Changes during most construction projects are inevitable and can lead to cost and schedule overruns. Effectively managing these changes can significantly reduce the risk of disputes and claims that often result in costly litigation. This article examines the various approaches to change management currently used in the industry and summarizes some of these practices. In addition, a case study involving the construction of a power plant impacted by a force majeure event that delayed the shipment of the major equipment for more than six months is discussed. Impacts to the project were tracked on a contemporaneous basis in order to efficiently quantify cost and schedule impacts for change order negotiations with the owner and for insurance recovery purposes. Some of the means and methods used on the project to track the impacts, including out-of-sequence work, winter conditions, stacking of trades, and others, are addressed in this article. The authors first presented this manuscript as CSC.607, at the 2011 AACE International Annual Meeting in Anaheim, CA.

Key Words: Claims, change orders, construction, cost, risk, and schedules

Changes during most construction projects are inevitable and can lead to cost and schedule overruns. Effectively managing these changes can significantly reduce the risk of disputes and litigation. This article examines the various approaches to change management currently used in the industry and summarizes some of these practices.

In addition, a case study involving the construction of a power plant is discussed. Construction of the plant was impacted by a force majeure event that delayed the shipment of the major equipment for more than six months. Impacts to the project were tracked on a contemporaneous basis in order to efficiently quantify cost and schedule impacts for change order negotiations with the owner and for insurance recovery purposes. Some of the means and methods used on the project to track the impacts, including out-of-sequence work, winter conditions, stacking of trades, and others, are addressed in this article.

Defining Change

On many construction projects of varying size or type, changes often occur. Changes on a construction project occur when the scope of work performed differs from the scope of work outlined in the contract documents. Examples of common changes encountered on construction projects include the following:

• addition or deletion of scope;
• changes to the project duration;
• revisions to material type and specifications;
• drawing and specification errors and omissions;
• late or defective owner-furnished material;
• differing site conditions;
• equipment procurement and manufacturing issues;
• force majeure; and
• contractual non-compliance by the owner.

Changes to a construction project can be defined in many ways, including being generally categorized into three broad categories:

• directed changes;
• constructive changes; or
• cardinal changes.

Directed changes are changes typically issued by the owner or its representative that are often written as
formal change orders [2]. As such, the owner recognizes directed changes as changes to the contract documents [10]. Examples of directed changes include the addition or deletion of scope and revisions to material specifications.

In contrast, constructive changes are typically defined as acts by the owner or its representative that are not directed changes but which still require the contractor to perform work different from that required by the contract documents [5]. Examples of constructive changes include performance interference by the owner, and untimely responses by the owner to contractor submittals, among others.

Cardinal changes are typically changes which require the contractor to perform work that was not contemplated by the parties when they entered into the contract and is fundamentally different from the scope of work outlined in the contract documents [5]. For example, the deletion of a large portion of a contractor’s scope of work by the owner could constitute a cardinal change.

Summary of Change Management Approaches Being Used Within the Construction Industry

Effectively managing changes on a project can significantly reduce the risk of cost and schedule overruns, which oftentimes result in disputes and claims. Implementation of change management processes can aid in the effective management of change.

Currently, there are no widely accepted industry standards related to change management processes; however, numerous organizations and individuals have recommendations on change management processes. The following publications are just a few examples:

- Project Change Management by the Construction Industry Institute [4];
- AACE International’s Professional Practice Guide to Contracts and Claims, which includes a number of AACE International Transaction papers with titles such as, Project Trends and Change Control, Change Management for Today’s Projects – A Process Approach, and Effective Management of Project Change Orders [11];
- Change Management Best Practices for the Engineering and Construction Industry by Oracle [10]; and
- Proving and Pricing Construction Claims by Robert F. Cushman, Craig M. Jacobsen, and P.J. Trimble [2].

AACE International does not have an existing Recommended Practice for change management processes, perhaps highlighting the difficulty of establishing a widely accepted change management industry standard. One challenge is that there is no one specific change management process that is most beneficial and appropriate for all types of construction projects. Each project has its own unique set of facts and circumstances which may make standardization difficult, examples of which are discussed below.

The methods and procedures used for managing changes can vary based upon the type of construction contract. Detailed support of a change and its impact to the project may be more beneficial on a lump sum or fixed price contract compared to a cost-plus contract.

Additionally, the standard contract documents used in the construction industry include various methods for managing change. For example, the standard AIA documents and ConsensusDOCS documents each include language related to change, including sections on change orders and interim directed changes. However, the methods and procedures for managing change differ between each [6, 8].

Variances in the size, length, and complexity of a project can also be a factor in how change is managed. For example, a large, multi-year project with multiple contractors, subcontractors, architects, engineers, and other consultants may use a robust change management process that can electronically track changes, notify and coordinate the change among the parties, update the project schedule, and track the cost and schedule impacts going forward through the completion of the project.

