Change Management Best Practices for the Architecture, Engineering, and Construction Industry

An Executive White Paper
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I. INTRODUCTION

Construction contracts differ from most legal agreements in that they expect and plan for changes. In order to deal effectively with the changes that might arise on a construction project, the project participants need a comprehensive and workable process for identifying and managing changes. The purpose of this white paper is to highlight best practices and provide a process to effectively manage changes on construction projects. It is by no means exhaustive or complete, but does present the basics of a workable and proven process for dealing with changes. Although the terminology used and contract documents referenced are geared toward traditional design-bid-build public improvement projects, the process and principles presented are applicable and adaptable to other kinds of delivery methods or types of projects.

Because this process is not written for a particular contract or project, readers are urged to review the procedures presented carefully and seek appropriate assistance when adapting to their own project or construction programs. Please contact Trauner Consulting Services, Inc. if you have any questions regarding this Change Management Process, the intent of its requirements, its implementation, its customization for your construction program, or any other reason related to the development and implementation of a change management system on your project or construction program.

II. GLOSSARY

**Ambiguity, Conflict, Error, or Omission.** A deficiency in the Contract Documents that effects the construction of the work as intended by the drafter of these documents.

**Cardinal Change.** A change having the effect of making the work as performed essentially dissimilar from the work the parties bargained for when the contract was awarded.

**Construction Change Directive (CCD).** Typically, a unilateral change order issued by the owner without the contractor’s concurrence.

**Constructive Change.** A change to a contract resulting from conduct by the owner or its authorized agents that has the effect of requiring the contractor to perform additional work or otherwise modifying the contract.

**Contract Documents.** Typically, any of the legally-binding agreements, specifications, plans, or other written information that comprise the agreement between the owner and the contractor.

**Contractor.** The contract party having responsibility for the construction.

**Design Consultant.** A party under contract with the owner to provide design and, sometimes, oversight or owner’s representative services for the project.

**Directed Change.** An order to the contractor adding work to or deleting work from the contract, or modifying the manner or method of work performance.

**Dispute Review Board (DRB).** An alternate dispute resolution procedure that is gaining popularity on large, complex construction projects. A DRB typically consists of three members experienced in the type of work involved, and respected by their peers.

**Owner.** The agency, commission, or other organization that administers the contract.

**Potential Change Order (PCO).** Typically, any project condition that is identified as being a possible change to the contract.

**Project Manager (PM).** Typically, the owner’s agent responsible for administrative oversight of the project.

**Request for Information (RFI).** Typically, a written request for clarification or additional information issued from the contractor to the owner or design consultant.
III. UNDERSTANDING PROJECT CHANGES

A change is typically understood to be the difference between the contract requirements as set forth in the original agreement between the parties (often as established at the time of bid) and the requirements imposed subsequent to this agreement (usually recognized during the actual construction of the project.) Changes that arise during construction may originate with the owner, contractor, or even a third party to the contract. Though the contract defines what constitutes a change, some typical examples of changes include, but are not limited to, the resolution of ambiguities, conflicts, errors, or omissions within the contract documents; new or unanticipated requirements imposed by third parties, such as permitting agencies, railroads, and utility companies; unforeseen environmental issues; design changes; material shortages (under certain circumstances); value engineering; safety-related changes; and alterations to the duration or sequence of work activities. Changes can be categorized as either directed or constructive, as will be further explained in this paper. Cardinal changes, on the other hand, constitute a breach of contract and are, therefore, typically not allowed (meaning that these changes are changes the contractor has no obligation to perform).

A. Directed Changes

Directed Changes are changes that are directed by the owner and are, therefore, understood by the owner to be a change to the contract. Subject always to the specific requirements of the contract, examples of Directed Changes include:

- a. The addition or deletion of work
- b. A revision to the material specifications
- c. A revision to the project phasing
- d. A change to site access or the hours of operation
- e. A change to the contract duration

B. Constructive Changes

Constructive Changes typically result from the actions or inaction of the owner, and usually are not intended or recognized by the owner to be a change. Subject to the specific requirements of the contract, Constructive Changes might include:

- a. The failure to disclose material information (superior knowledge)
- b. The impossibility or impracticality of performing the work as designed (constructability)
- c. The imposition of joint occupancy or use of the project before completion
- d. The slow turnaround of submittals and requests for information
- e. Untimely inspections

Constructive Changes are usually more difficult to recognize than Directed Changes and, therefore, often become the basis for a dispute, or in the worst case, a formal claim.

C. Cardinal Changes

A cardinal change is a change that has the effect of making the work to be performed fundamentally different from the work the parties agreed to when the contract was bid and awarded. An example of a cardinal change might be an owner’s instruction to remove asbestos or other hazardous materials found on the project when the contract documents identified no such materials and did not provide for their removal. Though this paper is not a legal treatise on the subject, a cardinal change is typically viewed as a breach of contract by the owner and a contractor is not obligated to proceed with a cardinal change if directed to do so by the owner.

