



# مدیریت فناوری‌های دیجیتال در صنعت ساخت (بر اساس سندی از انجمن مدیریت ساخت آمریکا (CMAA))

فصل دوم: فرآیند استاندارد برای مدیریت فناوری‌های دیجیتال در پروژه

بخش سوم: به کارگیری فناوری‌های دیجیتال در مرحله طراحی

ارائه دهنده:

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# مدیریت فناوری‌های دیجیتال در صنعت ساخت

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سیدمحمد رضا علوی‌پور (PhD, PMP, CMIT) از دانشگاه Illinois Tech آمریکا

نریمان درافشان

هانیه طباطبایی

زمستان ۱۴۰۳

## What we will learn?

- ☐ Introduction
- ☐ Initial design meeting
- ☐ Communications and document control
- ☐ Design document review
- ☐ Scheduling
- ☐ Cost control

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# INTRODUCTION

## Technology in pre-design phase

❑ The **design phase's goal** is to **finish** a set of documents

that

1. Define an on-time, cost-effective project/program
2. Can be **bid** in the current local market and
3. **Meets** the owner's technology requirements (as well as quality, sustainability, etc.).

**What is the primary role of the CM  
in this phase?**

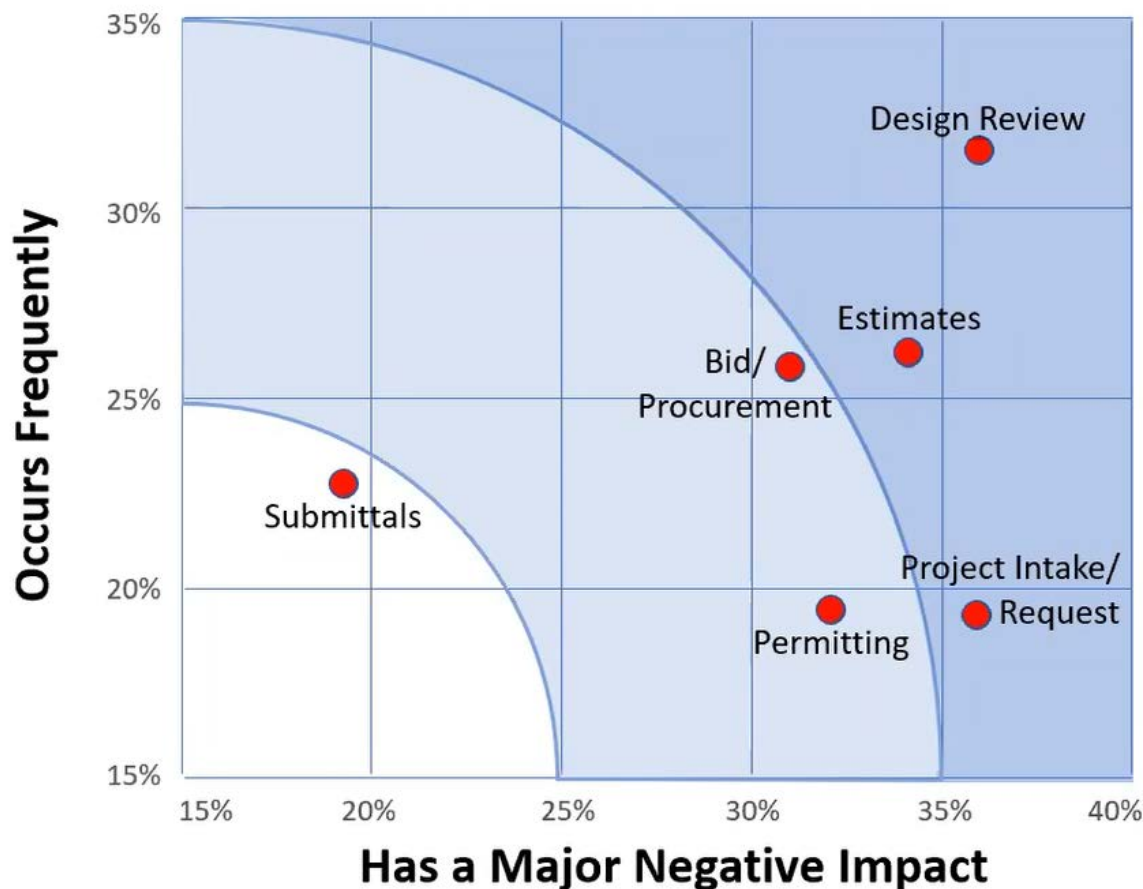
## CM's primary design phase role

- ❑ The CM's **primary** design phase **role** is to coordinate and guide the **other team members**.
- ❑ The CM **helps** the owner **turn** their **technology goals** into realistic technology requirements/COS during **pre-design and design**.
- ❑ The **entire team** must also constantly review and consult on **all issues** during the design phase.
- ❑ **Digital tools** can **enhance** this **collaboration**,  
so the **CM looks** for **opportunities** to use technology that will add value.

## CM's primary design phase role

- ❑ During the predesign and design phases,  
the CM **ensures** that the owner **understands** the **implications** of any technology the project or program will use.
- ❑ The CM should **obtain copies of all** the design contracts  
so the CM knows
  1. **Design team's obligations** to the owner and
  2. The **owner's duties**.
- ❑ The CM should also **review** the design deliverables  
to **verify** that the **design meets** the owner's technology requirements.

## Preconstruction & design: frequency and impact of issues



# **INITIAL DESIGN MEETING**

- ❑ The CM should **plan** and **conduct** an initial design meeting with the **design team** and **owner's representatives** to
  - ❖ **Confirm** the owner's design standards and
  - ❖ **Ensure** that scope and technical requirements align.
  
- ❑ The CM should **encourage** the **owner** to include **members** of the owner's O&M staff and other end-users to help **define** what they will need from the completed design.

What if the BIM is being used?