At times, large, complex projects may require multiple people fully dedicated to tracking and managing change. This detailed process may require additional resources and is less likely to be fully employed on projects of smaller scale and scope.

As demonstrated by these few examples, there may not be one specific change management methodology that is appropriate for all construction projects. However, despite the differences that exist between the scenarios mentioned above, each of the change management methodologies reviewed include certain underlying consistencies and commonalities among the alternative approaches.

Summary of Practices to Change Management Processes

As explained above, there are numerous approaches to change management currently being used within the construction industry. The following change management process summarizes some of the practices from these various approaches and outlines the steps that can be taken to effectively manage change on a construction project:

- Address potential changes in the contract documents.
- Identify the potential change.
- Create a proposed change order and document the proposed change.
- Review and evaluate the proposed change order timely.
- Execute the change order. And, document the executed change.

Address Potential Change in the Contract Documents

Effective management of change begins prior to the commencement of construction on a project. The first step in the change management process is to address change in the contract documents.

As mentioned above, standard AIA documents and ConsensusDOCS documents each include language related to change and change management. In addition to this standard language, consider including in the contract well-defined processes to deal with change as explained below.
Changes Clause

The changes clause in a construction contract allows for changes to the scope of work and allows the contractor an equitable adjustment to the contract price or schedule as a result of a change [2]. This clause defines the process which both parties should undertake when a change is recognized.

For example, the changes clause typically defines the timeframe for which the contractor should notify the owner of the change, the timeframe for which the contractor should provide a cost and schedule estimate to the owner for the changed work, and in some instances, the timeframe for which the owner should review the contractor’s estimate and respond to the contractor [2].

The changes clause also typically outlines the means and methods of how the contractor should calculate changes on a lump sum basis, a time and material basis, or on a cost plus fee basis.

In addition, the changes clause sometimes identifies the parties who are authorized to make changes to the contract [2]. For example, the ConsensusDOCS outline a change process whereby change orders can be either directed by the owner or requested by the contractor [8]. The AIA documents require that the owner, contractor, and architect approve changes to the contract [6].

Dispute Resolution Clause

In addition to the changes clause, the contract documents often also include a dispute resolution clause which defines the steps the parties should undertake if they cannot successfully negotiate a change.

For example, the 2007 AIA contract documents outline a dispute resolution process that begins with an initial decision maker (the architect on the project unless the parties appoint another individual) who can request additional information, reject the claim, approve the claim, or suggest a compromise [7].

Following the decision of the initial decision maker, the parties can mediate the claim [7]. If mediation is unsuccessful, the contract language allows the parties to select the binding dispute procedure (e.g., arbitration, litigation, or some other method) [7].

Similarly, the ConsensusDOCS contract documents outline a dispute mitigation and resolution process whereby project personnel first attempt to resolve the dispute [9]. If these negotiations are unsuccessful, discussions between senior executives from each party take place in a further attempt to resolve the dispute [9]. If these attempts also fail, the parties can go before a project review board, a project neutral, or attend mediation [9]. If the claim remains unresolved, the parties then have the option to either litigate or arbitrate the claim [9].

Clearly defined change management processes, including what to do if the parties cannot reach agreement on a change, are often included in the contract documents in order to prevent disputes and claims and aid in the overall success of a project.

Identify the Potential Change

The second step in the change management process is to identify a potential change and correctly classify the type of change according to the contract documents [10]. Early identification of a potential change helps the parties to ensure that the contract provisions related to the particular type of change is followed and that the contract requirements have been fulfilled.

Create a Proposed Change Order and Document the Proposed Change

Next, a proposed change order should be created. Each proposed change order should be given a unique identification number and a log should be created in order to track the following:

- proposed change order number;
- description of proposed change;
- date of submittal;
- date of owner approval/rejection; and
- other relevant information.

Documentation supporting the proposed change, including project correspondence, project schedules, or other contemporaneous records often accompanies the proposed change order when available.

The proposed change order should clearly state the reason for the proposed change, as well as quantify the cost or schedule impacts of the proposed change. For example, in the instance of added work, the proposed change order often includes a price for all added work including direct costs and indirect costs (e.g., labor, material, equipment, contractual markups, and any time-related costs incurred because of schedule delay as a result of the change) and any requested schedule extension.

There are multiple methods for determining the cost and/or schedule impacts resulting from a change to the project. Many times the owner and contractor agree on a method to price the change prior to the performance of the work. Other times, the contractor and owner may not agree on the appropriate method or cost until after the work is completed. Generally speaking, discretely tracking the cost and schedule impacts will lead to a greater likelihood of recovery [2].

In order to discretely capture the costs associated with the proposed change, a unique cost code is often created. This allows the contractor to more accurately price and track the costs of the change order.