IV. THE CHANGE MANAGEMENT PROCESS

Construction contracts are unique in that they typically provide the owner the right to make revisions to the contract documents without voiding the contract. Therefore, effectively managing changes requires the successful completion of several crucial activities that are described in this section. Again, while this process is not exhaustive, it identifies the essential steps as follows:

Step 1: Identify the Contract Requirements;

Step 2: Identify the Potential Change and Create a Potential Change Order File;

Step 3: Determine Entitlement, Measure the Effect of the Change, and Calculate the Cost of the Change;

Step 4: Negotiate & Execute the Change Order; and

Step 5: Maintain Complete Records of the Executed Change.

STEP 1: IDENTIFY THE CONTRACT REQUIREMENTS

The Contract Documents identify the requirements for the Project in terms of its scope, schedule, and budget. The contract requirements must first be identified so that any deviation (i.e. a change) can be recognized, since a change is essentially a requirement that deviates from the requirements set forth in the contract documents. The Contract Documents typically include the following components: the Contract (addenda, agreement, special provisions, and all similar or related provisions or references), Specifications (general provisions, technical specifications, supplemental provisions or specifications, and other referenced standards), and Plans (project plans, standard plans, standard details, boring logs, or other information that depicts the work to be constructed or site conditions prior to the start of construction).

It is important to apply general rules of contract interpretation when reviewing the contract documents. This means to read the contract as a whole and follow the order-of-precedence clause when interpreting the component contract documents. For example, the order-of-precedence clause might indicate that in the event of a conflict, the specifications take precedence over the plans.
The owner and contractor should also pay particular attention to the contract clauses related to notice and changes as these clauses are the logical starting points for the identification and administration of changes.

1. Changes Clause

The “changes clause” may be the most important clause in a construction contract in that it specifies that the owner may make changes in quantities or other alterations it deems necessary to complete the work (scope), which can effect the contract time (schedule), or cost (budget). The contractor, on the other hand, is obligated by the changes clause to execute changes to the work in accordance with the owner’s instructions provided that a mechanism exists for the contractor to be compensated in terms of cost and time.

Changes include changing the quantities of work or the conditions under which it is to be performed, and suspending, adding, or eliminating work that is within the scope of the contract.

Though there are many versions of change clauses used in construction contracting, the following exemplifies many of the most important features of such clauses:

During the course of the Contract, the Owner has the right to make written changes in the quantities or other alterations as necessary to complete the work:

A. Such changes in quantities or alterations neither invalidate the Contract nor release the surety.

B. Contract time will be adjusted [insert appropriate reference to the contract time extension clause] for changes that require additional time to complete.

C. [Insert appropriate reference to contract payment clauses] governs payment for changes.

Agree upon the basis for Contract adjustment before beginning work addressed by the change. If agreement cannot be reached, the Owner may order the work to proceed under the Time and Materials (or “Force Account”) provisions of [Insert appropriate reference to time and materials or force account provisions].

Notice that the changes clause in the above example first addresses the potential scope, schedule, and budget effects of the change, then directs the reader to the appropriate contract provisions governing payment and time extensions. As an example of how this might work in practice, changes that affect the project’s critical path may necessitate the issuance of a time extension, the requirements for which are described by another provision of the contract, as referenced by this clause.

Likewise, the provisions that govern the payment requirements for the changed work are referenced by the changes clause. For contract changes that affect unit-priced work items, the preferred solution is typically to use the existing contract unit prices to price the changed work. If contract unit prices for the changed work do not exist, then either new ones can be negotiated, a lump-sum price for the work can be negotiated, or the contractor can be paid its actual costs, plus an appropriate markup (with or without a not-to-exceed number being established for the change). In each case, the provisions governing payment for changed work specify how the changed work will be paid for.

2. Contractor Notice Clause

The contractor typically has the responsibility to inform the owner of any condition that is potentially a change before proceeding with the affected work. Notice must typically be provided in written form, but some contracts may also allow oral notice. Contracts typically define notice as written notice that is provided within a certain time (typically, not longer than a week or so) of identifying a change. The notice clause is important because it prevents the contractor from prejudicing the owner’s rights to investigate, mitigate, and document the change while the opportunity exists. In other words, the notice clause provides the owner with an opportunity to decide on the appropriate course of action before any work is performed or additional cost incurred and document the changed work as it is performed. Notice clauses are often enforceable, and the contractor’s failure to notify the owner within the specified timeframe could result in the forfeiture of all rights for additional compensation or time. Notice provisions not only encourage (or force) the parties to communicate effectively, they also instigate the collaborative process necessary for the project participants to resolve the change.

The 2003 edition of the Standard Specifications for Road and Bridge Construction for the State of Wyoming contains a good example of a notice clause:

104.2.7 Contractor-Engineer Notification

104.2.7.1 General

The Owner will consider requests for contract amendments only when the notification procedures in this subsection are followed. The Owner will not consider requests when these procedures are not followed. The specified time limits may only be extended through a written, jointly signed agreement between the contractor and the Owner. Throughout, the Owner will endeavor to address the underlying issue prompting the notification in a timely and satisfactory manner.

104.2.7.2 First Notice, by Contractor

Notify the Owner verbally as soon as a contract amendment appears necessary. Do not start or continue an activity or item of work for which a contract amendment may be necessary without authorization from the Owner.

