust amongst the parties and/or delay COP approvals. An effective approach to pricing changes is for both parties to pre-agree to utilize a published estimating database, such as from RS Means.

After all of the direct work and subcontracted work is totaled on the change order proposal, the general contractor will add a series of markups to the estimate. There are many percentage markups which may be added to the bottom of a COP including: labor burden, consumables, small tools, fee, potentially jobsite general conditions, contingency, liability insurance, bonds if applicable, and others. These percentage add-ons are often cumulative and their total effect on the direct cost of the work can be substantial. Markups, or percentage add-ons, are utilized by some GCs and subcontractors as fee enhancement and recovery for other indirect costs. Clients often get frustrated with these add-ons. They do not understand why they have to pay more for the change than simply the direct costs. Most of these markups are required, and sometimes it is just the presentation that makes them difficult to accept. An alternative approach is to figure the exact impact for each item, but this can be difficult for the contractor to account for and the project owner to understand and accept.

As discussed throughout this book, home office overhead and profit, or fee, is a very important cost add-on and is closely monitored by the home office chief executive and financial officers. Commercial general contractors will receive a 3–7% markup for fee. Civil, residential, and smaller commercial projects will see up to 10% fees. This rate is usually the same percentage fee that was used on the original estimate and is stated or allowed in the contract. Evergreen Construction Company (ECC) and Northwest Resorts (NWR) agreed to a 7% fee markup for additive direct work and 3% for subcontracted work and inserted that into their A102 contract, Article 5.1.2. There was no deduction of fee for reductions in scope, which is often the case, unless there is a major scope change, such as the elimination of a parking garage floor. Home office overhead is typically included in a general contractor's fee and is not a separate add-on for GCs.

Most construction contracts also do not allow the GC to charge for additional jobsite general conditions on change orders. The exception is if schedule extension can be proven, then some jobsite general conditions line items may be allowed. In order for the jobsite project team to prove that additional general conditions and/or time are warranted, they need to provide documentation to back up the time and costs, such as a very detailed construction schedule. Contractor attempts to recover for additional jobsite general conditions, time extensions, home office general conditions, and/or impact costs are often seen as contentious from the owner's perspective and are typically rejected in the change order proposal process, in which case they could result in a contract claim. Development and management of jobsite general conditions estimates was the topic of Chapter 5.

Specialty contractors often charge a higher fee on change orders than will a general contractor because their volume of work is less and their direct labor percentage is higher. Direct labor is an estimating risk for subcontractors as well, even on change orders. Subcontractors may receive a 10% fee and an additional 10% for overhead. Fee and overhead rates allowed on change orders will depend upon how many other markup items are included in, or are in addition to, the fee and overhead markup. Contract language should define all of this.

Negotiations and approvals

A formal contract change order is utilized to modify the construction contract after the contract is executed. The contract change order is generally prepared by the architect. If the architect and client and the general contractor have negotiated a mutually acceptable adjustment in the contract price, schedule, or both through the use of the change order proposal process, a contract change order is executed modifying the terms of the contract. The supplemental or special specifications of most prime contracts contain the change order procedures. ConsensusDocs form 202 and AIA document G701 are common formal change order coversheets and preferred by many contractors, clients, and architects. Because Resorts International, the holding company for Northwest Resorts, which is the owner for the Olympic Hotel and Resort case study project, builds and owns hotels across the country, they have their own customized formal contract change order form. An example contract change order incorporating the gypsum wall board COP and others is included as Figure 15.2.

CONTRACT CHANGE ORDER

Where the basis of payment is a guaranteed maximum price

Client: Northwest Resorts, LLC
Address: 1001 First Avenue, Seattle, WA 92012, (206) 392-5336

Contractor: Evergreen Construction Company
Address: 1449 Columbia Avenue, Seattle, WA 98202, (206) 447-4222

Project: Olympic Hotel and Resort — Project Number: 422

Change Order Number: 2 — Change Order Date: 8/21/19

Original Contract Price:		$24,530,015
Previously Approved Change Orders:	Through Change #: 1	$ 75,050
Previous Contract Price:		$24,605,065

Incorporate the following agreed change order proposals. See attached COP log.

13	Unsuitable soil removal	$ 27,550
24	Building Permit Issue	$ 0
25	Add ATB Asphalt for Winter	$ 44,567
28	Extend Roof Warranty to 25 Yr.	$ 20,102
32	Level Four GWB Finish	$ 52,015
Total added/reduced/unchanged this CO:		$117,245
Current and revised Contract Price:		**$24,722,310**

Previous Contracted Schedule Completion:		7/10/2020
Net change per this CO: 0	Days added/reduced/unchanged:	0
Current and Revised Contracted Schedule Completion:		**7/10/2020**

Contractor's Approval:	*Chris Anderson*	Date: 8/21/19
Architect's Approval:	*Stan Zimmer*	Date: 8/22/19
Client's Approval:	*Sandi Chambers*	Date: 8/22/19

Figure 15.2 Contract change order

A formal contract change order can be used either for one large change order proposal or a group of COPs. Some clients choose to issue monthly formal change orders incorporating all COPs approved during the month. This is a good process for the general contractor if the change order is executed before the monthly pay request is drafted, allowing the CO to be invoiced this month. COPs do not modify the terms of the contract, and are not added to the schedule of values for payment purposes until incorporated into the contract by formal contract change order. Because the contract often does not allow payment of COPs until they are formally incorporated into the contract and added to the pay request SOV, expediting the formal contract change order is of high importance to the construction team. The contract documents should be annotated with all scope changes contained in each change order. The project manager should walk the formal change order through, gaining approval signatures from the architect and the project client. Once the change order has been signed by the architect, client, and contractor, the contract scope, price, and time have been modified. There often is language in both the COP and formal contract change order that indicates once the GC has signed they agree with the adjustment in price and time and will not submit an additional claim for this scope. The GC will incorporate similar language in their changes to subcontractors and suppliers.

Incorporation into cost control and accounting control systems

After the general contractor's contract has been modified, the project manager or cost engineer will modify appropriate subcontracts and purchase orders for major material suppliers. Only then can the subcontractors and suppliers begin their pay request process for the changes.

After the formal contract change order has been executed, the project manager will generate journal entries to the cost accounting system, increasing (or decreasing) the total contract value, adjusting individual estimate line items for approved changes of scope, and modifying percentage markups such as insurance and fees. These changes to the home office accounting system will be done through the use of journal entries, often initiated by the jobsite cost accountant for approval by the PM. These journal entries do not need to 'balance' as did changes made to the cost control system during the early estimate correction stage of the cost control cycle. The net effect should equal the total value of the approved change orders.

The cost engineer will assign new cost codes to added scope and assist the foremen with work package development. If the changes are being performed on a time and material basis, it is important that only true costs be charged to those cost codes. The client trusts the contractor to be fair when performing work T&M and the construction team can damage relations if mis-coding occurs. Some large open-book projects may have the on-site owner's representative actually initial on time sheets and material invoices associated with change orders. In some instances, if the parties cannot agree on a price before the work commences, the contract may allow the client to direct the contractor to proceed either on a T&M basis or on a price 'to-be-negotiated' basis. In either case it is important that the costs be tracked accurately. Actual tracking of some costs are also accomplished inadvertently through the use of the superintendent's diary when he or she notes manpower on site and work accomplished, materials delivered, and equipment utilized. The equipment ledger will also track if new equipment was used for changed conditions.