- ☐ If using BIM, this **initial meeting** may include a **BIM kickoff** that would also include the BIM integrator (if a separate entity).
- ☐ If a project/program uses **BIM** but the initial design meeting does not include a BIM kickoff,  
the CM should ensure that a **BIM kickoff meeting** occurs before the design work begins.
- ☐ The **BIM kickoff meeting** should explain and build consensus for the **contract's** BIM standards and implementation procedures that the **team established** during the pre-design phase.

# **COMMUNICATIONS AND DOCUMENT CONTROL**

- ❑ **Effective communication** requires a comprehensive system to access and control letters, transmittals, plans, sketches, and other important documents.
- ❑ **Technology helps** teams provide factual, accurate, and timely communications that are critical to a project or program.
- ❑ The **MIS determines** project's or program's **document control systems**.



# Communication

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بخش سوم: به کارگیری فناوری‌های دیجیتال در مرحله طراحی

RFI Submittal CD Inspection Punch List T&M Tags Permits Non-Compliance RFS

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**RFI # 45**

Created By: General Contractor, Derrick Morgan  
 Date Created: 04/22/2014  
 Date Submitted: 04/22/2014

Status: Closed  
 Priority: Low  
 Due Date: 04/29/2014

+ Additional Send & Assignment Information

Subject: Question about 3" conduit E103  
 Folder:  
 File Index: 8 Construction

**History**

|                       |                   |                            |                |             |                                                                |
|-----------------------|-------------------|----------------------------|----------------|-------------|----------------------------------------------------------------|
| Apr 22 2014 3:55:20pm | Created By        | General Contractor         | Derrick Morgan |             |                                                                |
| Apr 22 2014 3:55:31pm | Submitted By      | General Contractor         | Derrick Morgan | Assigned To | Owner/Construction Manager Priority: Low, Due Date: 04/29/2014 |
| Apr 22 2014 3:56:24pm | Read By           | Owner/Construction Manager | Eric           |             |                                                                |
| Apr 22 2014 3:56:47pm | Forwarded By      | Owner/Construction Manager | Eric           | Assigned To | Engineer Priority: Low, Due Date: 04/29/2014                   |
| Apr 22 2014 3:57:16pm | Read By           | Engineer                   | Rodney Dawson  |             |                                                                |
| Apr 22 2014 3:58:21pm | Responded to By   | Engineer                   | Rodney Dawson  | Response    | 1 - Engineer Response to RFI # 45                              |
| Apr 22 2014 3:58:21pm | Forwarded By      | Engineer                   | Rodney Dawson  | To          | Owner/Construction Manager                                     |
| Apr 22 2014 4:45:51pm | Forwarded By      | Owner/Construction Manager | Eric           | To          | General Contractor                                             |
| Apr 22 2014 4:45:58pm | Official Response | Owner/Construction Manager | Eric           | Response    | RFI Response # 1 - Engineer Response to RFI # 45               |
| Apr 22 2014 4:45:58pm | Closed By         | Owner/Construction Manager | Eric           |             |                                                                |

Who should update these protocols?

## Document distribution and control protocols

❑ The CM **ensures** that the team follows the document distribution and control protocols.

- ❖ If using BIM,  
the **BIM integrator** (if separate from the CM) may help fill this role,  
but the CM is the **central** point for **all** team communications.
- ❖ If revisions to the document control protocols are **necessary**,  
the CM also **updates** the BIM procedures (if applicable).

Do we need a communication matrix?

## Team communication matrix

- ☐ A **team communication matrix** supports fast and accurate information distribution.
- ☐ The matrix may be
  - ❖ Part of the MIS,
  - ❖ Part of another document (e.g., The PMP/PgMP), or
  - ❖ A separate spreadsheet.
- ☐ The matrix **establishes**
  - ❖ Document types,
  - ❖ Communication needs,
  - ❖ Originators,
  - ❖ Recipients, and
  - ❖ Time limits for review/response for each type of document.
- ☐ In addition, the matrix should establish the media of deliverables, such as electronic data format, paper copy, etc.

# **DESIGN DOCUMENT REVIEW**

❑ Periodic design review **meetings** must address and monitor

**compliance with**

1. Owner's technology requirements and
2. Established BIM standards (if applicable).

❑ The MIS

- ❖ **Facilitates** design reviews and
- ❖ Should **include** procedures or tools for all relevant stakeholders to provide comments during each design stage.

- ☐ The CM must remember that the **newest technology may not** be the right solution and that some technologies create **risk or are unfamiliar** to stakeholders.
- ☐ **Design reviews** that the CM properly **coordinates** with stakeholders can help **uncover hidden issues** with technical requirements before they become **sources of claims**.

Who should participate?

- ☐ The CM **ensures** that all **stakeholders** who might have **significant contributions**
  1. Know the project's/program's progress and
  2. Have opportunities to provide their input.