104.2.7.3 Written Notice, by Contractor

If the Owner responds unacceptably, or not at all, provide a written notice within five working days of the first notice. Include the following:

1. A description of the situation;
2. The time and date the situation was first identified;
3. The location of the situation, if appropriate;

4. A clear explanation of why the situation represents a change to the contract, including accurate references to the pertinent portions of the contract;

5. A statement of the amendments deemed necessary in the contract price(s), delivery schedule(s), phasing, time, etc. Because of its preliminary nature, the Owner recognizes that this information may rely on estimates;

6. An estimate of the time by which the Owner must respond to minimize cost, delay, or disruption; and

7. Anything else that will help achieve a timely resolution.

As shown in this example, initial contractor notice may be provided orally instead of in writing, which can save time—a benefit to both the owner and the contractor. The contractor is still required to provide written notice within 5 days if the owner responds differently than anticipated, or fails to respond to the oral notification. Conversely, if the owner agrees with the contractor that a change has occurred, then steps can be taken to document and administer the change.

In summary, the notice clause should be part of a fair and workable change management process that serves the needs of the owner, the contractor, and the project.

3. Contract Ambiguities, Conflicts, Errors & Omissions

Because no set of plans and specifications is completely error-free, it is imperative to understand contract errors and their potential to become project changes. Contract deficiencies are classified as either errors or omissions as follows.

Error. An error is any mistake or inaccuracy in the contract documents that can effect the construction of the work. Contract errors can be simple numerical or grammatical mistakes, but can include ambiguities and conflicts among different contract documents, which are further defined below. Errors may result in the re-ordering of materials, the removal of constructed work, or make the work impossible to construct as intended. Consequently, errors may cause project delays and cost overruns and become the basis for a dispute or formal claim.

Ambiguity. An ambiguity is a type of error that occurs where more than one reasonable interpretation of a contract provision exists after applying general rules of contract interpretation—reading the contract as a whole and applying the correct order of precedence among the contract documents. A simple example might be a note on the plans for a bridge deck repair contract that says, “Remove 4 inches to sound concrete.” Reasonably, one could interpret this to mean that a minimum of 4 inches of concrete must be removed from the bridge deck at locations where deck repairs are required or that finding sound concrete will determine the concrete removal depth.

Conflict. A conflict is another type of error that occurs where, after applying general rules of contract interpretation, it is not possible to make a reasonable interpretation of the contract requirement. For example, the order-of-precedence clause would not resolve the situation where the plans show a pipe diameter of both 36 and 24 inches for the same pipe.

Omission. An omission is yet another type of error where a work item is left out of the plans and specifications, but is found to be necessary to complete the work as intended. The reason for distinguishing omissions separately from errors (i.e. “errors and omissions”) relates to the potential costs to a design consultant associated with defects in their design.

Though a full discussion is outside the scope of this white paper, design consultants may be responsible for the costs an owner incurs as a result of a defect in the design prepared by the design consultant. Responsibility for such costs will usually be specified by the agreement between these parties and applicable law, but commonly the design consultant is assessed responsibility for the costs associated with performing negligently or failing to apply the standard of care normally expected of such professionals. In such cases, the owner typically may be entitled to recover the additional costs incurred as a result of the change due to the error. However, if the error is an omission, then the owner is typically not entitled to recover the full cost of the change, only that portion in excess of the costs the owner would have incurred had the omitted work been part of the contractor’s original bid.

Errors and omissions are further classified as either patent or latent. Patent errors and omissions are obvious and the contractor is obligated to point them out to the owner before bidding. Contractors are typically prohibited from taking advantage of obvious errors in the bid documents. On the other hand, latent errors and omissions are not obvious and are the owner’s responsibility to correct.

In Federal contracting law, the Spearin Doctrine stipulates that the owner (as the provider of the contract documents) is responsible for their completeness and accuracy and provides an implied warranty that the project is constructible as designed.

When one of the parties to a contract undertakes to prepare the specifications, that party is responsible for the correctness, adequacy and feasibility of the specifications, and the other party is under no obligation to check and verify the work product of the party who assumed responsibility for the preparation of the specifications, even though he may be as much or more of an expert than the party who prepared the specifications.

— Administration of Government Contracts, 3rd Edition

As a final note, in some types of construction contracts, such as design-build, the owner makes no warranty as to the completeness or accuracy of the plans and specifications because the design-builder is responsible for their development. While the resulting differences in the change order management procedures of traditional design-bid-build and design-build construction projects are beyond the scope of this whitepaper, suffice it to say that the basic actions—reviewing the baseline requirements, identifying the changed condition, measuring the difference, etc.—are the same.
STEP 2: Identify the Potential Change and Create a Potential Change Order File

When a potential change is identified, it is important to correctly classify it and follow the correct procedures. In this step of the process, a potential change is classified among the different types of change provisions that are defined by the contract. Next, a Potential Change Order (PCO) File should be created to track the issue. Creation of the PCO File should be performed before entitlement for the potential change is determined. Public contracts are often thorough in identifying the different kinds of changes that may be encountered during construction and defining the procedures that must be followed upon their identification. The common types of change provisions defined in public contracts are: a Change in the Character of Work, a Differing Site Condition, a Suspension of Work, Extra Work, or Elimination of Work. Each of these change categories are identified and discussed as follows:

A Change in the Character of Work is defined as a significant variation in quantity or change in the conditions under which the work is to be performed. For highway construction, which are usually “unit price” contracts, a significant change in quantity is usually defined as quantity changes that result in a total quantity of more than 125% or less than 75% of the bid quantity. This component is less relevant on other types of contracts, where work is not bid or compensated on a per-unit basis and the quantity estimates are not provided by the owner as part of the bidding process. A different example of a change in the character of the work is an owner restricting access to the jobsite so that the contractor cannot construct the work as it anticipated. Work is not added or deleted, but the conditions under which the work is to be performed are changed.

