



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 پنجم: به کارگیری فناوری‌های دیجیتال در مرحله ساخت

ارائه دهنده:

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(PhD, PMP, CMIT)

CMAA Authorized Trainer

دانشگاه Illinois Tech آمریکا

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

PERMITS, INSURANCE, LABOR AFFIDAVITS, AND BONDS

- ❑ The MIS or a specialized digital dashboard can help the team **track the status** of permits, insurance, labor affidavits, and bonds (including approvals and expiration dates).
- ❑ **Contractors** must not begin work **until** the required permits, insurance, labor affidavits, and bonds are in place.
- ❑ The CM should
 - ❖ **Receive** copies of all documents,
 - ❖ **Review** each for compliance, and
 - ❖ **Store** them using appropriate recordkeeping procedures.

- ❑ Note that a project or program with technology requirements may have **unique systems** that carry increased risk and require extra approval before the team may install/use them.
 - ❖ *For example, digital alarm systems that signal local police, fire, or paramedic services in an emergency may need special permits from those agencies.*
 - ❖ *In another example, digital equipment that monitors the health and safety of all jobsite personnel may increase the owner's claims risk, so the CM should confirm that all parties have appropriate insurance, such as builder's risk, general liability, and worker's compensation.*

QUALITY

- ❑ **Many different technologies** can enhance quality control (QC) and quality assurance (QA).
 - ❖ *For example, drones can help inspection teams survey completed work in hard-to-reach areas.*
- ❑ **Inspection and testing** may use
 - ❖ IoT digital sensors (e.g., electronic gauges/meters that measure pressure, humidity, voltage, etc.) and
 - ❖ Cameras (e.g., infrared, visible imaging, etc.) to create and share data about the work.
- ❑ **AI and BI tools** may also help teams analyze **testing and inspection data** to identify problems a human could not.

- ☐ The **contract documents** must clearly state which parties have QC and QA responsibilities.
- ☐ In **most cases**, the builder is responsible for the QC of the work, and the **CM performs QA**,
but this **may vary** depending on the CM's role (agency or at-risk),
the type of work, and the owner's requirements.

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- ☐ A project/program may have **unfamiliar or unique** technology requirements, which may require **unusual or complex** installation, inspection, and testing procedures.
- ☐ If the **CM's contract** with the owner requires, the CM **monitors** any acceptance and performance testing that the builder performs.
- ☐ If **any work does not fall** within a contractor's scope and has **unusual** testing **requirements**,
the CM may **arrange to test** those portions of the work.

COMMISSIONING

- ❑ The CM must **recognize** that the **owner's COS** may involve unique or complex systems with **unfamiliar requirements**.
 - ❖ *For example, the owner may have specific technical requirements related to sustainability/ resiliency, O&M, accessibility, and security.*
- ❑ The owner may also **supply** their own components, materials, or equipment that **require** separate installation and testing procedures.

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- ❑ The CM should **work** closely with the **commissioning agent** and the rest of the team to
 - ❖ Integrate commissioning activities into the overall construction schedule,
 - ❖ Schedule site inspections that focus on system O&M.
- ❑ The **commissioning agent** will **document** that equipment, systems, and assemblies are installed, integrated, and operational in a manner that meets the **owner's requirements**.

- ❑ The commissioning agent may have their **own electronic system** that provides a digital dashboard for managing these processes.
- ❑ The CM
 - ❖ Must **understand** how to access the information from the commissioning dashboard and
 - ❖ May consider **integrating** it with the **MIS or the owner's other systems**.

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PROGRESS MEETINGS

- ☐ As the CMP or PMP/PgMP should **outline**,
the CM **regularly leads** these meetings as appropriate to the project's or program's scale, complexity, and risks.
- ☐ Each **meeting** should **review** the **team's work** to achieve the owner's technology requirements.
- ☐ **Attendees** should include
CM, prime contractor(s), critical representatives from trade partners, an owner's representative, key representatives from the firm or persons responsible for obtaining certifications (e.g., sustainability), and a designer representative, when required.

- ❑ Technology may **enhance delivery** in many ways, so there may be many different topics related to technology that **each meeting** should address.
- ❑ Some of the **general agenda topics** may include (but are not limited to):
 - ❖ Safety data;
 - ❖ Changes to the BIM or virtual model, when appropriate;
 - ❖ Sustainability documentation, when appropriate;
 - ❖ Submittal status;
 - ❖ Labor and equipment status;
 - ❖ Schedule status;
 - ❖ Cost status;
 - ❖ Inspections;
 - ❖ Commissioning; and
 - ❖ Other project- or program-specific performance data.

