

Project Cost Management

PMG 213

Lecture 9

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Time and Cost Change Management &
Impact of cost-estimation changes on project



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Second: Time and Cost Change Management will be covered through the following ideas:

2. Change Order

2.1 Change order sources

2.2 Change order proposal process

2.3 Change order proposal pricing

2.4 Negotiations and approvals

2.5 Incorporation into cost control and accounting control systems

2.6 Summary

Third: Impact of cost-estimation changes on project: will be covered through the following ideas:

3. Cash flow

3.1 Cash flow curve process

3.2 Cost loaded schedule

2.2 Change order proposal (COP) 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.

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.

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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.

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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.

COPs should include at least the following:

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- 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.

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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.

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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.

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Example 1: 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 2: 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.

2.3 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.

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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.

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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.

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As discussed, 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.

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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.

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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.

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Example 3 : General Conditions vs. Claims in Change Orders:

The owner delayed a school project by one month due to an interior design change. The contractor submitted a COP demanding the extra material costs plus an extra month of site security and office trailer rentals (Jobsite General Conditions). The owner rejected the extra general conditions as contentious. Because they could not agree, this dispute escalated into a formal contract claim requiring a dispute resolution process

2.4 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.

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.

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2.5 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.

2.6 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 maintains a COP log to track all COPs whether generated by the client, GC, or subcontractors. Once the GC and the client have negotiated a mutually agreeable adjustment in contract price and time, a formal change order is executed modifying the contract. A claim differs from a COP or contract change order in that it is a request for time and/or cost by the contractor, and the client has not yet agreed to accept, and will be resolved according to the dispute resolution process defined in the prime contract agreement. The most efficient way to process and attain approval for change orders is clear and timely communications between the parties, completely open-book accounting, fair pricing, and good bookkeeping at the jobsite level.

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Third: Impact of cost-estimation changes on project:

3. Cash flow:

Even though many construction management tools have changed, there is one tool that project owners have used with general contractors (GCs) and GCs likewise with subcontractors for hundreds of years, and will continue to do so into the future, and that is cash.

Project owners also have the next potential contract as a tool to use with GCs, and GCs do the same with subcontractors, but without cash, contractors will realize financial difficulties and potentially suffer bankruptcy. Cash for this discussion is not necessarily actual dollar bills and coins but a positive flow of money through the bank.

In fact, very few contractors will deal in hard currency and those that do may be trying to avoid various taxes. Even contractors who report profits, have a good reputation for quality work performed safely, and bring their projects in on time may still have financial difficulties if they are not being paid on time and do not have a positive cash flow. The lack of a good positive flow of cash has an even greater effect on subcontractors and suppliers, especially those which are subcontractors to subcontractors and are far removed from the client and the bank. The lack of cash flow is likely the single most common reason for contractor failures.

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3.1 Cash flow curve process:

A cash flow curve is a projection of the total value of the work to be completed each month during the construction of the project. It is created by cost loading the schedule and plotting the total monthly costs. Often, it is one of the first things the owner will ask of the project manager and may be required by the construction contract. One reason this is required is to provide information to the bank for anticipated monthly payments. Some PMs resist on the basis that the curve will be wrong and that they may be penalized for it. The most important thing a PM does is to get paid from the owner for the work that has been completed on the project.

3.2 Cost loaded schedule:

The cash flow curve is easy to prepare and begins with the development of a cost loaded schedule. Development of the cost loaded schedule by the estimator or cost engineer starts with a summary schedule and a summary estimate. Detailed versions of these may be helpful to prepare the cost loaded schedule but schedules and estimates that are overly detailed with hundreds or thousands of line items might be cumbersome. Schedules and summary estimates with less than 25 activities are probably too few and 40–50 activities would be ideal.

Anything with over 100 would still be usable, but potentially unnecessary. The list and description of the activities on both the summary schedule and the summary estimate should more or less be similar. The best method to explain development of a cost loaded schedule is with a set of step-by-step instructions as follows:

1. Start with an Excel spreadsheet. List direct work activities down the left side of the sheet. Add the cost of those activities in the next column. Add a subtotal row below the direct work activities and add the costs vertically down. Verify that this subtotal cost matches the subtotal cost from the summary estimate. Some of this may be cut and pasted from the summary schedule or pay request schedule of values (SOV).
2. Across the top of the Excel spreadsheet list the months from the construction schedule or weeks for a short duration project.

3. Take the estimated costs for each direct work activity and spread them according to when the activities will be complete. Following are four examples of how direct costs might be spread:

- a.** If the foundations are worth \$90,000 and will be spent in May, then put \$90,000 in May adjacent to the foundation line.
- b.** Structural steel installation, estimated at \$270,000, occurs in months six and seven and can be split evenly at \$135,000 for each month.
- c.** Assume the exterior skin is worth \$720,000 and will start in the middle of December and work continues through January and February and overlaps into March. It is suggested that the costs be pro-rated as:

16.67% – 33.3% – 33.3% – 16.67%

This approximately equates to \$120,000 for December, \$240,000 in January and December each, and the last \$120,000 in March. Exact estimates and dates are not necessary as this is not an exact science. It may be easier and just as accurate at the end of the day to round all these percentages and dollars to the next whole digit. Do not use cents in any of these calculations.

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d. Ten percent of the \$1.2 million plumbing subcontract is attributed to month two for under-slab rough-in, 50% occurs over a three-month span when wall and ceiling rough-in are scheduled, and the balance during the last couple of months of the project for trim and testing. This proportions out as:

\$120,000 – \$200,000 – \$200,000 – \$200,000 – \$240,000 – \$240,000

If there is a slight adjustment to be made for any of the work line items, do so in the last month.