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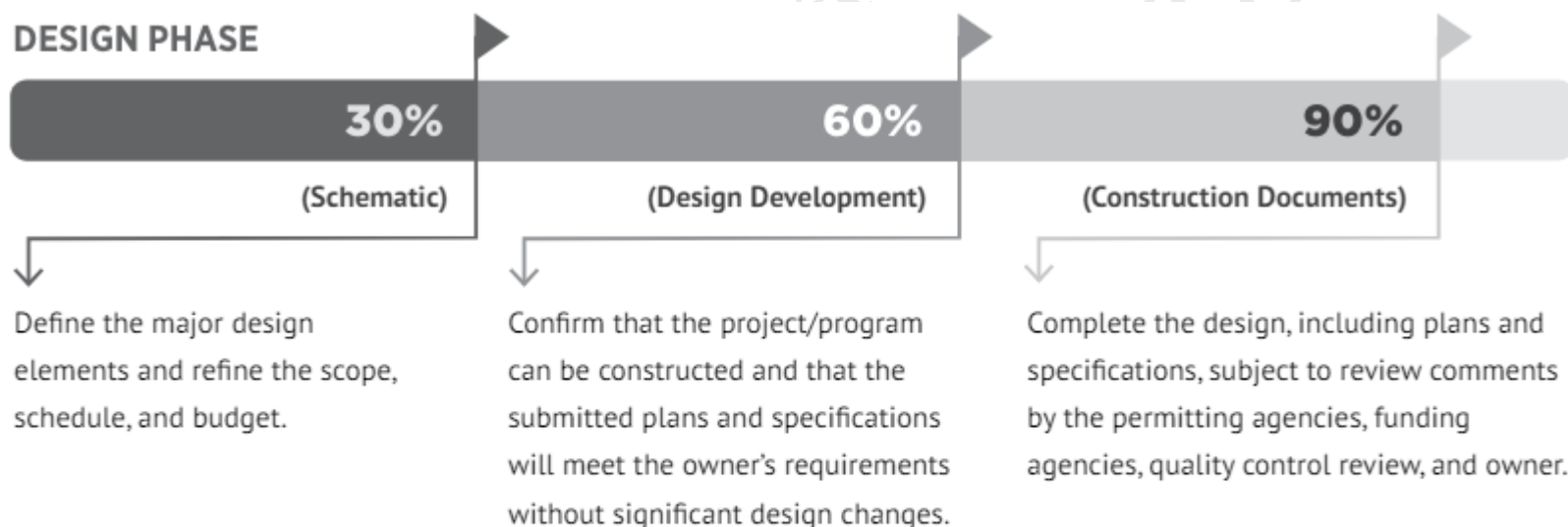
☐ **Design reviews** should include

1. BIM integrator (if using BIM),
2. Owner's O&M staff,
3. Independent estimators and schedulers, and
4. Sustainability consultants, as appropriate.

**When to review?**

❑ At a **minimum**,

the parties should have a **chance to review the designs** at schematic (30%), design development (60%), construction documents (90%), and final construction bid document stages.



*Figure 3 – Design milestones. These are typical benchmarks for 30%, 60%, and 90% design stages, but definitions may vary.*

**Should CM communicate to the community?**

## Communicate to the community

- ❑ If needed, the CM also helps the owner **communicate** project/program details to the surrounding community and other public stakeholders after **major design milestones**.

- ❑ The CM may use
  - ❖ BIM model,
  - ❖ Phasing, and
  - ❖ 4D simulation

as part of these communications, if applicable.

## Biddability, constructability, operability, and sustainability reviews

- ❑ The CM must recognize that **design elements** may affect structure's
  1. **Biddability** (if the owner could put the project or program out for bid in the marketplace),
  2. **Constructability** (how reasonable and efficient construction would be),
  3. **Operability** (how well the design specifications allow the owner to operate and maintain the completed structure efficiently), or
  4. **Sustainability** (use of energy and resources).

Let's see an example!

## Biddability, constructability, operability, and sustainability reviews

- ❑ For example, **technology requirements** could impact a contractor's ability to implement their "**means and methods**,"
  - ❖ Determine safety policies,
  - ❖ Affect the permitting process, and
  - ❖ Create utility conflicts during construction.
- ❑ During operation, the owner may have specific
  - ❖ Testing,
  - ❖ Balancing, or
  - ❖ Commissioningrequirements or need the **record model** to integrate with **other digital facility management systems**.

## Biddability, constructability, operability, and sustainability reviews

- ❑ Therefore, **design reviews** must consider how the **design's technology requirements** **impact** biddability, constructability, operability, and sustainability.
- ❑ The CM should **routinely review** the designer's submissions throughout the design phase.
- ❑ The CM must **reconcile** these reviews and ensure that the team **resolves all issues** before work continues.

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- ☐ When **using BIM**, the CM, designer, and BIM integrator (if a separate entity) **must review** the design **submittals** for compliance with **established BIM standards**.
- ☐ The **model** allows the team to
  1. Visualize spaces and functions,
  2. Optimize the design, and
  3. Make decisions.
- ☐ **All design disciplines** should participate and perform clash detection.

- ❑ **Site visits** may be necessary to ensure spatial accuracy and support design reviews.
- ❑ These visits typically **produce** digital records, including
  - meeting minutes,
  - pictures,
  - video recordings,
  - photogrammetric data, etc.
- ❑ The CM should **participate** in these site visits and **ensure** that the team accurately records all data.

# **SCHEDULING**

- ❑ The CM usually **establishes** a specification for **acceptable scheduling software** with the lead **designer's input**.
- ❑ The CM **develops** the **scheduling specification**  
because they will monitor the **builder's schedule** during construction.
- ❑ The **specification** should
  - ❖ Consider the **software's ease** of use and
  - ❖ Interoperability with the **team's other systems**.
    - ✓ *For example, the CM must consider how well the scheduling software integrates with the team's MIS or if the MIS already has built-in scheduling functionality that would meet this need.*

## Preliminary design schedule

- ❑ The CM may **use** the **scheduling software** to provide a preliminary design schedule to
  - ❖ Lead designer and
  - ❖ Determine a reasonable construction duration.
- ❑ The **designer** further **develops** the preliminary design schedule to **facilitate** the planning and execution of the design work.
- ❑ As the **design work progresses**, the **team's scheduling experts** should also use the software to develop a pre-bid construction schedule that serves as a **baseline** to **estimate** the **overall construction time**, which the CM should review.

❑ However, this process may vary,

so the CM should **carefully review**

- ❖ Design professional's contract and

- ❖ Their own CM contract with the owner.

- ✓ *For example, the contract documents might require the CM to*

*fully prepare the design schedule,*

*using details of the work that the design professional provides.*

# **COST CONTROL**

- ❑ Technology may help the CM **monitor costs** to assist the **designer (or design-builder)** with construction **budget compliance**.
- ❑ The CM **constantly monitors** the **design** to
  - ❖ Identify scope changes,
  - ❖ Evaluate the cost (and time) impacts, and
  - ❖ Report the impacts to the team.
- ❑ The CM may **consult** a variety of
  - ❖ **Industry databases**
  - ❖ **Data from past projects/programs** to evaluate, monitor, and **control** estimates.