A typical clause governing changes in the character of the work is shown below:

(i) The Owner reserves the right to make, in writing, at any time during the work, such changes in quantities and such alterations in the work as are necessary to satisfactorily complete the project. Such changes in quantities and alterations shall not invalidate the contract nor release the surety, and the contractor agrees to perform the work as altered.

(ii) If the alterations or changes in quantities significantly change the character of the work under the contract, whether or not changed by any such different quantities or alterations, an adjustment, excluding loss of anticipated profit, will be made to the contract. The basis for the adjustment shall be agreed upon prior to the performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the contractor in such amount as the engineer may determine to be fair and equitable.

(iii) If the alterations or changes in quantities do not significantly change the character of the work to be performed under the contract, the altered work will be paid for as provided elsewhere in the contract.

(iv) The term “significant change” shall be construed to apply only to the following circumstances:

(A) When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction, or

(B) When a major item of work, as defined elsewhere in the contract, is increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of original contract item quantity, or in case of a decrease below 75 percent, to the actual amount of work performed.

A Differing Site Condition is defined as a subsurface or latent (hidden) physical condition encountered on the project. “Type I” differing site conditions are site conditions that differ materially from those indicated in the contract documents. “Type II” conditions differ materially from conditions that are normally encountered. Unknown subsurface foundations, fuel tanks, or other structures requiring removal and disposal are examples of Type II Differing Site Conditions. A differing site conditions clause from a public contract is shown below:

(i) During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the contract or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract, are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected work is performed.

(ii) Upon written notification, the Owner will investigate the conditions, and if he/she determines that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the contract, an adjustment, excluding loss of anticipated profit, will be made and the contract modified in writing accordingly. The Owner will notify the contractor of his/her determination whether or not an adjustment of the contract is warranted.

(iii) No contract adjustment which results in a benefit to the contractor will be allowed unless the contractor has provided the required written notice.

(iv) No contract adjustment will be allowed under this clause for any effects caused on unchanged work.

Suspension of Work is defined as an order by the owner to stop the work, or elements of the work, for a period of time. Work suspensions are changes of particular importance as they impede the contractor from performing the work in the sequence or manner it intended. Suspensions of work that delay “critical path” activities may extend...
the overall duration of the project, potentially resulting in both added costs and delaying the scheduled project completion date, unless the contractor can mitigate the delay by accelerating or re-sequencing the work. A standard work suspension clause from a public contract is shown below:1

(i) If the performance of all or any portion of the work is suspended or delayed by the Owner in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the contractor believes that additional compensation and/or contract time is due as a result of such suspension or delay, the contractor shall submit to the Owner in writing a request for adjustment within 2 calendar days of receipt of the notice to resume work. The request shall set forth the reasons and support for such adjustment.

(ii) Upon receipt, the Owner will evaluate the contractor’s request. If the Owner agrees that the cost and/or time required for the performance of the contract has increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the contractor; its suppliers, or subcontractors at any approved tier; and not caused by weather, the Owner will make an adjustment (excluding profit) and modify the contract in writing accordingly. The Owner will notify the contractor of his/her determination whether or not an adjustment of the contract is warranted.

(iii) No contract adjustment will be allowed unless the contractor has submitted the request for adjustment within the time prescribed.

(iv) No contract adjustment will be allowed under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of this contract.

Extra Work is defined as added work not provided for in the original contract, but found to be essential for the satisfactory completion of the project within its intended scope. Extra work may be added to the project’s scope due to a design consultant’s error or omission, or through changes requested by the owner or demanded by a third party. The extra work clause is particularly important as it provides a mechanism for the owner to introduce additional elements of work. A changes clause from a public contract is shown below: (Please note that this clause presumes that the term “extra work” has already been defined. A good definition of this term is provided at the beginning of this paragraph.)

Perform Extra Work as directed by the Owner. The Owner will pay for Extra Work as specified in 109.05. Time extensions, if warranted, will be determined according to 108.06.

Eliminated Work is defined as original contract items that are no longer desired or necessary to complete the work and are, thus, removed from the project’s scope by the owner through a deductive change order. Eliminated work items can become the basis for disputes, however, if the contractor has already incurred cost for those items—for instance, purchased materials. In such cases, it is customary for the contractor to request reimbursement for actual costs incurred. A standard eliminated work clause from a public contract is shown below:

The Owner may partially or completely eliminate contract items.

The Owner will make an adjustment to compensate the Contractor for the reasonable cost incurred in preparation to perform the eliminated Work prior to the date of the Owner’s written order eliminating the Work. The adjustment will be determined according to 109.04 and 109.05. Such payment will not exceed the price of the Contract Item.