There are two methods to incorporate change orders into the pay request process. The schedule of values had been established and approved at the beginning of the project. Each line item affected

by changes may be modified on a monthly basis when changes are approved. The problem with this method is it is difficult to keep track of the original estimate and melding invoices for original scopes with changed scopes. The other system is to add line items at the bottom of the SOV listing approved contract changes and invoicing against them directly. The problem with this method is it is difficult to track the revised subcontract and purchase order values and match monthly invoices with lien releases. Evergreen Construction Company utilized the second approach in its SOV and monthly invoices with Northwest Resorts on the Olympic Hotel case study.

Unresolved change orders

Some regard all change orders as 'claims' but claims are not necessarily the same thing as a change order proposal or a formal contract change order. Claims often stem from a COP that has been rejected by the client, or added scope that was forced on the contractor. Many claims arise late in the construction process, after contractors have realized that they did not achieve their anticipated estimate or schedule. For this reason, the contract will stipulate time frames for when a claim must be filed, for example within 21 days of occurrence. The value of a claim is also customarily much larger than a COP. A COP may be for $3,000 on the Olympic Hotel case study project for a change to hotel room signage, whereas the contractor may file a claim for $350,000 or more due to a two-month schedule extension caused by the owner or an unusually cold winter. Validation of actual costs incurred plays an important role in claim settlements. It is difficult to argue against 'actual' costs on changed conditions versus 'estimated' costs and it is through the use of accurate cost coding and recording by the cost engineer that this is accomplished.

The method to resolve claims is described in the prime contract agreement. The least expensive and most expedient solution is prevention which requires all parties to be diligent about their communications and resolve issues at the lowest level possible, which is at the jobsite, before they have escalated back to the home office. If a conflict arises, the parties are encouraged to negotiate its solution, also at the jobsite level. The change order proposal process described earlier is the preferred less expensive path. If a change is not resolved between the parties at the project level, the claim resolution process will likely follow these discourses, in order of least to most expensive and time to resolve: mediation, dispute resolution boards (DRB), arbitration, and litigation. Claims and dispute resolution are not directly a cost accounting topic, but good accounting practices can facilitate either claim prevention or successful claim resolution.

Summary

Change orders are part of the construction process and occur on almost every project. The jobsite management team, including the owner, architect, and general contractor, needs to deal with changes in the most expedient and fair manner possible. Change orders arise from a variety of sources including discrepant design documents, scope additions, differing site conditions, and not-in-contract equipment. Change order proposals may be initiated either by the client or by the GC. An owner-initiated proposal requests the project team provide an estimate of the cost and schedule impact. A GC- or subcontractor-initiated proposal describes the proposed change in the scope of work and requests an acceptable adjustment to the contract price and/or time. The project team

CHAPTER

16

Financial close-out of the construction project

Introduction

As construction projects near physical completion, contractors transition into a close-out phase. The jobsite team should develop a project close-out plan to manage the numerous activities involved in closing out the job. Just as start-up activities are essential when initiating work on a project, good close-out procedures are essential to timely completion of contractual requirements and receipt of final payment. Not only is efficient project close-out good for the general contractor (GC), but it is also good for the client. All contractors want to close out a job quickly and move on to another project. Minimizing the duration of close-out activities generally enhances profit, as it limits jobsite general conditions costs and facilitates timely receipt of final payment and release of retention. Efficient close-out and turnover procedures also minimize the contractor's interference with the client's move-in and start-up activities. Contractors may lose client relationships and damage their reputation in the industry because of slow close-out processing.

Close-out involves completing all physical construction work and assembling all paperwork documentation required to contractually close out the project. The prime client-GC contract will address requirements for substantial completion and final payment. The AIA A102 contract utilized on the hotel case study outlines the close-out activities required to process final payments in Article 12.2. Superintendents generally are responsible for accomplishing construction field work and physically closing out the project. The project manager (PM), with the assistance of the jobsite cost engineer, is responsible for the paper close-out, including all of the associated financial and accounting aspects. This chapter discusses elements of close-out implementation including: construction close-out, project management close-out, financial close-out, and as-built estimates.

Construction close-out

The work required to complete construction and close out physical aspects of the project are the responsibility of the project superintendent. There are many physical construction close-out activities including:

- Complete construction in accordance with contract requirements;
- Punch list walkthroughs, documentation, and resolution of outstanding items;
- Start-up, commissioning, and training;
- Certificates of substantial completion and occupancy;
- Client move-in; and
- Physically moving off the jobsite, or demobilization.

The jobsite team, headed by the superintendent, continuously inspects completed work and identifies deficiencies during construction of the project as part of an active quality control program. In-process *punch lists* are one of the tools a general contractor will utilize to reduce the size of the final punch list which ultimately saves all parties money. When the project is nearing completion, the GC requests a walkthrough inspection from the owner and architect. The list of deficiencies identified during this inspection is known as the punch list, or formal punch list. The punch list usually is developed by the architect, but some clients prepare their own. Some consultant design team members, such as mechanical or electrical engineers, may also develop punch lists. The best method is for all parties who are interested in inspecting the project to gather and walk the jobsite at the same time and one formal punch list is developed.

Timing of the formal punch list walkthrough is critical. It should be early enough to allow time for corrections, but not so early as to mix incomplete base contract work with repairs of completed work. If there still are basic construction activities to complete, additional damage may be incurred that was not listed on the original punch list and it therefore would require revisions. Conversely, if the project team has waited to develop the punch list until after the client has moved in, it is difficult to determine who did what damage.

The general contractor should take no more than one month to repair all of the work identified on the punch list. All items on the punch list must be corrected before the project can be considered 100% complete. If the process takes too long, the subcontractors will likely have demobilized and it may be difficult to get them remobilized back on the jobsite. The punch list should be signed off by each subcontractor and the GC as deficiencies are corrected. A copy of the completed punch list should be sent to the architect. The architect may then wish to re-visit each punch list item and verify its completion or may perform spot-check audits. The certificate of substantial completion is then originated by the architect.

All of the mechanical, electrical, and plumbing (MEP) systems and equipment need to be *started and tested* to assure they are performing properly before turning over the completed project to the client and their facility maintenance personnel. The MEP subcontractors usually take the point on testing and must follow the requirements in the specifications as well as those dictated by equipment manufacturers. These tests are scheduled with the GC's superintendent and the client and often the design engineers will attend. Once complete, a test certificate will be generated and all present will sign. These reports are then customarily included in the operation and maintenance (O&M) manuals as discussed later. The heating, ventilation, and air conditioning (HVAC) systems

will also require to be balanced – sometimes by an independent third party. Many projects today also are commissioned either by the contractor, the client, or again by an independent third party. All of these HVAC balance and commissioning reports will also be included in the O&M manuals.