To help ensure that the actual costs associated with the change are captured accurately, field personnel should be notified of the new cost code. Afterwards, cost reports and time sheets should be reviewed to verify the new cost code is being properly used.

In addition, the project schedule can be updated to reflect and discretely track the change ordered work if the change impacts the schedule. Not only is accurate cost and schedule data important when pricing the change order, but it is also important if the change order is not approved and the contractor needs to pursue a claim.

By discretely tracking the cost and schedule impacts, the actual historical costs will have been collected and segregated in a manner that is preferred.
by the courts [2]. If all of the costs associated with the change cannot be quantified at the time the proposed change order is created, the contractor can often reserve its rights to submit these costs at a later date [1].

According to AIA Best Practices – The Proposed Change Order Process, a construction change directive is issued rather than a proposed change order if the contractor believes, “a change is necessary to maintain the project schedule [3].” Often times, because of the criticality of time, the cost of the change, and any associated time extension required as a result of the change, cannot be determined at the time of issuance. Instead, the contractor often requests that the changed work be priced on a time and materials basis. A similar process to the one outlined above should be used to document the change.

**Review and Evaluate the Proposed Change Order Timely**

Next, the proposed change order is issued to the architect, subcontractors, or other relevant parties for their review. Suggested changes to the proposed change order should then be reviewed by the contractor and incorporated into the proposed change order if necessary.

The revised proposed change order is then issued to the owner per the processes outlined in the contract documents. The owner should perform a detailed review and evaluation of the change documents in order to assess the impact of the change.

Many times this evaluation is performed in concert with the architect/engineer for the project. The owner typically evaluates the contractor’s entitlement to recover additional costs or time by determining whether or not a change has occurred and if a remedy for the change exists in the contract documents.

If the owner determines that the contractor is entitled to recover costs and/or time associated with change, the owner often measures the effect of the change by calculating the additional costs and/or time extension required as a result of the change. These calculated impacts can be compared to the impacts quantified in the proposed change order.

**Execute the Change Order**

Once all parties have reviewed and evaluated the proposed change order, negotiations between the parties typically take place in an attempt to execute the change. If the parties can agree to the terms of the change, a change order is created. The change order should be dated, be assigned a unique number, and include a detailed description of the change including the revision to the contract price and/or duration. Similar to the proposed change order, the change order should also include relevant documentation supporting the change. This could include drawings, correspondence, and other contemporaneous documentation. Typically, the contractor and the owner sign the change order as an acknowledgment by both parties that the original contract documents have been modified. The AIA documents also require the architect’s approval [6].

If the negotiations between the parties are unsuccessful and an agreement cannot be reached regarding the cost and schedule impacts of the change, the parties typically refer to the dispute resolution clause outlined in the contract documents.

**Document the Executed Change**

After the change order is executed, the change should be properly documented. A change order log should be created that tracks the following:

- change order number;
- corresponding proposed change order number;
- description of the change;
- cost of the change;
- modified contract amount;
- time extension associated with the change;
- parties involved in approving the change;
- change order submittal date; and, change order approval date by each party.

Proper record keeping allows change ordered work to be effectively tracked on an individual basis, as well as on a cumulative basis. It also generally allows for more effective project management. In addition, the change order log is a useful tool should claims arise on a project. It not only tracks both agreed upon and disputed changes to the contract, but it also documents adherence to contractual obligations including, for example, the time it takes for the owner to respond to the change order.

**Case Study**

The following case study provides an example of a construction project that was impacted by a force majeure event during the construction phase, which resulted in numerous changes to the project. The change management process used on the project and the efforts undertaken to contemporaneously monitor and track the cost and schedule impacts are explained below.

**Case Background**

The project involved the design and construction of a gas fired combined cycle electric power plant. The owner hired a firm to engineer, procure, and construct the power plant.

The project was proceeding along slightly ahead of schedule approximately one third of the way through the construction phase when a force majeure event occurred. Some of the major equipment was procured and manufactured overseas.

The equipment was in route via a cargo ship when the ship encountered a typhoon. The equipment broke loose on board and was tossed about in the storm. The equipment was severely damaged or completely destroyed. Much of the equipment had to be rebuilt or repaired. As a result, the equipment was delivered to the project approximately six months late.

At the time of the typhoon, the equipment that was in transit was on the critical path for the completion of the project. The contractor immediately notified the owner, the manufacturer of the equipment, and the insurance carriers of the problem.
Two types of insurance were involved. First, the equipment was insured via cargo insurance that insured the “cargo” while in transit. Second, the contractor’s builders’ risk insurance was also put on notice of the pending impacts to cost and schedule. It was not known which of these parties would ultimately pay for the cost impacts caused by the typhoon, but it was clear that the contractor was still responsible to finish the project.