Once a contractor, owner, or third party has determined the type of change the alleged change is and has identified the appropriate change provision, as indicated previously, it showed then demonstrate that it has met all of the requirements set forth in that provision—including notice requirements if the change is identified by the contractor. All contract documents, contemporaneous project records, and correspondence used to support the position that the potential change is a legitimate contract change should be filed in a Potential Change Order File for further analysis.

1. Creating a Potential Change Order File

A change may originate with the owner, the contractor, a third party such as design consultant, or the project’s end user if that party is different from the owner. For example, an owner may initiate a directed change by issuing a Stop Work Order. A contractor may initiate a change by providing notice after encountering a differing site condition. And a design consultant may initiate a change by revising the plans and specifications (sometimes issuing these revised drawings as a “bulletin”) or responding to a Request for Information (RFI). The party that has identified the potential change—whether it be the contractor, design consultant, or owner—should document the issue in a Potential Change Order (PCO) File as early as possible. Because the PCO File will be used as the basis for any subsequent evaluation or action that results from the change, it should be as complete as possible. Depending upon the scope, size, and complexity of the potential change and the project, it is advisable to establish and maintain five separate sub-files of information for each potential change as follows:

Potential Change Order File Components

Sub-file 1: All documents or information that establish the baseline requirements—i.e., the contract, specifications, plans, and schedule.

Sub-file 2: All documents or information that explain what has been encountered, or what is now being required that is allegedly different from the baseline.

Sub-file 3: An analysis that contrasts the information in sub-file 1 to the information in sub-file 2 and articulates the “net difference.”
Sub-file 4: All schedules and analysis supporting delay resulting from the change, as well as any mitigating alternatives that might be available.

Sub-file 5: All cost information supporting the estimated price of the “net difference” (sub-file 3) and the resulting delays (sub-file 4).

All relevant information including the status of the PCO; required submittal, review, or approval dates; estimated or documented actual costs; related contract documents; and identification of personnel involved in analyzing the change should be kept in the PCO File, which should also be regularly updated and transmitted to the parties involved. This will allow all parties to track the status of each PCO and will be a valuable tool to keep the change order process moving forward in an organized manner. Figure 1 shows a snapshot of a sample PCO Log in Primavera.

2. Change Order Initialization

Before continuing with the change order management process, it is relevant to discuss some of the different ways in which a change order can be initiated. As previously discussed, project changes can originate from any of the several parties involved on a project and, thus, the owner’s procedure for managing changes must be flexible enough to accommodate and accurately track changes with different points of origin.

A flow chart depicting a simplified representation of a typical owner’s process for managing changes is shown in Figure 2. The numbers at the top of the figure depict some of the different pathways that a change may ultimately become approved change order. Figure 2 is a simplified representation and each of the pathways depicted will likely have more steps than are shown here. However, as shown in the figure, the creation of the PCO File is one of the key activities performed in STEP 2. Although the PCO File may be created by any of the parties involved, it is essential for only one party to track all PCOs on the project through the issuance of a unique PCO number. Even if the potential change is ultimately not accepted by the owner; the issue and all relevant supporting information should be maintained in the PCO File. Doing so will greatly assist any post-project or forensic analysis, such as audits or claims evaluation, should such efforts be necessary.

3. Requests for Information

During the performance of work on a project, questions often arise regarding the meaning or intent of the contract documents. These questions may relate to simple clarifications or more significant discrepancies in the contract documents. The contractor may address these questions as RFIs to the owner or design consultant, depending on how the project team is organized. While RFIs are not in and of themselves indicative of a change, they are discussed here because the RFI process may identify the need for a change. For this reason, RFIs should be tracked judiciously.

The contractor will generate the RFI and send it to either the owner or its design consultant depending on the requirements of the contract. In some instances, contracts will define the period of time that the owner or its agents have to respond to a contractor’s RFI. Many times the response from the owner or design consultant has no cost or time consequence, and the response to the RFI will be transmitted to the contractor and administered as a simple clarification to the work.
There may be instances, however, where the RFI response will itself represent a change to the contract or will induce the owner and its design consultant to make a change that affects the cost or time to perform the project. In these instances, all associated documentation should be maintained in the PCO File. The contemplated change should then be transmitted to the contractor in the form of a request for proposal (RFP). In the event that the contractor views a response to an RFI as a change to the contract but the owner does not, the contractor should begin the PCO process.
All information regarding RFIs, including their status, required dates, related documents, and the party that is currently accountable should be kept in a RFI log that is regularly updated and transmitted to the responsible parties. This summary log should be reviewed at all project meetings to ensure that the RFI process is being managed effectively and to minimize the opportunity for project delays to result from late responses. Examples of common RFI forms, the RFI log and the Project Dashboard are provided in Figure 3, Figure 4, and Figure 5.
STEP 3: Determine Entitlement, Measure the Effect of the Change, and Calculate the Cost of the Change Order

Upon receipt of a potential change order, the owner must, in a timely fashion, evaluate the potential change order and determine if the contractor is entitled to the recovery of the additional time and costs requested. Such an evaluation should be performed in the following sequence: Establishing Entitlement, Measuring Impacts, and Pricing Costs.