- ❑ The team may also use **AI and BI tools** to **identify** cost variances and opportunities to increase **design efficiency**.
- ❑ The CM
  - ❖ **Verifies** that AI's and BI's uses **follow** the contract specifications,
  - ❖ **Ensures** that all team members **understand AI's/BI's role**, and
  - ❖ **Advises** the owner regarding **potential claims**.

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ارائه دهنده:

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## What we will learn?

- ☐ Introduction
- ☐ Procurement planning
- ☐ Advertisement and solicitation of bids
- ☐ Pre-bid conference
- ☐ Contract award

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# INTRODUCTION

- ❑ **Procurement** relies on the **documents** the team created in the **pre-design and design phases**

to **acquire** products and services that meet the **owner's COS**.

- ❑ The **PMP/PgMP** should **clearly outline**
  - ❖ Procurement phase's systems,
  - ❖ Methods, and
  - ❖ Procedures.
- ❑ Similarly, the **design documents** must establish technology's specifications.

**How delivery methods affect?**

- ❑ The CM must remember during procurement that **each delivery method** uses **technology differently**.
  - ❖ For example, it is more difficult to **integrate technology** in the design-bid-build method **than in** design-build or CMAR because design-bid-build contracts are less collaborative.
- ❑ The CM **must tailor** the procurement process to the specific delivery method and the owner's requirements.

**What factors determine the CM services regarding to technology in this phase?**

## CM technology services in procurement

### ☐ Depending on

1. The **CM's contract** with
2. The owner and the owner's COS,

the CM may need to **procure** certain project/program control **technologies** (e.g., inspection tools, a commissioning dashboard, etc.).

### ☐ If a CMAR,

the **CMAR** might need to

1. **Procure technologies** to build the structure(s) (e.g., Smart materials, exoskeletons, etc.)
2. In addition to project/program **control technologies**.

# **PROCUREMENT PLANNING**

## Pre-qualification and pre-approval

☐ Many owners require

1. The pre-qualification of contractors and
2. Pre-approval of **materials** and **suppliers**

to ensure these **vendors** meet the owner's requirements.

☐ Some owners also require **potential vendors** to

**register** for digital systems that the **owners use** to communicate procurement information.

Do we need specific services for each project?

## Pre-qualification and pre-approval

❑ These pre-qualifications and pre-approvals

may **apply** to the owner's entire construction portfolio and

are **not necessarily** project- or program-specific.

❖ However, some owners also pre-qualify vendors for **types of** construction and scopes of work.

What the CM should mostly do here?

❑ The CM must

- ❖ **Understand** owner's digital procurement requirements and
- ❖ **Facilitate** the procurement process.

What parties should be involved?

❑ **Procurement planning** must involve

**all affected parts** of the owner's organization, including

- ❖ Those responsible for establishing the requirements,
- ❖ Purchasing group, and
- ❖ End-users.

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- ☐ The owner and CM might use **digital sources** to create a select bidders list **when** the owner **requires** prequalification or pre-approval.

What this list means?

☐ A **select bidders list** limits solicitations for

1. Equipment,
2. Materials, and
3. Services

to

a **specific** group of sources that have previously demonstrated **reliable quality and performance**.

☐ **Limiting** the sources may be prudent when the owner has **complex** technology requirements,

but this could also **increase** the **cost**.

❖ The CM ensures that this follows a **fair, reasonable process**.

# **ADVERTISEMENT AND SOLICITATION OF BIDS**

### ☐ The CM

❖ **Markets** the project/program and

❖ **Generates** interest from entities

that understand and are qualified to meet the **owner's technology requirements**.

☐ The CM should **follow** the owner's prescribed methods for **contacting** vendors and contractors.

☐ Note that **some owners** may require advertisement, solicitation, and submission of bids to occur entirely on the **owner's digital platform**.

☐ This process must meet all legal requirements.

- ❑ The CM must **develop** an appropriate plan to attract qualified sources when the owner does **not require** a specific **advertising method**.
- ❑ This advertising may include digital media to reach the **target audience effectively**.
  - ❖ *Examples include online newspapers, business journals, and trade association newsletters.*
- ❑ The **advertisement** should include instructions to bidders that explain the procurement requirements and how to obtain copies of the procurement documents.
- ❑ The CM might **distribute** the procurement documents virtually, such as through the owner's online platform where bidders can download them.

## Relevant technology documentation

❑ The CM must **encourage** the owner and designer

to formally include any **relevant technology documentation** (such as the BIM models, AI/BI requirements, etc.) in the **procurement documents**.

❖ This approach helps **bidders to understand** the project/program better.

✓ **If** the owner and designer choose **not to include** these documents formally,

the CM should **recommend** their use as reference documents.

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# **PRE-BID CONFERENCE**

- ❑ The pre-bid conference
  - ❖ **Helps** the bidders **understand** team's responsibilities and requirements,
  - ❖ **Clarifies** any issues, and
  - ❖ Often **includes** a site visit.
- ❑ This meeting may also be called a pre-proposal meeting.
- ❑ The CM should **conduct** the pre-bid conference,  
but **other team members** (such as the owner and designers)  
should also be present to **address any technical** (as well as  
contractual or administrative) issues.

## Owner's technology requirements/COS

- ☐ The CM **highlights** and **explains** the owner's technology requirements/COS.
- ☐ If using BIM,  
the CM **uses** the **BIM model** to help explain and generate  
**comments or questions** from potential bidders.
- ☐ If using AI or BI,  
the CM should **summarize** how the **team will use** these tools to monitor  
variances.
  - ❖ **How** the team will **use these tools** may vary significantly depending on the
    1. Owner's requirements
    2. The delivery method.

### □ After the meeting,

the CM should use the **owner's prescribed method**

to issue any necessary **addendum** to all potential bidders.

❖ *Examples of prescribed methods may include posting the addendum on the owner's digital bid solicitation platform and emailing all pre-bid conference attendees.*

- ✓ The CM should **repeat** this process **when answering** any **additional** questions from potential bidders.