PROGRESS PAYMENTS

Progress payments

- ☐ The CM should **propose** a contractor **progress payment** process to the owner,
unless the owner's current operations plan **already has one**.
- ☐ At the end of **each pay period**,
CM may **need** to analyze a **variety of data** in the MIS
to **determine** the **actual amount of work** performed
before recommending payment.
- ☐ As a best practice, the CM should **review**
the **contractor's drawings and summaries** of daily records in the
computerized MIS at least **monthly**.
- ☐ **Missing or incomplete** data may indicate a problem.

Cost-loaded CPM schedule

- ❑ The owner may have **specific data requirements** for the work.
 - ❖ *For example, the owner may require detailed commissioning data that meets certain thresholds before the owner will accept the contractor's work as substantially complete.*
- ❑ The owner might also require a **cost-loaded CPM schedule**.
- ❑ Relying on the cost-loaded CPM schedule requires the **contractor** to **maintain the schedule's data** with current activities, changes, and other conditions (such as out-of-sequence work, delays, incomplete work, etc.).
- ❑ The CM may use **scheduling software** to check the cost-loaded schedule for **front-end loading**.
- ❑ If the **contract specifications** allow, the CM may also use **AI and BI tools** for this review.

RECORD DRAWINGS

- ❑ The CM **establishes** procedures for assembling and reviewing record drawings that reflect the **as-built conditions** on the jobsite.
- ❑ In many cases, the **design team** also reviews and approves record drawings.
- ❑ The owner will want the **BIM model** to reflect the as-built condition for facilities designed in a BIM environment.
- ❑ Consequently, the CM must **understand** the contract requirements that designate
 1. Who is **responsible** for **updating** the BIM model and
 2. When those updates occur (see “document control and distribution” above).

PRE-CLOSEOUT MEETING

- ❑ An **industry best practice** is to hold a **“red zone”** pre-closeout meeting between **90 and 120 days** before substantial completion.
- ❑ The CM **chairs** the pre-closeout meeting, which includes at least the builder(s), owner, and relevant trade partners.
- ❑ The **meeting** helps the team **plan for handover** to the owner and should discuss the remaining work, such as **steps** for commissioning important systems and the **plans** to train the owner's personnel on how to operate and maintain the facility's equipment, assets, and computerized models.

PUNCHLISTS

Beneficial occupancy/substantial completion

- ❑ When the project or program approaches beneficial occupancy/substantial completion,

the builder makes a **written request** for a punchlist walkthrough/inspection that will **identify** any nonconforming or incomplete work and assign corrective actions.

- ❑ The CM, contractor (if a separate entity), owner's representatives (including O&M staff), design representatives, and other relevant stakeholders (insurance representatives, lenders, etc.) should **participate**.

- ☐ The CM should **ensure** that the team appropriately records and manages all **punchlist** data.
- ☐ This **walkthrough** should **document** the status of the work and **produce** digital records (such as pictures, video recordings, and descriptions)
that the team **links to the BIM model** (if using BIM) or **digital plans to pinpoint** the work's exact location.
- ☐ The CM and contractor should also use a **punchlist tracking log**
to **monitor** the remaining punchlist items as part of the document control system in the MIS.
- ☐ **Punchlist completion** may be tied to the release of retention,
depending on the contract requirements.

- ☐ Once the punchlist work is **complete**,
the contractor notifies in writing that it is ready for the final inspection.
- ☐ The **final inspection** should be a formal site tour with the CM, owner, end-user(s), lender(s), contractor(s), and designer(s).
- ☐ The CM should **confirm** that **all final punchlist work** is complete.
- ☐ The owner should also **sign off** to give **final acceptance**.

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- ☐ **Minor punchlist** work that does **not affect** the owner's use may remain **incomplete** if the owner and CM **approve**.
- ☐ After the owner **declares** the construction contract substantially complete and **receives** a certificate of occupancy from permit inspections, the owner's responsibilities for insurance, utilities, maintenance, and warranties usually either change or begin.