1. Determine Entitlement

As previously stated, the changes clause indicates that changes to the contract may be necessary for the satisfactory completion of the project or that project conditions may differ from the conditions originally shown in (or reasonably interpreted to be part of) the contract. The first step in determining the contractor’s entitlement to additional costs or time related to an alleged change is establishing that a change, according to the contract, has in fact occurred and then determining whether the contract provides the contractor with remedies for the change.

In order to establish that a change has occurred, the contractor should identify the specific change-related contract language associated with the alleged change. Then, referencing the specific change provision, the contractor should demonstrate that the alleged change is in fact a change by comparing it to the baseline requirements set forth in the contract.

After establishing that a change has occurred according to the contract, the contractor must show that the relevant contract provision allows the recovery of additional time or costs that result from the allowable change.

2. Measure the Effect of the Change

Only after a contractor has established entitlement to a change can the measurement of the effect of the change begin. Typically, a change will consist of either the addition or elimination of work. If a change requires the addition of work, the contractor should use the contract’s time extension provision to determine how the delay associated with the change should be measured and the appropriate extension of time determined.

However, if the contract’s time extension provision does not provide direction to the contractor on how to request additional contract time for the delay that might result from the additional contract work, then the contractor should use an appropriate schedule analysis technique to measure the delay to the project and the duration of the appropriate time extension. Though analysis of delays is outside the scope of this white paper, the American Association of Cost Engineers, International (AACEI), has published a document entitled “Recommended Practice
No. 29R-03, Forensic Schedule Analysis,” that sets forth a number of ways to determine the critical delay attributable to a change. One method, called the Prospective Time Impact Analysis, may be appropriate for use to determine the time extension in situations where the work associated with the change is in the future. This technique involves the development and insertion of a fragnet, or “fragmentary network” of activities linked with relationship logic, that represents the additional work. This fragnet is inserted into the project schedule current at the time the change is made and properly linked to the affected work. By comparing the project schedule before and after the fragnet is inserted, the effect of the change on the project schedule can be measured. In accordance with the prospective nature of this analysis technique, the contractor should develop and insert the fragnet representing the added work into the project schedule before the added work is started. Inserting the fragnet into the project schedule before the added work begins allows the both the owner and contractor to estimate or predict whether the change is likely to cause a delay to the scheduled project completion date or the completion date of some intermediate contract milestone. If so, then this method can also be used to estimate the extension of contract time that should be provided as a result of the change. If it is agreed by both parties that the contractor is entitled to a time extension, then the additional contract time should be addressed in the “change order” executed for the change.

Conversely, if the change resulted in the elimination of the contract work, then the same approach may used; deleting the activities from the schedule that represented the eliminated work.

Primavera provides a “reflection” feature that enables the project participants to effectively manage the time extension review and approval process using the project schedule. The reflection feature enables the project participants to create multiple copies of the current project schedule that can then be used to model different scenarios or "what-if" situations to represent the changed work. Using copies of the current project schedule ensures that the integrity of the current schedule is not violated during the development, review, and approval of the changed work items. After the owner completes its review of each of the various scenarios and both parties agree on the scenario that best represents the changed work, then the parties can merge the copy of the current schedule that contains the agreed upon changes back into current version of the project schedule. Figure 6 shows a schematic representation of the reflection process.

3. Calculate the Cost of the Change Order

The third step in the owner’s evaluation of the contractor’s proposed change order is calculating the cost of the change order. Typically, the change provisions will instruct the contractor as to how to calculate the cost of the change. In some instances, there may be a contract unit price that can be used to determine of the change order value. However, when a contract unit price does not apply or the line item is priced on a lump-sum basis and the contractor and owner are unable to come to an agreement on the calculation of the price for the change, then the contract may instruct the contractor to calculate the cost of the change according to the contract’s time and materials (force account) provision.

A force account provision typically compensates the contractor for the direct costs of labor, equipment, and material necessary to complete the added work item. The force account provision will include detailed directions as to how to calculate the direct costs of labor, equipment, and materials, that were expended to perform the added work associated with the change.

Additionally, the force account provision will provide a specific markup percentage that should be applied to the direct costs and subcontractor effort necessary to complete the added work. Typically, the contract will state that the markup percentage is considered full compensation for the contractor’s field office overhead, home office overhead, profit, and any other costs incurred to perform the added work.

In cases when the contractor demonstrates that the change results in a critical project delay, the contractor may be entitled to recover additional time-related costs resulting from the extended performance of the project. These types of costs may include extended field overhead and unabsorbed home office overhead costs. The extended field overhead costs are costs for indirect, on-site, field-related costs that are chargeable to the project as a whole, such as jobsite trailer rental, utility costs, costs related to the ongoing need for a project manager, etc. The unabsorbed home office overhead costs are indirect home office costs that are incurred regardless of whether a project is being worked or not. These are typically costs that are not chargeable to any specific project, such as home office rent, home office power,
home office telephones, etc. Additional costs should be addressed in the negotiation of a change order if the work extends the completion date of the project. Figure 7 shows an example of a Proposed Change Order with markup.

STEP 4: Negotiate & Execute the Change Order and Avoid Disputes

Many contracts dictate the process, including the duration of time, that each party must follow to address any potential changes to the contract work. The contractor must disseminate the information included with an owner’s RFP to all affected parties, including subcontractors, and then assemble the detailed responses to support the estimated cost or the delay resulting from the change within this specified period.