Impacts Caused by Change

As a result of the anticipated six month delay in receipt of the critical path equipment, the contractor recognized that the as-planned sequence and timing of the installation of the equipment was no longer valid. The contractor explored and analyzed various options on how to proceed, including delaying the project in order to maintain the as-planned construction sequence.

However, the contract with the owner contained a liquidated damages clause requiring the contractor to pay damages to the owner if the power plant was not brought on line in time for the high electricity demands of the summer months. As a result, the contractor elected to implement numerous mitigation efforts to minimize the delay of the completion of the project and accelerate the construction after the delayed equipment arrived. All of the involved parties were informed of the options considered and the chosen approach.

The delay in equipment arrival caused numerous changes and impacts to the project including the following:

- **Weather Impacts**—Much of the work was planned to be performed in the summer and fall, but because of the delay, a majority of the work was actually performed in the winter months. The project was located in the US midwest and all work was outdoors. As a result of the cold weather, the craft labor was less efficient than they would have been had the work been performed as-planned during warmer months.
- **Out-of-Sequence Work**—Because of the delay, the sequence of the work had to be changed. Work that could be completed while waiting for the damaged equipment to be reshipped was performed. However, work was performed in a less efficient manner as a result.
- **Stacking of Trades**—The original plan was to have only one trade working in an area at a time. For example, boilermakers would first finish their work, then the pipefitters, then the electricians, and so on until the work was completed. However, as a result of the delay, numerous trades were forced to work in the same area simultaneously. This impacted labor productivity and caused inefficient use of cranes and lifts.
- **Additional Overtime**—The original plan included limited use of overtime, but the delay caused overtime to be used extensively after the late equipment arrived.
- **Extended Time Related Costs**—Certain costs such as equipment rental, project personnel, and site office costs were extended because of the delay caused by the late shipment of the damaged equipment.

Discussion of Change Management Process Used to Track Impacts to the Project

The contractor recognized early on that the changes to the project because of the late arrival of equipment were going to be numerous. The contractor also recognized the importance of effectively managing these changes by measuring and tracking the cost and schedule impacts associated with these changes. However, the existing project cost and schedule management system was not set up to monitor and track the myriad of increased costs.

One of the authors of this article was retained to assist in setting up the means and methods to both measure and track the cost and schedule impacts to the project as a result of the late delivery of the critical equipment. The following summarizes the efforts undertaken to measure and track the cost and schedule impacts associated with the changes.

- For each of the subcontractors, the schedule prior to the event was used to measure what would have been performed and when it would have been performed but for the force majeure event. Separate cost codes were established specifically for tracking the cost impacts.
- The actual timing and conditions of when and how the work was performed was compared to the baseline schedule and planned conditions. For example, if certain work was planned to be performed in September with one crew, no overtime, and with no other craft in the area, but was actually performed in January with two crews working overtime in below freezing conditions with two other craft in the area, these different working conditions were noted. Daily observations were made for each of the subcontractors working in the respective week.
- Next, various recognized construction industry studies that measure the impacts of weather, overtime, stacking of trades and out-of-sequence work were used to measure the labor impact of the changed working conditions. The labor impacts were calculated each week. Other cost impacts were also contemporaneously tracked including equipment rental, field office costs, incremental project personnel costs, and others. In certain instances, change orders for subcontractors were prepared and approved.
- At the end of each month, a separate invoice summarizing all of the cost impacts was prepared and submitted to the insurance carriers for payment. The invoices included all supporting documentation including pictures of the changed working conditions and the basis for each of the increased costs.

Lessons Learned

For various reasons, the insurance companies declined payment of the invoices for the increased costs. Eventually, the contractor was forced to litigate the matter with the insurance companies.
The contractor was able to recover all of its increased costs but not until after a successful trial. At trial, the insurance companies tried to argue, using hindsight, that the costs were overstated and inaccurate. However, the jury concluded that the costs, as tracked contemporaneously, were an accurate measure of the impacts to the contractor.

The key lesson learned was that when faced with changes to a project, do not wait until after the project is over to try and measure the impacts. Rather, set up cost codes and means and methods to contemporaneously measure and track the cost and schedule impacts. The time and effort spent during the project to measure and track these impacts will assist in recovering what is owed under a changed condition.

Conclusion

Change during most construction projects is inevitable and can lead to cost and schedule overruns. The change management process typically includes:

- address potential change in the contract documents;
- identify the potential change;
- create a proposed change order and document the proposed change;
- review and evaluate the proposed change order timely;
- execute the change order; and,
- document the executed change.

These are some of the practices being used in the construction industry to effectively manage change.

As illustrated by the case example above, contemporaneously measuring and tracking the cost and schedule impacts associated with project changes will assist in the recovery of what is owed under a changed condition. Effective management of changes can significantly reduce the risk of claims that often result in costly disputes and litigation.◆

REFERENCES


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