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بخش ششم: به کارگیری فناوری‌های دیجیتال در مرحله پس از ساخت

ارائه دهنده:

سید محمدرضا علوی پور

(PhD, PMP, CMIT)

دانشگاه Illinois Tech آمریکا

What we will learn?

- ☐ Introduction
- ☐ Final documentation
- ☐ Q&M manuals and training
- ☐ Spare parts and warranties
- ☐ Commissioning
- ☐ Lessons learned

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INTRODUCTION

Post-construction phase and technology

- ❑ The **post-construction phase** provides the **bridge** between construction and the long-term operation of the completed structure.
- ❑ There can be a **tendency to rush** the closeout process, but the CM should **remember not** to lose momentum and diligently follow the closeout procedures.

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Post-construction phase and technology

- ❑ The CM's technology management **obligations** to the owner are **not yet over**, **even though** construction is complete.
- ❑ Once again, the CM does **not need** to be a technology expert but must **understand** the **owner's COS** well enough to ensure that the **handover** to the owner satisfies the owner's requirements.
- ❑ The CM must recognize that some **owners may not understand** the process.

Post-construction phase and technology

❑ The CM **advises** on

1. Available tools and data,
2. Their ROIs/ROVs, and
3. How to prioritize them.

❖ *For example, the team may use electronic systems to manage closeout processes and final documentation during this phase.*

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FINAL DOCUMENTATION

- ❑ The **team** must
 - ❖ **Organize** these documents and
 - ❖ Efficiently **transfer** them to the owner.
- ❑ The CM should use the **document control features** in the **MIS** to **track** the timely delivery of these records,
but note that the **owner may require** the team to use a separate digital system (such as the owner's facility management database) to submit these files to the owner.
- ❑ The CM
 - ❖ **Advises** the owner throughout this process and
 - ❖ **Clarifies** any **questions** the owner has about the documentation.

- ☐ The CM should **ensure** that the **owner receives copies** of all final records, which the owner may need for **future reference**.

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- ❑ These records may be **digital**, depending on the contract's requirements, and should include (but are not limited to) the following:
 - ❖ As-built drawings or models;
 - ❖ Shop drawing logs and related drawings;
 - ❖ Schedule development, revisions, and as-built data;
 - ❖ Commissioning documentation, including balancing, testing, inspection, and startup;
 - ❖ Photographs;
 - ❖ Job cost records;
 - ❖ Diaries and quantity books;

- ❑ These records may be **digital**, depending on the contract's requirements, and should include (but are not limited to) the following:
 - ❖ CM correspondence files;
 - ❖ Sustainability documentation;
 - ❖ Certification of materials; and
 - ❖ Certification of any required minority, woman, or veteran-owned, disadvantaged, local business, or other special business enterprise participation.

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Q&M MANUALS AND TRAINING

☐ Manuals and training for

- ❖ Facilities operators,
- ❖ Maintenance personnel, and
- ❖ Owners

may be **necessary** for equipment, assets, models, and computer-based management systems.

☐ The **contractor** or **another designated team member**

- ❖ **Develops** O&M manuals and
- ❖ **Trains** the owner's personnel

to operate and maintain the facility, as required in the contract documents.

☐ If the project or program **uses BIM**,

this training must include **how to use** the BIM model properly.

- ❑ This process ideally begins in **construction**,
but **some training** is best **deferred until** the owner assumes **responsibility** for
the facility.
- ❑ The CM should **realize** that many **data-intensive control systems** require a service
provider
to perform software updates or calibration first.
- ❑ Examples include
 - ❖ Certain energy production or
 - ❖ Security systemsthat O&M staff can manage from a digital dashboard.

- ❑ The contractor may **not be able** to
 1. Update the O&M manuals and
 2. Perform any necessary training until those earlier steps are complete.
- ❑ Either way, the CM must **ensure** that the **handover** of all O&M manuals and all training occurs **before** the final closeout.
- ❑ The CM **tracks** the **O&M manuals** through the document control system in the MIS to **verify** that the owner receives this documentation.
- ❑ The **CM and the owner** should also **receive** digital records of all training sessions to **confirm** that the training happens and for the owner's future reference (such as when training new personnel or performing less routine procedures).