**CONTRACT AWARD**

## Pre-award conference

- ❑ The owner and CM should conduct a pre-award conference with the **apparent successful bidder**

to **review** the pricing and scope of services, including **technology services**.

- ❑ Typically, the **PMP or PgMP formally establishes** the owner's COS/technology requirements,

but the **contract documents** must include these requirements (as applicable) to

- ❖ **Align** the bidder's goals with the owner's,
- ❖ As well as **any additions or revisions**, including meeting notes.

## Before signing the contract

- ☐ Before signing the contract,  
**both parties** should fully **understand** their responsibilities and commitments.
- ☐ The CM should **review** the owner's COS and any other technical requirements with the contractor.

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## Before signing the contract

- ❑ The review must **confirm** the absence of any errors or omissions in the proposal and the contract documents. **For example:**
  - ❖ The CM should **confirm** that the proposal and contract documents **specify**
    - ✓ **Which systems** the team will use and
    - ✓ **Which team members** are responsible for maintaining and integrating those systems, if the owner requires.
  - ❖ The CM must **remember** that **integration is more difficult** in certain delivery methods, such as design-bid-build.

## Before signing the contract

❑ The review must **confirm** the absence of any errors or omissions in the proposal and the contract documents. **For example:**

❖ When the PMP/PgMP requires **full BIM implementation**,  
the CM **verifies** that the contract documents require participants to  
update and revise

1. The model and all parts,
2. Sub-models, and
3. Databases to reflect as-built conditions.

## Before signing the contract

- ❑ The review must **confirm** the absence of any errors or omissions in the proposal and the contract documents. **For example:**
  - ❖ The **contract documents** should require
    - ✓ **Linking** the documented models and databases
    - ✓ **Submitting** them during post-construction.
  - ❖ The contract documents must include  
**training** for the owner's staff and any other relevant team members  
on **how to access** information from the updated BIM  
model.

## Before signing the contract

- ❑ The review must **confirm** the absence of any errors or omissions in the proposal and the contract documents. **For example:**
  - ❖ When the project or program will **use AI or BI tools** to monitor the budget and schedule,  
the CM must **ensure** that the **apparent successful bidder**
    - ❖ **Understands** how the team will **use these technologies** and
    - ❖ That relevant team members **receive** any **necessary training**.
  - ❖ This **training** may include members of owner's staff,  
who must understand that **AI and BI may produce** unique or challenging claims.

## Before signing the contract

- ❑ The review must **confirm** the absence of any errors or omissions in the proposal and the contract documents. **For example:**
  - ❖ Finally, the CM must **recognize** when the owner has **digital procedures or systems** to execute and administer contracts formally.
    - ✓ *For example, the owner may require digital signatures on agreements and contractors to register for web-based payment systems.*
  - ❖ The CM should **understand and follow** the owner's procedures to **notify** the successful and unsuccessful bidder(s).
  - ❖ The CM or owner should **issue** a notice to proceed (NTP) after **owner approval** and all parties **execute the contract**.
  - ❖ The **written NTP** may be **electronic**,  
such as an email or a message through the **MIS**.



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## What we will learn?

- ☐ Introduction
- ☐ Pre-construction conference(s)
- ☐ Existing conditions
- ☐ Construction planning and scheduling
- ☐ Communication procedures
- ☐ Recordkeeping and reporting
- ☐ Document control and distribution
- ☐ Permits, insurance, labor affidavits, and bonds
- ☐ Quality
- ☐ Commissioning
- ☐ Progress meetings
- ☐ Progress payments
- ☐ Record drawings
- ☐ Pre-closeout meeting
- ☐ Punchlists

# INTRODUCTION

## Construction phase and technology

- ❑ The construction phase is when the team **implements**
  - ❖ **Owner's technology requirements** (as well as time, cost, etc.),  
as stated in the PMP/PgMP, CMP, and
  - ❖ **Contract documents**, to achieve the owner's **COS**.
- ❑ The CM is not necessarily a technology expert but must **understand** the owner's COS well enough to manage delivery.
- ❑ The CM should **use appropriate technology** to control the schedule, budget, quality, etc.

**What the CM should ensure here?**

## Construction phase and technology

❑ The CM **ensures** that

each team member fulfills their

1. Technology responsibilities and
2. The scope of work

that the **contract documents** require.

❖ The CM should **encourage**

proactive stakeholder participation throughout  
construction.

Frequency and impacts of issues?