The *certificate of substantial completion* is issued by the architect, or engineer in the case of a heavy-civil project. This important certificate indicates the project is sufficiently complete such that it can be used for its intended purpose, but there still may be some minor deficiencies that need to be completed, hence 'substantial.' All items on the punch list may not have been corrected but the architect agrees that the project is ready to be used. A copy of the corrected or updated punch list should be attached to this certificate. Contractual completion is the date by which substantial completion is achieved. Issuance of the substantial completion certificate ends the GC's liability for liquidated damages (LDs) and signifies the start of the warranty period.

The authority having jurisdiction (AHJ) over the project site, which is likely the City, County, State or the Federal Government, issues the *certificate of occupancy* (C of O). This is the same agency that issued the original building permit. The C of O signifies all code-related issues have been accounted for and that the building is approved and safe to use. It is often a formality which follows completion of all of the various inspections and subsequent approval and sign-off of all other construction permits. The most critical aspects of the certificate of occupancy are usually inspection and approval from the fire marshal for life-safety issues along with the elevator inspection. The project may have minor deficiencies that are not related to life-safety and still be approved for occupancy. For example, one window blind in hotel room # 405 may not yet be installed or corrected, but it is safe from a life-safety perspective and the balance of the hotel is still usable and built to code. Some public agencies will issue a temporary certificate of occupancy (TCO) which allows the client conditional use of the building for a stated period of time, say six months, while other non-critical work such as recreational room exercise equipment or some interior finishes may be completed at a later time. In order to obtain contractual close-out, the GC's jobsite team needs to obtain both certificates of completion.

Most project owners are anxious to move into their new projects as soon as the authority having jurisdiction allows them to be occupied. *Joint occupancy* occurs when the client accepts and occupies a portion of the building while the contractor is still working in another portion. This may be dictated by the client's need to begin business in the new facility, host a conference, or the client may want to begin moving equipment and furniture into the building. Joint, dual, or conditional occupancies often are unavoidable and may be undesirable if not managed properly. The project team may have problems differentiating the client's cleanup and routine maintenance from construction punch list and warranty work. It is better for all parties if occupancy is delayed until both certificates of completion have been obtained and all items on the punch list have been corrected. If the GC and the client are to have joint occupancy, both parties have to work together to establish procedures to accomplish each other's goals; all of which needs to be identified in the contract.

Commercial estimators seldom put a line item in their original estimate for either mobilization or *demobilization*. Demobilizing, or physically moving off the site, involves considerable work and can be expensive, especially to the general contractor. At that time, there may not be funds that can be dedicated to a foreman and a small crew to clean up the site. The question always arises between the GC and its subcontractors as to whose garbage and surplus materials remain. Similar to the discussion regarding joint occupancy, garbage accumulation may become mixed between the construction crews and the client, as the client is also in the process of moving in.

Demobilization involves closing the project office and physically removing all contractor-owned equipment, files, and personnel from the project site.

Project management close-out

Close-out starts for the project management team during the project start-up phase by reviewing the contract and specifications for close-out requirements. This ideally happens early so that close-out requirements are delineated in each subcontract agreement and major purchase order. The project manager (PM) or project engineer (PE) should make a list of what they think needs to be done and then ask the design team for verification. Some of the major items the project team will submit during the close-out process include as-built drawings, operation and maintenance manuals, test reports, extra finish materials, and signed-off permits.

During the course of construction, actual dimensions and conditions of the installed work are noted on the contract drawings. These drawings then reflect the as-built conditions which therefore should be more accurate than were the original design drawings. The project manager and jobsite project engineer should collect all of the *as-built drawings* from the subcontractors. The general contractor develops as-built drawings for civil, architectural, and structural work; MEP subcontractors prepare and submit their own as-built drawings to the GC's PE. Mechanical, electrical, plumbing, and civil installations are very important because they include hidden systems that would cause severe damage if cut or may need to be accessed during a future remodel.

The foreman or assistant superintendent who oversaw construction is the most appropriate project team member to mark up the as-built drawings. The as-built drawings should be submitted to the client or designer using the same procedures as shop drawings were submitted. Many projects which utilized building information modeling or computer-aided design by the architectural and engineering teams may also require contractors to record as-built conditions electronically. An additional specialized project engineer may be added to the general contractor's jobsite staff and general conditions estimate if electronic as-built drawings are required.

Operation and maintenance manuals are used to gather manufacturers' data regarding operational, preventive maintenance, cleaning, and repair procedures for all equipment as well as many of the architectural finish materials. This information should be collected from all the subcontractors and suppliers and organized in several sets of three-ring binders for the client's permanent service record. The contract specifications will describe the format and organization of O&M manuals. It is a good procedure to process the O&M manuals also as a submittal and request architect approval. This is sometimes required and always a good idea. Some designers will request draft copies be submitted for comment prior to submission of the final copy. Similar to as-built drawings discussed earlier, the O&M manuals may be required to be submitted electronically.

Throughout the course of construction, materials and systems are started up and tested and *test reports* document the results. This includes *balancing and commissioning reports* for the mechanical systems. All of these test reports may be bound as a section in the O&M manuals. The project engineer will help with collection and filing of these reports and final assembly of the O&M manuals.

Specifications require *extra material quantities*, say 1–3% of various architectural materials, be supplied to the client upon completion. This would include materials such as paint (of each color used), ceramic tile, carpet, and ceiling tile. This assists the client with future repairs and remodels.

Construction craftsmen sometimes incorrectly use up these materials for punch list or change order work and contractors run a danger of being short at the time of turnover. Extra finish materials should be kept in secure storage or turned over to the client once received.

Many subcontractors were required to obtain their own building *permits* from the authority having jurisdiction. This often includes firms such as electrical, elevator, and fire protection contractors. Once complete, their permits must also be signed off by the AHJ. This indicates that the subcontractor's work was performed in conformance with code requirements. Signed-off permits may also be included as a section in the operation and maintenance manuals, similar to other close-out documents. The jobsite management team also may be required to submit to the designer or include in the O&M manuals all interim *inspection reports* or signature cards received from the city or county throughout the course of construction. All of these items should be included in a close-out log.

Financial close-out

The financial close-out of a project is not the chief financial officer or the officer-in-charge's (CFO or OIC) responsibility. The general contractor's project manager is responsible to financially close-out the project with both the client and his or her subcontractors, but may obtain the assistance of upper-management as well as the jobsite cost engineer. The GC's ultimate goal is to receive its retention, and all issues related to financially closing out the project are necessary before the client will write the final retention check. Some of the items involved in financial close-out of a project include final change orders, final payment request, client audits, final lien releases, final fee forecast, and others.

Final change orders

Financial close-out for the general contractor's project manager includes negotiating final change orders with the client. The client wants to make sure that change orders will not continue to trickle in for months after they have agreed the project is complete and have accepted it for use. Change orders which may have been rejected or tabled earlier must now be resolved. Unresolved change orders tend to turn into claims as was discussed in the last chapter. The client should request a final change order from the GC, even at $0.00, with the word FINAL printed clearly at the top.