SPARE PARTS AND WARRANTIES

- ☐ The CM **coordinates** the transfer or delivery of specified spare parts (also called **attic stock**) and warranties to the owner.
- ☐ The CM should **monitor** this process through the **document control portion** of the MIS for all constructed items with a spare part or warranty.
- ☐ The CM **ensures** that a system for the transfer/delivery, cataloging, and storage of spare parts is developed in **conjunction with** the owner's staff, which might be part of the **owner's digital facility management system**.
- ☐ **All warranty** information should be logically organized and meet the owner's requirements before the owner receives it.

- ☐ The CM may **continue coordinating** contractor responses to **warranty items** throughout the warranty period if the CM's contract with the owner requires it.
- ☐ At a **minimum**, the CM should provide the owner with a list of key contacts for warranty or maintenance work.
- ☐ The CM should also **provide** a checklist of items with a warranty requirement.
- ☐ The **checklist** should include **dates** of warranty expirations and inspections.
- ☐ If **using BIM**, this information may be element data in the **record model**.

COMMISSIONING

Owner and commissioning agent

- ☐ The CM **works closely** with the owner and commissioning agent to carry out the commissioning plan.
- ☐ At a minimum, commissioning activities should continue through the **end of the contractual** warranty/correction period and **ideally will continue** for the facility's entire lifecycle.

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Owner and commissioning agent

- ☐ The **performance** of systems, equipment, assemblies, and components will **tend to degrade**
from an **as-installed condition** over time.
- ☐ Re-commissioning or ongoing/recurring commissioning may be necessary
to **periodically evaluate** the systems' performance
compared to the owner's requirements.
- ☐ Seasonal commissioning may also be necessary
to **test** equipment and systems in a peak season to observe peak load
performance.

LESSONS LEARNED

Lessons learned preparation

- ☐ The CM may **use** digital systems and tools to **document lessons learned**.
- ☐ The CM should
 - ❖ **Prepare** a lessons learned report and
 - ❖ **Store** the **report** for **easy retrieval** (such as in a digital MIS or lessons learned database)
to **benefit future** projects and programs.
- ☐ The CM may also **conduct** a lessons learned meeting
at the **end** of the project/program to share the report with all stakeholders.
- ☐ **Ideally**, however, the CM will **help** the **team identify** any lessons learned throughout all phases.

- ❑ Some owners and firms may have their **own proprietary systems** with unique requirements for capturing this information which the **CM should understand**, if applicable.
 - ❖ *For example, some digital systems may require the CM to format the lessons learned report in a specific way or provide certain types of lessons learned data so that AI and BI tools can analyze them.*
- ❑ The CM must be **diligent** and **ensure** that this process meets all requirements so that lessons learned become **useful data** to help the owner and CM **improve** delivery on **future** projects and programs.



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بخش هفتم: مطالعات موردی (Case Studies)

ارائه دهنده:

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STANDARDIZING CM PROCEDURES

Many personnel on a wide range of projects



Many Personnel on a Wide Range of Projects

- | | |
|--|--|
| <p>1. \$225M Project</p> <ul style="list-style-type: none"> • Staff augmentation • Design-Build <p>2. \$200M Program</p> <ul style="list-style-type: none"> • Technical Adviser • Design-Build <p>3. \$100M Project</p> <ul style="list-style-type: none"> • 3rd Party CM • Design-Bid-Build <p>4. \$50M Project</p> <ul style="list-style-type: none"> • 3rd Party CM • CM At Risk • 3 Owner agencies • 4 Engineering firms | <p>5. \$30M Program</p> <ul style="list-style-type: none"> • 3rd Party CM • Design-Bid-Build <p>6. \$7M Project</p> <ul style="list-style-type: none"> • 3rd Party CM • Design-Bid-Build <p>7. \$500K Project</p> <ul style="list-style-type: none"> • 3rd Party CM • Design-Bid-Build <p>8. \$100K Project</p> <ul style="list-style-type: none"> • Inspection Services • Design-Bid-Build |
|--|--|

Typical CM scope of work

- ☐ Coordination / Management
- ☐ Administration
- ☐ Budget
- ☐ Costs
- ☐ Schedule
- ☐ Reporting
- ☐ Files and records
- ☐ Claims and disputes



Common challenges, regardless of project size

- ☐ Budget
- ☐ Documentation: Tracking
- ☐ Documentation: Referencing
- ☐ Claims and litigation
- ☐ True risks
- ☐ Project team
- ☐ O&M documentation