## Frequency and impact of issues arising from preconstruction and construction/closeout activities

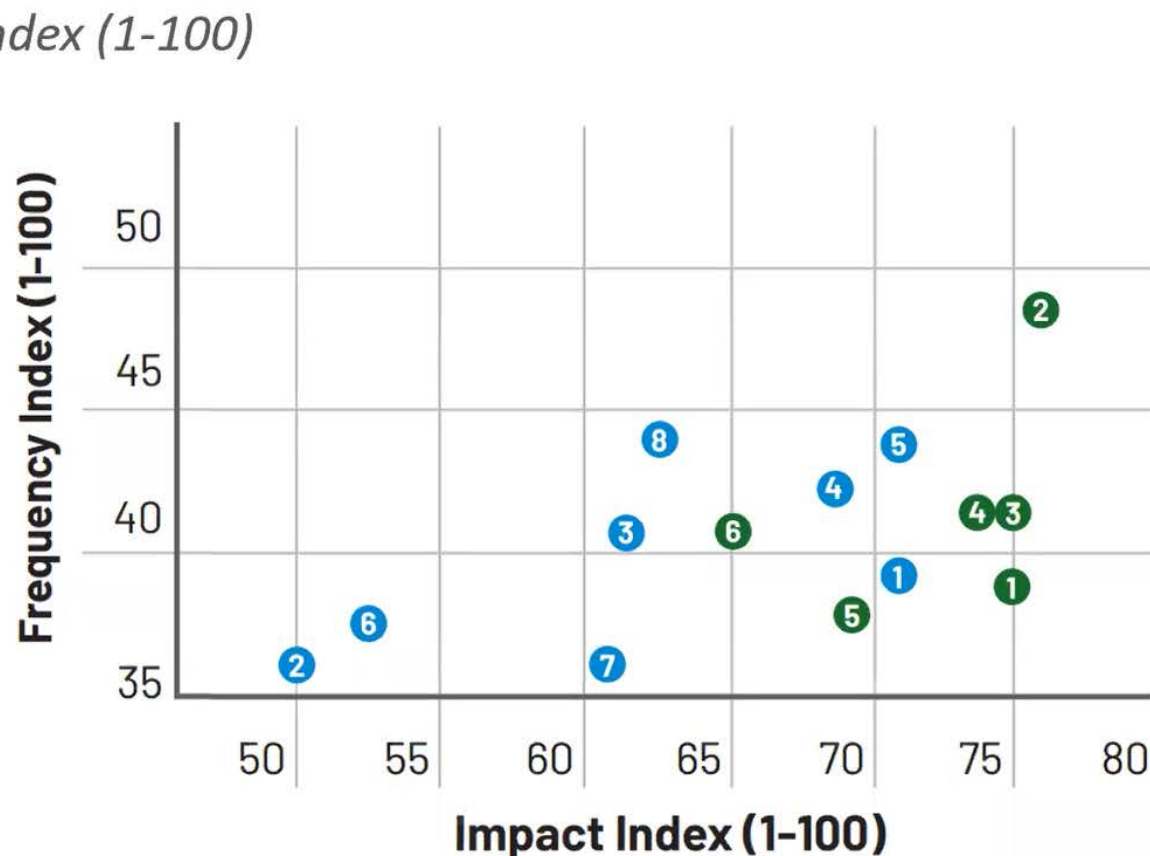
11

### Preconstruction

- ① Project Intake/Request
- ② Design Review
- ③ Estimates
- ④ Bid/Procurement
- ⑤ Permitting
- ⑥ Submittals

### Construction/Closeout

- ① RFIs
- ② Field Inspection/Daily Reports
- ③ Project Details Update
- ④ Potential Change Order
- ⑤ Budget Approval/Change
- ⑥ Commitment Invoices/Approvals
- ⑦ Construction Payment Application
- ⑧ Project Closeout



# **PRE-CONSTRUCTION CONFERENCE(S)**

## Pre-construction conference

- ❑ The contract documents should require a **pre-construction conference** that
  - prime builder(s),
  - owner,
  - CM,
  - BIM integrator (if applicable, and a separate entity),
  - commissioning agent,
  - major trade partners,
  - sustainability consultant(s) (if applicable),
  - affected utilities,
  - local agencies, and
  - designers
  - all attend.**

- ❖ The CM **leads** the meeting and **distributes** minutes **afterward**.

**What should be discussed?**

❑ As part of the meeting, the **team** should **discuss**

1. The owner's COS and
2. Any other technical delivery requirements  
in detail.

Who should present a plan to  
implement technology requirements?

## Pre-construction conference

- ❑ The **prime** builder/general contractor or **another designated** team member should **present** a plan to achieve these requirements.
- ❖ The **meeting** should **summarize**
  - ✓ Technology's use during construction and
  - ✓ The team's roles.

What the summary of the meeting should include?

## Meeting summary

- ❑ This summary may include, but is not limited to:
  - ❖ Any particular technology requirements to accomplish **certain features** in the **finished structure** (such as smart materials, fixtures, equipment, technologies that improve end-user access, O&M, etc.);
  - ❖ The **team's MIS plus** any other digital systems, as applicable;
  - ❖ **Any AI and BI tools** that will monitor variances in the budget, schedule, quality, etc.;
  - ❖ **Document control protocols** (workflows, alerts, and queues to automate the flow of RFIs, submittals, and shop drawings);

❑ This summary may include, but is not limited to:

❖ If **using BIM**, the processes to

1. Transition the model to the construction phase,
2. Model revisions based on existing conditions,
3. Shop drawings,
4. Clash detection, and
5. Other relevant parts of the BEP;

❖ Use of connected mobile devices for **onsite** coordination;

❖ Owner-provided materials and equipment;

❖ Commissioning requirements, including the time necessary to complete commissioning on any unique or complex systems;

❑ This summary may include, but is not limited to:

❖ Payment application requirements,

particularly if they are related to any **jobsite data** such as

- ✓ health/safety information,
- ✓ inspection reports,
- ✓ commissioning data,
- ✓ etc.; and

❖ Any other project- or program-specific requirements.

**What if sustainability is part of the project?**

- ❑ For projects/programs with **sustainability requirements**,  
it is wise to **conduct a separate sustainability preconstruction conference** to discuss sustainability/resiliency requirements.
- ❑ These requirements may include special technologies, such as
  - ❖ Systems for renewable energy production or storage,
  - ❖ Water reclamation,
  - ❖ Noise reduction, etc.
- ❑ If the **option** for a separate meeting is **not available**,  
these topics should also be **part of the pre-construction** conference agenda.

**What should be done after the meeting?**

### ❑ After the meeting(s),

the CM should **update**

1. CMP,
2. PMP/PgMP, and
3. PPM with **any changes**

in procedures or responsibilities

**arising** from the pre-construction conference(s).

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# **EXISTING CONDITIONS**

### ☐ The CM

- ❖ **Minimizes** the potential damage of claims by carefully **reviewing** existing conditions that construction will impact.
- ❖ **Conducts** a **jobsite** walkthrough
- ❖ **Records** the condition of existing structures and other areas of note.

☐ The prime builder(s) should also **participate** to **minimize** disagreements later.

What CM should do with digital records?

## Technology for existing conditions

- ☐ The CM should properly **create** and **store** digital records from the walkthrough in case they are relevant to **future disputes**.
- ☐ The CM can **record** the inspection by **photo or video** with a **date stamp** to **benchmark** existing conditions before construction begins.
- ☐ The walkthrough may also include building envelope scans that use **digital thermal imaging equipment** to record **existing conditions**.