Before the general contractor's project manager can guarantee to his or her client that there will not be any further change orders, they must 'shake the tree' and be sure that all of their subcontractors and suppliers also do not have any pending cost issues. On any typical commercial construction project there may be 100 subcontractors and suppliers, so assuring that they all are satisfied and will not be submitting a latent change request or claim is a difficult financial close-out task. As in all areas of risk-management for the GC, they should ask the same from their subcontractors as the client asks of them. In this case that means the GC's PM and cost engineer should issue FINAL subcontract and purchase order modifications to their subcontractors and suppliers, which incorporate all of the remaining change issues and back charges, even again if written for $0.00. An example final subcontract change order for Evergreen's

Evergreen Construction Company
1449 Columbia Avenue, Seattle, WA 98202
206.447.4222

FINAL SUBCONTRACT CHANGE ORDER

Project: *Olympic Hotel and Resort*
Subcontractor: *Hoquiam Drywall* Subcontract Modification Number: ***003***

We agree to make the following change(s) in the subcontract scope of work:

Mod 1: *Incorporate lobby finishes allowance ($274,000 in base bid, mod @+$0)*
Mod 2: *Change from level 3 and light texture to level 4 finish (+$50,000)*
Spec Section 092500, RFI 101, Sub proposal 1 and COP 32
Mod 3: *Final subcontract modification for no change in time or cost*

Subject to the following adjustment(s) to subcontract value:

Original Subcontract Amount:	*$ 999,000*
Previous Subcontract Modifications (through mod *002*):	*$ 50,000*
Previous Subcontract Amount:	*$1,049,000*
Cost of this Modification Number *003*:	*$ 0*
Revised Subcontract Amount:	***$1,049,000***
Revised Completion Date:	*No change*

Issued by/Contractor: Evergreen Construction Company
By: *Chris Anderson*, Project Manager Date: *9/28/2020*
Authorized Signature/Title

Accepted by/Subcontractor: *Hoquiam Drywall*
By: *Jimmy Dunham*, President Date: *9/30/2020*
Authorized Signature/Title

Figure 16.1 Final subcontract change order

gypsum wall board subcontractor on the Olympic Hotel and Resort case study is included here as Figure 16.1.

Final payment requests

The general contractor will prepare a final payment request for the client. Some GC project managers will include their last month's progress payment request combined with their request for retention. This might result in complications if the client is okay with the quality of the work completed in the last month, and is willing to pay that amount, but is not yet ready to release the GC's retention. If the two issues are combined with one request, and have one lien release with the totals combined, the client may hold back on the entire amount. This will result in a financial strain on the GC and its subcontractors. It is recommended that two separate requests for payment

be prepared, one for the last month of work and one for release of retention, even if the two are submitted to the client at one time. This scenario is shown in the following examples:

Example One: Combined month 16 pay request with complete release of retention:

Month 16 work accomplished: $475,000 ($500,000 – 5% retention of $25,000)
+ whole project retention release of $1,500,000 (including their last $25,000)
Invoice #16: Total request = $1,975,000

Example Two: Month 16 pay request separate from retention request:

Invoice #16: Month 16 work: $475,000 ($500,000 – 5% retention of $25,000)
Invoice #17: Whole project retention release of $1,500,000

The advantage for the general contractor and its subcontractors with Example Two is they can now receive $475,000 to use to pay for direct materials and labor, hopefully within ten days of submission of invoice #16, whereas invoice #17 will be predicated upon completion of all of the other project management and financial close-out items discussed in this chapter.

Preparation of the final request for payment for the general contractor's project manager and cost engineer is predicated upon their receipt of final pay requests from subcontractors. Similar to the discussion of final change orders earlier, this can also be a daunting task. The client should ask for the word FINAL clearly delineated on the pay application, and the GC should do the same with its subcontractors and suppliers. Once paid by the client, the GC's project team should expeditiously release payments to subcontractors. The pay request process will be accompanied by final lien releases from all of the GC's vendors and preparation of the same for the client as discussed later.

Audits

Taxes and audits are the subject of upcoming Chapter 18. Lump sum projects are fairly simple in that clients cannot audit the contractor's books because they are closed-book, unless of course there was contract language which allowed this, but that would be the exception and not the rule. Lump sum projects can have change orders that are authorized on a time and materials (T&M) basis and those change orders may be subject to the client or its agent reviewing the contractor's cost accounting, but for the change order only.

Open-book negotiated projects are often subject to a final audit by the client. Northwest Resorts, LLC (NWR) employed Evergreen Construction Company (ECC) to build the Olympic Hotel and Resort case study project on a negotiated basis with a guaranteed maximum price (GMP) of $24.5 million. At the end of the project, when ECC is preparing to request release of their retention, NWR will customarily audit the contractor's books to make sure that the contractor spent what they claim to have spent and only charged costs to the project that were agreed

to be reimbursable as defined in the contract. NWR must receive an acceptable report from its auditor (whether that be internal or outside certified public accountant), or they will not release ECC's retention, or at least not all of it. If the general contractor has employed open-book subcontractors, such as design-build mechanical, electrical, and plumbing, the GC may also audit the subcontractors' books and this will again be prior to the client's audit.

If the contractor is signatory to labor unions, the unions may also audit the contractor's books, but usually on an annual basis and not on a project basis, to verify that the contractor has paid its share of labor benefits. A sophisticated client again may request that the unions provide affidavits that their benefits have been paid to date, especially as related to their project, as the unions have a right to lien the project if unpaid. These union affidavits may be another section in the operation and maintenance manuals.

Final lien releases

The final change orders and final pay request processes are dependent upon several other prerequisites, but all happening at the same time. This is somewhat a 'chicken and egg' scenario. The processing of the final lien release is very similar. One item cannot happen until another is resolved, and that item is also pending another issue. Monthly conditional lien releases were discussed in Chapter 14, 'Payment requests.' At the end of the project, the client is looking for a FINAL or unconditional lien release from the general contractor. The conditional releases basically indicate that:

> *If the client pays the GC for a specified amount of money for a specified period of time, the GC will release its rights to lien the project for exactly that amount.*

The client is then protected from liens once that amount is paid. An unconditional lien release indicates that:

> *The GC has been paid and now completely and unconditionally releases its right to lien for the amount received.*

The owner will not release the general contractor's retention until all of the close-out requirements discussed in this chapter have been completed, including this final lien release. The GC is protected during the course of the project as they know they always have one or more pay requests coming, so that they have not completely given up all of their lien rights. But this is not the case with the final lien release. The client is basically asking for an unconditional release, even though the retention has not been paid. This author/project manager has simultaneously exchanged many unconditional lien releases for the retention check with the client. Lien releases can have complicated legal language and are usually drafted by attorneys. Contractors should check with their legal counsel before agreeing to sign a client's lien release form.

The general contractor's project manager again places the same responsibility on the subcontractors as the client has placed on him or her. The GC should not provide the client with an unconditional lien release until it has received all of the final lien releases from all of its subcontractors, and their subcontractors. The GC should reach as far back as they can to ensure that third-tier subcontractors and their suppliers have all been paid. Experienced owner's representatives will

also ask the GC to provide the subcontractor lien releases, along with its own, and include them in the operation and maintenance manuals.