Upon receipt of a contractor’s response to a RFP, the owner will review the information as described in Step 3 of this procedure and respond to it within the period of time specified by the contract. At this time, the owner will either accept the contractor’s proposal as submitted and generate a change order for signature or reject the proposal noting the basis for the rejection. As a standard practice, both of these actions should be performed in writing for record-keeping purposes. If the contractor’s proposal is rejected by the owner, the contractor may then respond in writing to the owner’s decision or set up a meeting with the owner to negotiate the matter until an acceptable cost and time extension are agreed upon.

If it appears that the change order process will be too lengthy and will impact the progress of the work and cause further delays, the owner may choose to address the change through means other than a bilaterally executed change order. A Construction Change Directive (CCD) could be issued to the contractor directing that the work be performed on a time-and-material basis, invoking the force account provision in the contract, with or without a not-to-exceed amount. A unilateral change order issued by the owner to the contractor allows the work to be performed in accordance with the changes clause of the contract without the cost and a time extension being agreed upon by the two parties in advance.

It is advisable for the contractor and owner to work together as diligently as possible to agree upon the cost and time adjustment for the change. If the parties have been working together throughout the course of the project, then their collaboration may enable them to find a middle ground during the negotiation process based on effective communication and trust. However, it is always possible that the two parties will not come to an agreement. If the parties are unable to agree upon a cost or time extension for the change, and if the contractor disagrees with performing the work included in a CCD after a final decision has been made by the owner, then the contractor’s only remedy may be to continue its dispute through the channels identified by the contract. These channels are known as the contract’s dispute resolution provisions and will vary by contract and according to governing laws and regulations.

There are several different methods for resolving change-related construction disputes to avoid costly arbitration or litigation. Dispute Resolution Boards (DRBs), a neutral authority consisting of 3 members, is one preferred method. Selection of the board members can be performed in a number of ways; however, it is crucial that the individuals are neutral and that both the owner and the contractor view each board member as being unbiased. Typically, DRBs are impaneled at the project level and administration of the DRB process is governed by the project’s contract. Other dispute resolution
procedures may escalate the dispute from the project level to a higher administrative level within the owners and contractor’s organization before proceeding to an arbitration panel or the courts. An example dispute resolution process for a state agency is provided below:

**STEP 1 of Dispute Resolution (Project Level).**
The PE/PS will meet with the Contractor’s superintendent within two (2) working-days of receipt of any early notice. They shall review all pertinent information and contract provisions and negotiate an equitable settlement according to the Contract Documents. If settlement is not achieved, they must escalate the dispute to Step 2.

**STEP 2 of Dispute Resolution (Administrative Level).**
If the dispute is escalated to Step 2, the District Construction Engineer or designee (other than the project personnel involved) shall meet with personnel from the Contractor’s headquarters, and consider the dispute. This Step 2 meeting shall occur within ten (10) working days of the completion of Step 1. The DCE and Contractor’s personnel shall review the information on the dispute presented by the personnel involved in Step 1 and negotiate an equitable settlement according to the Contract Documents. If settlement is not achieved, they must escalate the dispute to Step 3.

**STEP 3 of Dispute Resolution (Deputy Director Level).**
A Deputy Directors’ Board (DDB) will review disputes that are escalated to Step 3. The DDB will consist of the District Deputy Director of the District involved in the dispute, the Deputy Director of the Division of Construction Management, and the Deputy Director of the Division of Contract Administration. To prepare for a DDB review, the DCE will assign a dispute number, create a file on the dispute, and assign a person to review and manage the dispute. This manager will advise the Office of Construction Administration on the status of the dispute. The dispute number will consist of the District number, followed by a hyphen and then the project number, followed by a hyphen and the number of disputes on the project this dispute represents.

**STEP 5: Maintain Complete Records of the Executed Change**

Documentation of changes is a key responsibility of all project management personnel. At the beginning of a project, the staff should create standardized forms, procedures and a contract document log, issues log, RFI log, and PCO log to maintain detailed records and document changes that arise during the project.

The **contract documents log** should begin with the bid documents and include the most recent drawings or sketches that may be issued as part of a RFI or supplemental specifications by the owner or its design consultants. It should include the title of the revised document, the vehicle used to incorporate the document into the contract, and the date issued. The creation of the contract documents log aids in establishing the baseline requirements of the contract. As documents are revised and incorporated into the contract, they should be inserted into a “posted” set of documents that is available to all project personnel. This will ensure that the most recent information will be used as the project progresses and work is performed. The posted set of documents can then be used as the history set of documents.
detailing changes as they occurred throughout the project and used in evaluating changes or aid in generating the as-built set of documents. Figure 8 shows an example Drawings Log.

An issues log should be created to be used to track the pertinent information concerning an issue and assign responsibility for its resolution. The purpose of creating an issue log is for tracking purposes; it does not establish that the issue is a “change” or establish that the project was delayed or that the contractor incurred any additional costs resulting from the issue. The issues log should at a minimum contain: date created, number, a description of the issue, party responsible for the issue’s resolution, personnel or work effected by the issue, documents involved, and the date closed.