# **CONSTRUCTION PLANNING AND SCHEDULING**

## Planning and scheduling

- ❑ The **prime builder(s)** must submit  
a realistic work plan and CPM schedule  
that conform to **contract requirements**.
- ❑ The **schedule duration** must include **enough time** to
  1. Accomplish the technical requirements and
  2. Meet the owner's COS.
- ❑ The CM should remember that **new technologies** may come with **significant risks** and **unfamiliar** requirements.
  - ❖ Therefore, the **schedule duration** must include enough time for  
*prefabrication, material delivery, completion, submission, acceptance,  
testing, inspection, and verification of the completed work.*

**What the CM should do here?**

## Review the schedule

### ❑ The CM

- ❖ **Reviews** the **builder's baseline schedule** and
- ❖ **Determines** if the basic logic, sequencing, and workflow are
  1. Free of significant errors,
  2. Meet the contract requirements, and
  3. Follow industry practice.

What if the AI and BI used?

## Review the schedule

❑ If the contract specifications allow,

the CM may **use AI or BI tools** to analyze the contractor's plan.

❖ However, all team members must **understand how** the team will use these tools.

✓ The CM must use care **not to dictate** a builder's means and methods (**unless** the CM is at-risk).

How digital tools help here?

❑ **Digital tools** can help the CM **compare** the team's progress to the baseline schedule throughout the **construction** and **post-construction** phases.

❖ *For example, IoT sensors can report*

1. *Status and*

2. *Location*

*of prefabricated materials in the manufacturer's warehouse, during shipping, in staging, and during delivery to the jobsite.*

❑ This data **helps** the CM identify schedule variances sooner and take **corrective action**, if needed.

# **COMMUNICATION PROCEDURES**

## Communication in real-time

- ❑ Technology creates **more ways** for teams to communicate in real-time on jobsites.
  - ❖ *For example, the team's MIS, a document control system, or other software may have **built-in functionality** that allows all team members to communicate with each other via text, voice, or video.*
- ❑ This **functionality** may be **compatible** with portable devices, like phones and tablets.
- ❑ The CM
  - ❖ **Ensures** that the entire team follows established communications protocols and
  - ❖ **Uses** appropriate technology to address **problems** on the jobsite.

☐ The team must have **clear policies** about **how to use** technology to

1. Plan,
2. Discuss, and
3. Record

the work.

How digital MIS helps?



Johnson Construction Group  
Northern ring road, Newtown  
Document database – Waterproofing claim

| Date      | Type    | Ref.  | From | To   | Subject                                                            | Contents                                                                                                      |
|-----------|---------|-------|------|------|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| 08-Jul-13 | Letter  | 0306  | JCG  | APS  | Supply and Apply Eliminator System (Spray Type Waterproofing)      | Letter of intent                                                                                              |
| 18-Jul-13 | Mat App | 44    | JCG  | ENGR | Materials Approval                                                 | Product and subcontractor approval                                                                            |
| 25-Sep-14 | Test    | C1194 | APS  | JCG  | Test Certificate                                                   | Test Certificate 2A Underpass Bridge                                                                          |
| 14-Oct-14 | Letter  | 2053  | ENGR | JCG  | Laying of Sub-grade at Different Locations in Type 1 waterproofing | Waterproofing under investigation. Instructed not to lay until approved. APS to provide requested information |
| 16-Oct-14 | Letter  | 001   | JCG  | APS  | Waterproofing Type 1                                               | Request technical clarifications. Enclosing mix designs                                                       |
| 17-Oct-14 | Letter  | 2196  | JCG  | ENGR | Laying of Sub-grade at Different Locations Waterproofing Type 1    | back                                                                                                          |
| 17-Oct-14 | Letter  | 2061  | ENGR | JCG  | Laying of Sub-grade at 1C-2A on Waterproofing Membrane Type 1      |                                                                                                               |
| 25-Oct-14 | Email   | 1194  | APS  | JCG  | Waterproofing Type 1                                               |                                                                                                               |
| 01-Nov-14 | Letter  | 2114  | ENGR | JCG  | Waterproofing Membrane Type 1                                      |                                                                                                               |
| 02-Nov-14 | Letter  | 2264  | JCG  | ENGR | Waterproofing Type 1–APS report                                    |                                                                                                               |
| 03-Nov-14 | Letter  | 2123  | ENGR | JCG  | Waterproofing Type 1–APS report                                    |                                                                                                               |

RFI # 45

Created By: General Contractor, Derrick Morgan  
Date Created: 04/22/2014  
Date Submitted: 04/22/2014

Status: Closed  
Priority: Low  
Due Date: 04/29/2014

+ Additional Send & Assignment Information

Subject: Question about 3" conduit E103

RFI Response # 1 Closed

Subject: Engineer Response to RFI # 45

History

|                       |                    |                            |                |             |                    |
|-----------------------|--------------------|----------------------------|----------------|-------------|--------------------|
| Apr 22 2014 3:58:16pm | Created By         | Engineer                   | Rodney Dawson  |             |                    |
| Apr 22 2014 3:58:21pm | Submitted By       | Engineer                   | Rodney Dawson  | To          | Owner/Constructio  |
| Apr 22 2014 3:58:37pm | Read By            | Owner/Construction Manager | Eric           |             |                    |
| Apr 22 2014 4:45:51pm | Forwarded By       | Owner/Construction Manager | Eric           | To          | General Contractor |
| Apr 22 2014 4:45:58pm | Marked Official By | Owner/Construction Manager | Eric           | Shared With | General Contractor |
| Apr 22 2014 4:45:58pm | Marked Official By | Owner/Construction Manager | Eric           | Shared With | Owner/Constructio  |
| Apr 22 2014 4:45:58pm | Marked Official By | Owner/Construction Manager | Eric           | Shared With | Engineer           |
| Apr 22 2014 4:46:47pm | Read By            | General Contractor         | Derrick Morgan |             |                    |

**How the CM could help the owner here  
to reduce the risks?**

## Communication in real-time

- ❑ To **reduce** the owner's risk, the CM **ensures** that the team understands
1. which methods/systems are **acceptable** for project/program communications,
  2. who has access, and
  3. how to use them.