Retention release

Release of retention is the ultimate goal for the general contractor as well as their subcontractors. As stated in Chapter 14, retention use to be equal to 10% of the cost of the work and in many cases is now 5%, which approximately equals a contractor's fee. Until the retention has been paid, the contractor has not received its fee. But GCs who subcontract out the majority of the work will also have held a corresponding amount of retention from their subcontractors as the client did of them. Therefore the GC has been receiving portions of its fee, and only the retention held for their direct labor and material and equipment and indirect costs is outstanding. At-risk construction managers, which subcontract out the entire project, have only 5% held on their indirect labor. It is the subcontractors who are helping the client to finance the project due to being paid their monthly pay requests on a pay-when-paid basis, as well as retention held. Third-tier subcontractors are impacted even more.

Before the retention is released, all of the topics discussed in this chapter need to be 100% complete. Any one item can hold up release of retention. This starts with construction close-out procedures such as the punch list and certificates of completion. All of the project management paper close-out activities must be assembled and submitted to the architect and the client including as-built drawings, operation and maintenance manuals, and several others. The jobsite cost accountant will assist the project manager with processing several very important financial close-out activities such as final change orders, final pay requests, and final lien releases.

The actual release of retention should be by separate check as noted earlier. This is a milestone event for the general contractor. Once received, the GC should make sure that all of the close-out activities of its subcontractors have been resolved and pay them expeditiously as well. The GC relies on the financial well-being of its subcontractors to not only get them through this project, but to be solvent and provide them with a competitive bid on the next project.

Warranty management and accounting

One additional phase that occurs after all of the construction phases have been completed, including the close-out phase, is the warranty period. The specifications and the contract will indicate how long the project is warranted, which is usually one year. Several building systems and equipment are warranted longer, such as the roof for 20 years and the elevator for five years. During that first year of warranty, the general contractor will spend funds responding to warranty call-backs, which can range from leaking faucets to drywall cracks to dead landscaping. It is important for long-term relations with the client that the GC and its subcontractors respond quickly and repair any deficiencies. As stated at the beginning of this chapter, a poorly closed out project can have an effect on a contractor's reputation and this is similar with warranty management.

For lump sum projects, the contractor may have allowed a small amount of money in its jobsite general conditions estimate for the warranty period. In most cases, the general contractor is relying on subcontractors to take the majority of the risk for warranty call-backs, but still the GC must

manage the process. If the GC does not spend what they allowed, then they potentially improve their fee. If they over-spend their warranty allowance, then they will eat into their fee, just as an extended close-out phase will eat into the fee.

On negotiated open-book projects, the contractor will also have a general conditions line item for warranty. Evergreen Construction Company included $10,400 for warranty repairs as shown in the expanded general conditions estimate on the eResource. During the final audit the amount of money in that line item will come up for discussion. Can the GC really completely close out the project if there is still money set aside for warranty? That money may be just the right amount, in which case there is not an issue. But if there is money left over after the warranty period, it should belong to the client; again contract and savings split issues will determine this. If the contractor requires more funds than estimated, then other savings which may have already been returned to the client during the close-out financial audit would be necessary to cover the short-fall. Open-book negotiated projects with a guaranteed maximum price have protected the client on the high side for cost over-runs, but line-item over- and under-runs within the contract are to be expected and are available for the contractor to manage. So if the contractor under-ran its door and hardware estimate line item by $9,200, but over-ran its waterproofing estimate by $8,800, the two would nearly balance out. The same could be said for warranty estimates. The contractor does not want to take a risk on a warranty cost over-run yet the owner does not want the contractor to realize a windfall profit if they under-ran that estimate as well. Usually a compromise is established and the contractor agrees to track those costs separately, as an allowance, and if there is a significant over- or under-cost occurrence, which can be substantiated with time sheets for labor and material invoices, then the two will agree to resolve it a year from close-out.

Final fee forecast

Once the final monthly pay request and retention checks have been received, and all of the subcontractors have been paid, the project manager and cost engineer must perform a final cost and fee forecast. With each of the monthly forecasts the PM was predicting what the final fee would be at the end of the project. As the project progresses past buyout and through the direct labor portion of the project, the PM should become more accurate and confident in his or her forecasts. The OIC and CFO rely on accurate forecasts from each project to add up to a total income projection for the firm for the fiscal year. If Evergreen's PM has been forecasting a fee of $1.2 million for 15 months, but now at the end of the job surprises the front office with a final fee of $900,000, they will not be pleased. Conversely if the PM was forecasting overly pessimistic and the project came in with a final $1.6 million fee, although the front office would be happier than the previous scenario, they still would not be pleased. Consistent income projections are used to negotiate bonding and banking resources and to report to equity partners. Had the home office known the project was going to come in with a larger fee, they may have made other business decisions such as increasing bonding capacity and securing more work, or leveraging their equity to purchase additional equipment or expand into another market. The home office does not expect the PM's monthly forecasts to be exact from month to month, and in fact if they were exact one would wonder if the PM was backing into the fee forecast. Variations are acceptable, as long as they are manageable and the jobsite team can explain them.

One additional aspect of close-out that is often associated with the final fee forecast is an internal lessons-learned report generated by the project team. This is a useful tool that can help better prepare individuals and the company for future projects, possibly with this client or architect, or possibly on similar types of work. The lessons-learned report is basically a self-diagnosis of 'what worked and what didn't and why, and what we can do better on the next job.' A powerful addition to that report is an assessment of the GC's subcontractors and suppliers. Other PMs and staff specialists such as estimators and procurement specialists can benefit from a candid report card on subcontractor performance.

As-built estimate development and database input

The as-built estimate should be maintained throughout construction or prepared near the completion of the project but not months after close-out. Considerable work went into tracking actual costs. This is valuable input to the construction firm's ongoing ability to improve its estimating accuracy. Input of the as-built estimate into the estimating database is necessary, if the database is to be kept current. Many project managers or jobsite cost engineers will simply input actual costs alongside of the original quantities to the company's database. This is better than no input at all, but the most accurate historical cost data is created by combining actual direct labor hours and actual material costs with actual installed quantities, as exhibited in the following examples:

Example Three:

Estimated: 120 kitchenettes @ 20 man-hours per each (MH/EA) = 2,400 MHs
2,400 MHs @ $39/hour (HR) = $93,600 labor cost
Spent: $88,000 to install 122 kitchenettes (missed two reception areas), therefore:
$88,000/$39/HR = 2,256 hours/122 kitchenettes = 18.5 MH/EA labor productivity

Example Four:

Estimated: 200 window blinds @ $200/EA = $40,000 material cost
Spent: $42,000 to purchase 190 blinds (no blinds in pool room), therefore:
$42,000/190 EA = $221/blind unit price to purchase

If actual material costs and hours had not been factored in with the actual installed quantities, the historical as-built database would have been skewed. The contractor's estimating database is a compilation of all of their past projects. If averages only are looked at in the database, then extremely expensive or economical projects or line items or cost codes may distort the average. For example, looking at the window blind example in Example Four, if the contractor had several projects which ranged in window blind prices from $150 to $250 per each, then they would feel comfortable with the $200 average. But if two projects were factored in which had wood slats and

Table 16.1 Estimating database

Evergreen Construction Company

Estimating Database

(Abbreviated)