Primavera provides an issues log in the Project Manager Module that allows the user to input relevant information into the schedule and assign responsibility to the personnel charged with the resolution of the item. The issue can also be linked to a specific activity or node on the work breakdown structure (WBS) so that any possible delays to the project schedule can be tracked and evaluated on a global or project-specific basis. Figure 9 shows an example of issue information inserted into a log for tracking purposes.

Primavera is also capable of aiding in the process of generating and tracking issues by using thresholds to generate issues based upon low and high settings assigned to tasks by the user. If the activity information has changed so that it is no longer within the parameters specified, Primavera automatically generates the issue and notifies the user of the problem so that it may be addressed. Figure 9 shows an example of issues generated via thresholds.

The form used for RFIs, at a minimum, should include: the RFI number, the date the RFI is generated and by whom, the question written in a clear and precise manner, any reference documents, anticipated cost or delays (if known), when the response is required, and the date closed. An RFI log should be regularly maintained and should provide adequate information such that personnel not directly involved with the daily operations of the project can understand the information presented without making the document too unmanageable to be used as a summary. The log should include the RFI number, title, date generated, date the answer was required, current status, and associated PCOs (Refer to Figure 3 and Figure 4 for examples of a common RFI form and log).
Once the Owner determines that a RFP will be issued to the contractor or if a notice of potential change is submitted by the contractor, a number should be generated and assigned by the owner and the PCO File composed.

As previously stated, the first sub-file in the PCO will be used to establish the contract requirements. This file should include the relevant contract provisions, applicable specifications and plans detailing the work involved, and relevant schedule and cost information. The second sub-file in the PCO should include an explanation of what has been encountered, or what is now being required that is different along with all supporting documentation.

The determination of entitlement should now be performed by reviewing the contract requirements as defined in sub-file 1 and comparing them to the alleged change in sub-file 2. A description of the difference between the contract requirements should then be generated and included in sub-file 3.

The analysis required to identify any delay caused by an alleged change can be accomplished using the process identified above in the Measure the Effect of the Change section. During the review and evaluation of the proposed changes, Primavera can generate a listing of all of the changes between the current project schedule and the copy of the current schedule that contains the proposed changes. This is possible through the Reflection Process which automatically captures such changes. Figure 10 shows a Reflection report in Primavera that provides a difference analysis between schedules.

Primavera includes the capability to create reflections of current schedules that allow the user to input revised activity network logic and activities and view the resulting changes to project schedules without affecting the original schedule. P6 can then update the reflection schedule with any changes to the original schedule that occur.

The submitted costs should be analyzed for accuracy related to the work proposed, quantities, unit costs, and allowable markup as defined by the contract.

Following the completion of the time and cost analysis, the response detailing the owner’s position should be generated and a copy maintained for record purposes in the third PCO sub-file. Any further correspondence regarding the PCO should be maintained in the third sub-file. If the PCO is accepted by the owner and a change order is

![Figure 10 – Using a Reflection Process Comparison of Schedules for Delay Analysis](image-url)
issued, it should be generated with its own unique sequential number that is tracked in the PCO log. Copies of the change order should be maintained in both the project contract files and PCO files.

All information regarding PCOs, including their status, required response dates, submitted and estimated costs, related contract documents, and responsible personnel should be kept in a PCO log that is regularly updated and transmitted to the parties in the resolution process. These summaries will allow all parties to track the status of each PCO and be a valuable tool to keep the change order process moving ahead. Figure 11 is an example of a typical PCO log in the Contract Manager environment.

Primavera allows the user to link documents to activities and WBS nodes so that the information can be tracked and reviewed by the user in the CPM schedule. As an issue arises, an electronic copy of a RFI or change order document and all of its detailed information can be input into the Work Product and Documents Log and can be linked to an activity. The document can then be viewed by project participants. This information can then be used to track progress on a global or project-specific level as a tool to aid managers in evaluating the status of their projects.

In Figure 12, taken from a schedule in Primavera, RFI #19 has also been linked to Activity C-P102 to be used to track the change and measure its impact.

**VI. SUMMARY**

An effective Project Manager must have the ability to quickly identify and determine the time and cost effects of a change and effectively communicate with all project participants. The procedure for managing changes provided here is intended to identify best practices to effectively manage changes on construction projects. The terminology used and contract documents referenced in this white paper are geared toward traditional design-bid-build public improvement projects, although the basic principles are applicable to most any construction project. It should be noted that any change management procedure is only as effective as the participant’s ability to communicate and collaborate with one another during the course of the project.
The essential steps for managing changes on construction projects are as follows:

**Step 1:** Identify the Contract Requirements;

**Step 2:** Identify the Potential Change and Create a Potential Change Order File;

**Step 3:** Determine Entitlement, Measure the Effect of the Change, and Calculate the Cost of the Change;

**Step 4:** Negotiate & Execute the Change Order; and

**Step 5:** Maintain Complete Records of the Executed Change.

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**VII. REFERENCED DOCUMENTS**

3. FHWA Regulation 23 CFR 635.109
4. FHWA Regulation 23 CFR 635.109
5. State of Ohio Revised Proposal Note 025

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**Figure 12 – Link Work Product and Documents to Schedule Activities In Primavera**