What about the confidentiality of the information?

- ❑ Many owners are **sensitive** to the public perception of their facility investments.
  - ❖ From the **CM's staff to trade workers** on the jobsite, the **entire team** has access to information that the owner may need to control.
    - ✓ The CM must
      1. **Advise** the owner and
      2. **Establish** a procedure for sharing information with the public.
- ❑ The owner should **approve** any project/program **information** before it becomes public, such as **social media posts**.

- ❑ The contractor(s), CM at-risk, or design-builder is/are **responsible** for coordination during construction,
  - but **jobsite personnel** should follow the team's policies and **use connected mobile devices** to coordinate construction.
  - ❖ *For example, **personnel** should be able to **reference relevant plans and specifications** from the jobsite and provide real-time data on work in progress.*
- ❑ Comprehensive, **real-time coordination** can significantly enhance all aspects of delivery, including time, cost, quality, and safety.

# **RECORDKEEPING AND REPORTING**

## Importance of recordkeeping

- ☐ The CM must realize that high-quality, **thorough recordkeeping** and reporting are mandatory during construction.
- ☐ The **CM's goal** is to provide the team with **timely information** regarding the project's/program's **status** compared to the plans.
- ☐ The **MIS** should help the CM **proactively manage** the project or program.

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❑ During construction, the MIS should **store digital records**

that **document** the builder's progress.

❖ *Examples include*

- ✓ *Inspector diaries,*
- ✓ *A resident engineer's/project manager's daily report,*
- ✓ *Contractors' reports,*
- ✓ *Progress photos,*
- ✓ *Performance testing,*
- ✓ *Logs, and*
- ✓ *Schedules.*

❑ Builders should also incorporate **all additional work** into as-built drawings and other job records in the MIS.

- ❑ The MIS should **continue** to issue reports of type, format, and frequency that the team determined **during the pre-design phase.**

What to track in terms of cost control?

☐ The system includes a method of computerized cost control to track

1. Change requests,
2. Claims estimates,
3. Actual contractor bid prices, and
4. Progress payments.

☐ The CM should **monitor** and **maintain** daily cost records of

1. Expended labor,
2. Material, and
3. Equipment

for contract and force account work.

**How about the schedule?**

- ☐ While it is usually the **builder's responsibility** to revise the schedule,  
the CM also **uses the MIS** to
  1. Monitor the schedule and
  2. Help the contractor update the schedule at least monthly

What other capabilities the MIS should have?

- ❑ The **MIS** should **warn** the CM, owner, and other relevant team members of variances.
- ❑ If an **issue arises**, the system should be able to
  - ❖ Scan all the digital components and
  - ❖ Develop a chronological list of supporting data.
- ❑ The MIS should be **able to** sort by  
date, specification, contractor, or trade partner  
to **identify**
  1. Bottlenecks,
  2. Poor quality work, and
  3. Cost overruns.

What if AI and BI is used?

☐ If specified in the contract documents,

the MIS may **also use** AI and BI tools to **determine**

if the contractor is

1. Significantly behind or
2. Working materially different from the approved schedule logic.

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# **DOCUMENT CONTROL AND DISTRIBUTION**

❑ An **effective digital MIS** can establish

workflows, alerts, and queues to automate the flow of documents, such as  
RFIs, submittals, shop drawings, and change orders.

❑ A **digital MIS** also

- ❖ **Logs** changes to documents and
- ❖ **Helps** ensure the team only uses the latest versions.

How to implement?

## Implementing the electronic document management system

- ☐ Web-based system
- ☐ Initial training
- ☐ Follow up training
- ☐ Customizing the management system

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## How to process, manage?

### ☐ Hardcopy documents:

- ❖ Quantity of copies for each document
- ❖ Maintenance of individual tracking logs
- ❖ Process, compile, prepare documents to return
- ❖ Filing of documents

### ☐ Electronic documents:

- ❖ One document
- ❖ Tracking of documents integral with software
- ❖ Process, compile, prepare documents to return.

- ❑ On projects/programs that use BIM,
  - the CM, the BIM integrator (if a separate entity), and the construction team
  - use the **document control protocol** to transition the BIM model to the construction phase.
- ❑ The **contract documents** should require the builder(s) to
  1. Use the model for coordination and
  2. Must clearly indicate who is responsible for maintaining the BIM model.
- ❑ The CM must **understand** the contractual, legal, and any other applicable requirements.

- ❑ The CM **encourages** the full use of BIM tools in coordination and issue resolution.
  - ❖ *For example, the team must revise the model based on*
    1. *Existing conditions,*
    2. *Trade partners' shop drawings, and*
    3. *Clash detection.*
- ❑ On BIM projects/programs, the team
  - ❖ Develops a **4D model** that connects to the schedule and
  - ❖ Allows the team to **visualize any deviations** from planned sequences or durations.
- ❑ The **contract documents** or **PPM** should specify that periodic progress meetings include **4D reviews**.

- ☐ The CM **ensures** that the team updates the model throughout construction so that it evolves into an **as-built model** for record purposes.
- ☐ An **up-to-date model** helps the team
  1. Monitor progress and
  2. Review change orders' impacts.

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- ❑ The **specific approach** to updating the model **may vary** from project to project, so the CM should **verify** the contract documents' specifications.
- ❑ The **contract language** should clearly explain **which entity** is responsible for **updating**
  1. The **model** as an as-built record document and
  2. The **desired level of detail**.
    - ❖ Usually, the builder is responsible for **documenting changes**.
    - ❖ On larger or more complex projects and programs, an onsite model and designated BIM integrator may be **appropriate** to monitor and update the model as work progresses.

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