Job Number:			*109*	*114*	*332*	*410*	
Project Type:			*Retail*	*Mid-rise*	*Middle*	*Spec*	
Category	*Cost Code*	*Units*	*T.I.*	*Apartment*	*School*	*Office*	*Average*
Buy 1 x 4 Fir Trim	062214	LF	$2.20	$1.80	$1.75	$4.00	**$2.52**
Install Kitchenettes	641100	MH/Unit		$20			**$20.00**
Bath Vanities in place	064110	Vanities	$1,010.00	$950.00	$1,110.00	$940.00	**$1,000.00**
Buy HM Door Frames	081213	Opening	$250.00	$235.00	$170.00	$240.00	**$215.00**
Buy Relight Glass Kits	081318	EA	$65.00	$60.00	$55.00	$60.00	**$58.33**
Install Wood Doors	081418	MH/Leaf	$1.00	$1.50	$0.85	$1.15	**$1.17**
Install Door Hardware	087100	MH/Set	$5.00	$1.00	$1.10	$1.25	**$1.12**
GWB and Metal Studs/Sub	091500	SFW	$9.00	$8.00	$5.50	$8.25	**$7.25**
Interior Painting in place	099000	SFW	$0.50	$0.50	$0.75	$2.50	**$1.25**
Buy TP Dispenser	102813	EA	$15.00	$18.00	$22.00	$20.00	**$20.00**
Install Mirrors	102800	MH/EA	$1.00	$0.50	$1.25	$0.75	**$0.83**
Purchase Window Blinds *	122000	EA	$250	$173	$225	$150	**$182.67**

* Note: Excludes motorized blinds on the retail project.

were motorized and cost $2,000 per window, then that would bring the average significantly up. The solution is to compute averages for all of the like-items and disqualify extremely high or low figures. Also the estimator who uses the database should scan down the types of projects to find one or two which are the most similar to the one being currently bid. A combination of these two procedures, and using some discretion to pick and choose material prices and labor productivity rates, will yield the most reliable estimate. Table 16.1 is a sample estimating database for various items which Evergreen might use when finishing or trimming out the Olympic Hotel case study.

Summary

Construction close-out requires completion of all construction work and preparing and submitting all documentation required by the contract to consider the project contractually complete. The project manager, cost engineer or cost accountant, and superintendent work closely together to ensure close-out procedures are comprehensive and efficient. Good close-out procedures typically result in higher contractor profits and satisfied clients. Physical completion of construction is the responsibility of the superintendent and management of close-out documentation and financial close-out is the responsibility of the PM and cost engineer.

As the project nears completion, the general contractor will schedule the client and design team to conduct a formal punch list walkthrough. Any deficiencies noted during this inspection

CHAPTER

17 Time value of money

Introduction

The concept of time value of money (TVM) is basically defined as follows: *the benefit of having a stipulated sum of money today is greater than the benefit of having the same amount of money in the future.* TVM is a connection between the importance of a positive cash flow for contractors which is enhanced by fair and timely pay requests and negotiating and being paid for change orders. TVM is a popular topic in the study of engineering economics.

This is an advanced cost accounting and financial management topic and is not necessarily project-based, but more chief executive officer (CEO) and chief financial officer (CFO) related. This topic is very relevant to project managers (PMs) and cost engineers, as it is important that the jobsite team understands that 'money costs money' and if a contractor needs to borrow money from the bank to pay their monthly labor and material invoices, they will be operating with a negative cash flow, or 'in the red.' It would be unusual to find a general contractor (GC) including the cost of a construction loan in their estimate. This can be validated by looking back at the jobsite general conditions estimate included in Chapter 5 as well as the expanded blank general conditions template included on the eResource. There is not a line item for a construction loan. The contractor has no intention of financing the project for its client. If a PM operates in the red and has a negative cash flow, they will quickly be receiving a phone call or visit from the CFO. A construction application of TVM is more relevant to larger construction projects with longer durations than smaller and faster projects.

These financial terms are often used synonymously but have slight variations in definition, particularly as related to TVM, including:

- Price: the amount that is or was charged;
- Cost: the amount that was paid, or given up;
- Value: the worth an object has to someone, not necessarily the price; and
- Worth: the value that someone else is willing to pay.

One important premise of time value of money is the concept of 'equivalence.' A study of TVM makes analysis of former, current, and future investments as financially equivalent as possible. TVM does not factor non-quantitative elements such as wants and wishes and personal preferences. This chapter will discuss present value, future value, interest, inflation, and other value considerations. The cost of money is also related to our next two advanced cost engineering chapters on taxes and real estate development. An understanding of TVM helps companies and individuals when analyzing their current and future investments.

Present value

Present value (PV) is the current worth of future cash given an established rate of return and a time period, usually in years. The PV formula is the basic formula behind all aspects of time value of money. The PV formula is comprised of four variables as listed in the following and is commonly represented as:

$$PV = FV/(1+i)^n$$

- Present value (PV) is the value of an investment today, at time zero;
- Future value (FV) is the value of today's investment at a future point of time;
- 'n' is the amount of periods, often in years, in the future; and
- 'i' is the assumed interest rate an investment is projected to earn.

Any of these variables can be solved if one knows values for the other three. For example, what is the present value of $105,000 which can be garnered one year from now at an interest rate of 5%?

$$PV = \$105,000/(1 + .05)^1$$
$$PV = \$105,000/1.05 = \$100,000$$

The present value formulas make use of algorithms – a math concept that we all learned in high school but most of us do not use in everyday life. There are many financial calculators, software systems, and electronic spreadsheets that now do most of the math for us, including several web services. It is easiest for us to use pre-established tables which resolve for most of the more common combinations of years and interest. An abbreviated PV table is included as Table 17.1.

The best way to learn these formulas and concepts is through examples and exercises. If you had won the lottery and had an option to receive an established sum of money today compared to $500,000 ten years from now, assuming an interest rate of 3%, how much would be your bottom-line settlement today? Obviously $1 or $10,000 is too low. Since money today is worth more

than money tomorrow, anything close to $500,000 today would be an easy decision to forego the payment in the future. The present value of this example is resolved as follows:

Table 17.1 Present value

What is today's value of $100 'n' years in the future at an assumed 'i' interest rate?									
n	*i - interest:*								
Years:	*1%*	*2%*	*3%*	*4%*	*5%*	*7%*	*10%*	*12%*	*15%*
1	$99	$98	$97	$96	$95	$94	$91	$89	$87
2	$98	$96	$94	$93	$91	$87	$83	$80	$76
5	$95	$91	$86	$82	$78	$71	$62	$57	$50
7	$93	$87	$81	$76	$71	$62	$51	$45	$38
10	$91	$82	$74	$68	$61	$51	$39	$32	$25
12	$89	$79	$70	$63	$56	$44	$32	$26	$19
15	$86	$74	$64	$56	$48	$36	$24	$18	$12
20	$82	$67	$55	$45	$38	$26	$15	$10	$6
25	$78	$61	$48	$38	$30	$18	$9	$6	$3
40	$67	$45	$31	$21	$14	$7	$2	$1	$0.40

$$PV = \$500,000/(1 + .03)^{10}$$
$$PV = \$500,000/1.35135 = \$370,000$$
Or using Table 17.1 as a shortcut: $500,000 x 74/100 = $370,000

Any sum greater than $370,000 would result in choosing today's money versus $500,000 ten years from now. Any sum less than $370,000 would result in foregoing today's payment and taking the $500,000 ten years from now.