4. Total the spread of direct work items down for each month.
 5. Add a row at the bottom of the sheet below the direct work subtotal row for jobsite general conditions. The general conditions may be spread or proportioned in one of three different fashions:
 - a. Evenly spread the general conditions the same amount for each month.
 - b. Proportionately spread the general conditions such that if the general conditions amount to 6.8% of the total direct work estimate, attribute 6.8% of the subtotal direct work tally for general conditions across the page.
- Options 'a' and 'b' are both easy to compute and easy for a client to understand and accept, but neither will be completely accurate.

c. Calculate approximately how much of the jobsite general conditions will be spent for each month. Most projects realize more general conditions at the front end and the back end of the project, due to activities such as mobilization, buyout, and close-out, and a more even spread during the middle of the project. This is subjective and difficult to forecast accurately as well.

6. There cannot be too many sets of subtotals to keep the costs straight. Add a column on the far right-hand side of the schedule and add each of the direct work activities across the sheet. This set of totals should equal the original estimates from the far left-hand side of the sheet which were brought forward from the summary estimate. If there is a mistake, correct this now. If slight adjustments are necessary, make them either in the first or the last month that an activity occurs.

7. Add another subtotal row below the spread of general conditions and add the total direct costs to general conditions.

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8. Add another row (or more) for markups. All the markups can be grouped together such as labor burden, fee, insurance, contingency, taxes, and others. Calculate the percentage all these markups are of the subtotal for direct and indirect costs. Use this percentage to pro-rate the markups across the sheet to the right. Labor burden may be split out separately on projects which have a large amount of direct labor which often occurs early in the project. Most clients will accept a pro-rata share of markups be invoiced the same way this schedule is being prepared.

9. Add a total row below the markups and add the subtotal direct and indirect costs to the markups. This total in the column on the far left-hand side of the sheet and that on the far right-hand side of the sheet should equal the contract total. If they aren't exactly, go back and correct the error.

The cost data that is now summed at the bottom of the schedule for each month should reflect the anticipated monthly project expenses. Most of the scheduling software programs can prepare an 'exact' schedule of values with input of the detailed estimate, but again the line items must be exactly coordinated.

The computer will not do the logical thinking associated with spreading the estimated costs, but rather just perform the math. The likelihood of the general contractor being billed by each material supplier and subcontractor according to any anticipated schedule is somewhat remote.

The contractor would not normally provide the client or the bank all the detail on this cost loaded schedule; rather they would list just the monthly total figures from the bottom row.

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Cost loaded schedule

Evergreen Construction Company
Olympic Hotel and Resort, Project #422



COST LOADED SCHEDULE

3/31/2019

\$ X 1000:

Item	Description	Cost	Qtr 2, 2019	Qtr 3, 2019	Qtr 4, 2019	Qtr 1, 2020	Qtr 2, 2020	Qtr 3, 2020	Totals
3	Concrete	\$4,826,612	3000	1827					\$4,826,612
4	Masonry	\$150,000				150			\$150,000
5	Structural and Misc. Metals	\$411,103		411					\$411,103
6.1	Rough Carpentry	\$2,223,633		1000	1224				\$2,223,633
6.2	Finish Carpentry	\$895,560					896		\$895,560
7.1	Insulation	\$182,257				82	100		\$182,257
7.2	Roof and Accessories	\$573,638			200	374			\$573,638
7.3	Waterproofing	\$484,333			100	200	184		\$484,333
7.4	Sheetmetal and Flashing	\$154,586				100	55		\$154,586
8.1	Doors and Frames	\$390,720			150	150	91		\$390,720
8.2	Windows and Storefront	\$720,920			200	521			\$720,920
8.3	Door Hardware	\$173,300			75	75	23		\$173,300
9.1	Drywall	\$1,283,000				500	783		\$1,283,000
9.2	Painting	\$390,723				150	150	91	\$390,723
9.3	Floor Covering	\$663,343					400	263	\$663,343
10	Specialties	\$157,085					57	100	\$157,085
11	Equipment and Furnishings	\$355,237				100	155	100	\$355,237
14	Elevator	\$435,000	100			100	200	35	\$435,000
21	Fire Protection	\$442,700			100	143	200		\$442,700

22	Plumbing	\$1,211,379			400	400	300	111	\$1,211,379
23	HVAC and Controls	\$720,629			100	300	300	21	\$720,629
26	Electrical Systems	\$1,286,702	200	200	200	300	300	87	\$1,286,702
27	Low-Voltage Electrical	\$332,500					200	133	\$332,500
31	Excavation and Backfill	\$285,500	186	100					\$285,500
32.1	Paving	\$205,550					206		\$205,550
32.2	Walks and Misc. Site work	\$240,990					241		\$240,990
32.3	Landscaping	\$75,000					75		\$75,000
33	Site Utilities	\$621,271	300			200	121		\$621,271
	Subtotal Direct Costs:	\$19,893,271	\$3,786	\$3,538	\$2,749	\$3,845	\$5,037	\$940	\$19,893,271
	Labor Burden (Spread Evenly)	\$1,074,287	179	179	179	179	179	179	\$1,074,287
	Jobsite General Conditions (Even)	\$1,662,783	277	277	277	277	277	277	\$1,662,783
	Subtotal Direct and GCs:	\$22,630,341	\$4,242	\$3,994	\$3,205	\$4,301	\$5,493	\$1,396	\$22,630,341
	Fee and % Markups (Proportionate)	\$1,899,674	356	335	269	361	461	117	\$1,899,674
	QTR Total, Excluding Tax:	\$24,530,015	\$4,598	\$4,329	\$3,474	\$4,662	\$5,954	\$1,514	\$24,530,015
	Cumulative Totals:		\$4,598	\$8,927	\$12,401	\$17,062	\$23,016	\$24,530	\$24,530,015



Thank You