Future value

An expected value in the future is 'discounted' to reflect today's value, assuming a positive return on investment or inflation rate. Essentially one dollar in the future is not worth as much as one dollar today; the future dollar is worth less than today's dollar, hence discounted. The FV formula is essentially an inverse of the PV formula and is reflected by the following:

$$FV = PV(1 + i)^n$$

An abbreviated FV table is included here as Table 17.2. A simple $1 million investment made today at 5% interest in 20 years would have a value of $2,650,000 as represented in the following formula. This also can be calculated simply from our table by multiplying $1,000,000 by 265/100.

$$FV = \$1{,}000{,}000(1 + .05)^{20} = \$2{,}650{,}000$$

Table 17.2 Future value

What is the future value of today's $100 in 'n' years at an assumed 'i' interest rate?									
n	*i - interest:*								
Years:	*1%*	*2%*	*3%*	*4%*	*5%*	*7%*	*10%*	*12%*	*15%*
1	$101	$102	$103	$104	$105	$107	$110	$112	$115
2	$102	$104	$106	$108	$110	$115	$121	$125	$132
5	$105	$110	$116	$122	$128	$140	$161	$176	$201
7	$107	$115	$123	$132	$141	$161	$195	$221	$226
10	$111	$122	$134	$148	$163	$197	$259	$311	$405
12	$113	$127	$143	$160	$180	$225	$314	$390	$535
15	$116	$135	$156	$180	$208	$276	$418	$547	$814
20	$122	$149	$181	$219	$265	$387	$673	$965	$1,637
25	$128	$164	$209	$267	$339	$543	$1,084	$1,700	$3,292
40	$149	$221	$323	$480	$704	$1,495	$4,526	$9,305	$26,786

In addition to calculating the future value of a stipulated sum, the concept of time value of money also considers FVs of an annuity. An annuity is an equal series of payments received over equal time periods. An annuity is also known as a uniform payment series. The PV and FV formulas discussed earlier are supplemented by an additional variable 'A' for annuity. For example, let's assume your great uncle left you a $1 million inheritance annuity. On the surface, an annuity paying $50,000 per year over a 20-year period appears to be worth $1 million. But actually a PV investment of only $670,000 made today at 5% interest would be equivalent to this annuity. Conversely if $1 million were invested today at 5% interest to fund this $50,000 annuity, it would last much longer than 20 years. In fact if maintenance or management costs of the investment firm holding the annuity were ignored, 5% simple interest would produce exactly $50,000 annually and the original investment would be self-perpetuating and last into infinity. There are many more advanced formulas and scenarios derived from the PV and annuity formulas that we will leave to another chapter for another day.

Interest

Interest is simply the *cost of money*. Interest explains why we have a study of time value of money. Interest is how much one party will pay another to use their money. When you put your money into a bank savings account, the bank will pay you interest, say 2%, to use your money. They then loan your money to your neighbor and charge your neighbor 4% to use 'their' money. Interest rates from banks and investors depend upon many factors including market rates, risk of the

borrower, the Federal Reserve Bank (FED) interest rate, the borrower's intended use of the money, alternative investments available, inflation, and others. The higher a developer or contractor's risk factor and potential for bankruptcy as determined by the lender, the higher will be the interest rate. There are many different ways to look at interest rates including:

- Simple interest rate,
- Compounding interest rate,
- Effective interest rate,
- Nominal interest rate,
- Annual percentage rate (APR),
- Annual percentage yield (APY),
- Adjustable rate mortgage (ARM),
- Variable payment rate, and others.

Because an understanding of interest is not always 'simple,' borrowers might be confused when they thought they had signed up for a 7% home mortgage interest rate, but actually ended up paying almost 7.5% because they were being charged interest on top of interest by the bank. This is known as *compounding interest*. In 1968 Congress passed the Truth in Lending Act which requires loan institutions to also report the total annual rate that borrowers will be paying. An abbreviated interest table, comparing both simple and compounding interest, is included as Table 17.3. Note that the compounding interest Table 17.3 is very similar to the future value Table 17.2.

Another popular concept in a study of finance and economics is the *rule of 70*, also known as the *rule of 72*. It may also be technically known as the rule of 69.3, but 72 works well for many variable combinations. This rule implies that money will double when the years of an investment are multiplied by the whole numeric interest rate that the investment is earning, accounting for compounding interest and the result is 72. The rule of 72 is mathematically shown in the following equation:

$$i \times n = 72 \text{ (or } 70 \text{ or } 69.3)$$

For example, money will double, or an investment will double when:

- 2% is invested for 35 or 36 years (2 x 35 = 70, or 2 x 36 = 72);
- 5% is invested for 14 years, or 14% for 5 years (5 x 14 = 70);
- 6% is invested for 12 years, or 12% for 6 years (6 x 12 = 72);
- 7% is invested for 10 years, or 10% for 7 years (7 x 10 = 70); and others.

We have introduced various financial ratios throughout this book on cost accounting and financial management. The interest rate is an important contributor to many of these ratios for an investor or developer who focuses on their return on investment (ROI), return on equity (ROE), or rate of return (ROR). Simply put, investors would forego spending their own money today for the opportunity of more money tomorrow. They like to have their 'money working for them,' essentially 'making money off of money.'

Table 17.3 Simple and compounding interest

If $100 was invested today at 'i' interest rate, how much would it be worth in 'n' years?									
Simple Interest									
i	*n - years:*								
interest:	*1*	*2*	*3*	*4*	*5*	*10*	*15*	*20*	*25*
1%	101	102	103	104	105	110	115	120	125
2%	102	104	106	108	110	120	130	140	150
3%	103	106	109	112	115	130	145	160	175
4%	104	108	112	116	120	140	160	180	200
5%	105	110	115	120	125	150	175	200	225
7%	107	114	121	128	135	170	205	240	275
10%	110	120	130	140	150	200	250	300	350
12%	112	124	136	148	160	220	280	340	400
15%	115	130	145	160	175	250	325	400	475
Compounded Interest									
i	*n - years:*								
interest:	*1*	*2*	*3*	*4*	*5*	*10*	*15*	*20*	*25*
1%	101	102	103	104	105	110	116	122	128
2%	102	104	106	108	110	121	134	148	163
3%	103	106	109	113	116	134	155	180	209
4%	104	108	112	117	122	148	180	219	266
5%	105	110	116	122	128	163	208	265	338
7%	107	114	123	131	140	196	275	386	541
10%	110	121	133	146	161	259	417	672	1082
12%	112	125	140	157	176	310	546	962	1695
15%	115	132	152	175	201	404	813	1635	3289

Public clients, such as the City, borrow money from private investors in the form of bonds. These are different from bid bonds and performance and payment bonds that are part of construction estimating and contracting. If the City wants to build a new library or fire station or elementary school, or improve its roads, it will generate capital in one of a few ways:

1. Pass a bond which increases property taxes, such that the public pays for the new construction project. The taxpayers get to vote on whether they feel the investment is for the general 'public good' and they are willing to pay their share.
2. Sell bonds to private investors, essentially borrowing money from the bond holders at an agreed interest rate, say 5% for a set period of years, such as 30 years.
3. Enter into a public-private-partnership (PPP) where a private developer finances, designs, and builds the project and leases it back to the City.

Inflation

Inflation is factored into many financial studies, and although many economists focus their whole careers on making these predictions, it is not pure science as no one 'knows' exactly what the inflation rate will be next year. Inflation generally represents that *prices will increase in the future.* A consumer's purchasing power is progressively and systematically reduced by inflation. The United States Treasury and the FED work to stabilize the economy to avoid excessive spikes in interest and inflation rates. Table 17.4 reflects historical inflation rates in the United States for the past several decades. Inflation has considerably stabilized since the 1980s when we saw inflation rates exceeding 12%.

Inflation (f) variables can be substituted for interest in our present value and future value equations as shown in the following. Any of these variables can be resolved for separately the same as was discussed earlier with PV and FV. Inflation undercuts the effect of interest. If you received 2% interest on the savings account certificate of deposit your grandmother gave you for your college graduation, but inflation is 3%, you would be losing money by leaving it in the bank.

$$PV = FV/(1 + f)^n$$
$$FV = PV(1 + f)^n$$

Table 17.4 United States historical annual inflation rates

Year	*Rate*
1970	5.6%
1975	6.9%
1980	12.5%
1985	3.8%
1990	6.1%
1995	2.5%
2000	3.4%
2005	3.4%
2010	1.5%
2011	3.0%
2012	1.7%
2013	1.5%
2014	0.8%
2015	0.7%
2016	2.1%

Inflation is difficult to factor into construction estimates both by contractors and by project owners. If contractors include an inflation factor into a competitive lump sum bid project, they likely would not be the successful bidder as their competition would have either not included an inflation factor or included a lower one. It is commonplace for contractors to insert a clause in a negotiated contract protecting them from labor and material price escalations and passing that risk on to project owners. Project owners do not receive inflation exclusion clauses very well and an attempt by a contractor to change order for price increases as a result of inflation often ends up as a claim or project dispute. Contract clauses such as 'adjusted for inflation' are common risk mitigation methods for buyers and sellers in all aspects of life, not just construction.

Banks will offer a borrower a fixed 30-year mortgage with a 5% interest rate such that the home owner will have exactly the same payment (with a different mix of principle and interest amounts) over the life of the loan. But an adjustable rate mortgage may be offered as well at 4%, which can be 'adjusted for inflation' which allows the bank to slowly increase the interest, often with a cap such as 2% above the initial rate.

Other value considerations

There are many value considerations in a study of cost accounting and financial management relevant to project managers, cost engineers, and CFOs. This chapter has focused on time value of money, specifically present value and future value. In this section we briefly introduce a few additional value considerations, many of which also connect with previous chapters in this book covering cash flow, pay requests, and change orders and upcoming advanced chapters on taxes and pro forma.

Economy of scale is similar to an economic study of diminishing marginal returns; the first scoop of ice cream was great, but the fourth not necessarily so. For example, a small boutique hotel which has 30 rooms on two floors costs considerably more per hotel room to build than a five-story hotel with 120 rooms. If the fixed costs of an elevator, restaurant, and swimming pool were factored in, and both the two-story and five-story hotels had these same facilities, this would amplify the construction unit price cost if figured on the count of hotel rooms. The construction estimator needs to consider economies of scale when applying unit pricing to concrete and doors and other direct work items. It costs much more per cubic yard (CY) to place 10 CY of concrete in one day versus 100 CY. This easily applies to quantity of garage stalls as well; the larger the quantities, the more economical are the unit prices.

At some point a larger hotel plan would require an additional restaurant and an additional elevator, or in the case of a parking garage, an additional underground floor. These major additions are stepped cost increases. This is a similar concept to fixed and variable overhead costs discussed in Chapter 6. An investor must consider *sunk costs* when adding money to an initial investment. When the original investment is 'sunk,' it is gone and it cannot be recovered. Additional investments may enhance the investor's ability to recover the initial investment, but are not guaranteed to do so. An investor, including a real estate developer, may be faced with the dilemma of walking away from their original investment to avoid the old adage of 'pouring good money after bad.'

Another popular financial concept is the *cost recovery period*, or *payback*. An investor will put money into a building, such as improved mechanical equipment or new windows or insulation, if resulting savings in energy and utility costs will pay back that investment in a given period of time,

often seven years. If it takes longer to pay back the investment, then the developer often passes on the increased construction cost. If it is less than or quicker than seven years, then the developer may choose to invest in capital improvements today.

As stated, contractors do not typically factor a construction loan or interest on a loan in their estimates. But this may not be the case with subcontractors. As discussed in Chapter 13, 'Cash flow' and Chapter 14, 'Payment requests,' subcontractors are *paid after the GC is paid* and may be out-of-pocket two months before they are paid; and third-tier subcontractors even longer. Essentially subcontractors are used as a means for temporary construction financing by the project owner. This is why it is important that general contractors check subcontractors' financial strengths when they are evaluating awarding a contract to a 'best-value' subcontractor and not necessarily a low bid. An understanding of time value of money also re-enforces a contractor's interest in *front-loading* their pay request schedule of values so they are operating 'in the black' and using the owner's money and not their own.

Developers and contractors often prepare early budget estimates to assist with a variety of financial decisions. If design documents are preliminary, they may rely on facility dollars per square foot of floor ($/SF) *database pricing* published in sources such as RS Means. But although there are thousands of prices in any typical published database, they are national averages and are not specific to any one project or location. For example, if Evergreen Construction Company (ECC) or their client had used a published database they may have developed a budget for our case study project of:

Hotel:	100,000 SF @ $140/SF =	$ 14,000,000
Garage:	52,000 SF @ $60/SF =	$ 3,120,000
Total Project:		$ 17,120,000

But our case study project does not exactly fit the national average; no project really ever is 'average.' ECC's contract price is $24.5 million which is considerably higher than this budget. It was to be built approximately 100 miles north and west of Olympia, Washington so a location modifier of 1.05 (or an additional 5%) needs to be added just for Olympia and even more for a remote suburban area. The average database sizes for a hotel and garage are based on 50,000 SF and 160,000 SF respectively, but our case study project is different and therefore additional size modifiers need to be applied. This is because of an economy of scale as discussed earlier. If another database was to have been used, either an older one (published prices would be lower as explained in present value and future value earlier) or a future database edition (prices would be higher) then an additional TVM modifier would be necessary as well. Incorporation of all of these modifiers would adjust the budget to slightly greater than $20 million and closer to ECC's contract value.

Summary

Although a thorough knowledge of time value of money is typically relevant to a contractor's CEO and CFO, it is also important for a jobsite project manager and cost engineer to have a basic understanding. Money costs money, and if a project owner makes a late payment or negotiations are slow