Common challenges, regardless of project size

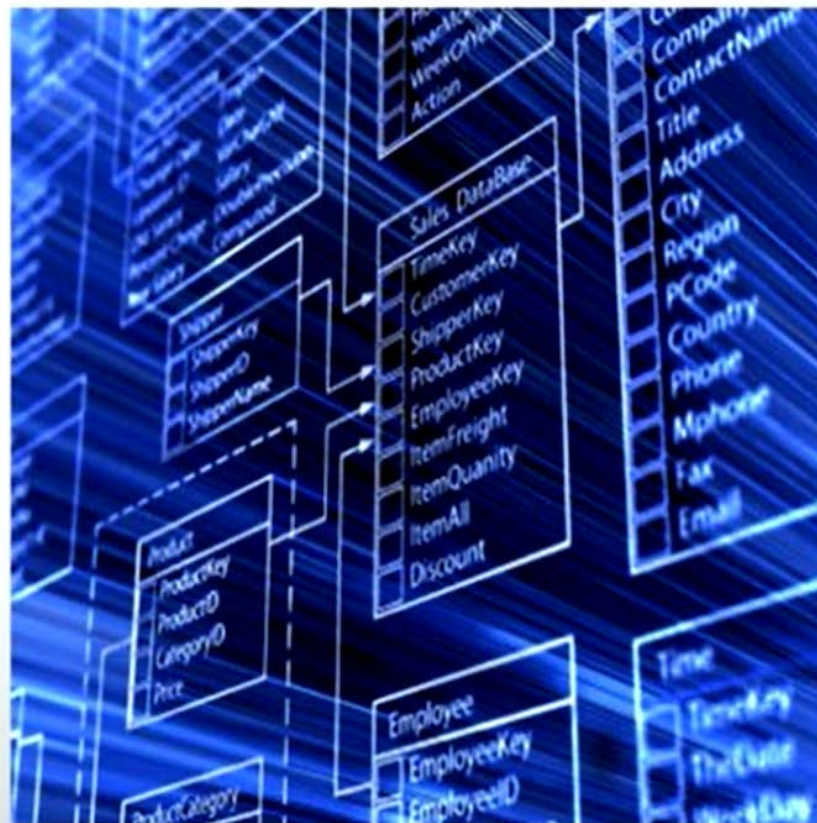


Document Repository



- Digital Storage
- FTP Sites
- SharePoint
- ProjectWise
- Can have version-control functions

Database



- Interconnected bits of information

❑ Small projects:

- ❖ Small cost changes = large budget impact
- ❖ Limited resources to enforce contract cost management processes

❑ Large projects:

- ❖ Small issues (delays, field conditions) can quickly balloon into major costs.
- ❖ Large number of contracts with varying scopes of work.
- ❖ More people involved with finance review can lead to delays and claims

❑ Small projects:

- ❖ PM cost control tool to manage all expenses
- ❖ Cost control tool must accept pay estimates / invoices from the contractor

❑ Large projects:

- ❖ Consistently track all project documentation and communication
- ❖ PM tool allows team members to quickly find information
- ❖ Electronic review of pay applications and change order proposals

Payment applications

Summary
Unit 1 Upgrade
Page 2 of 25

Pay Estimate: 0
Contract: 100
ISO Currency Code: USD

Pay Period: 00/1/2014
Pay Period From: 00/01/2014 To: 00/01/2014
Amount Recommended: 00/01/14

Contractor:

Schedule of Values Items

Item ID	Description	Schedule ID	Unit Price	Quantity	Unit	\$ Total	Qty to Date	\$ to Date	Qty This Period	\$ This Period	\$ Remaining	% Complete
0100	Primary Project		40.00	100.00	%	4,000.00	100.00	4,000.00	0.00	0.00	0.00	100.00%
02	Schedule Risk											
0300	Graphic Network Diagram		45.00	100.00	%	4,500.00	100.00	4,500.00	0.00	0.00	0.00	100.00%
03	and associated schedule RA											
0400	Physical Network Diagram		20.00	100.00	%	2,000.00	100.00	2,000.00	0.00	0.00	0.00	100.00%
04	and associated schedule RA											
0500	Preconstruction		10.00	100.00	%	1,000.00	100.00	1,000.00	0.00	0.00	0.00	100.00%
05	Photography RA											
0600	System pumping Plan RA		15.00	100.00	%	1,500.00	100.00	1,500.00	0.00	0.00	0.00	100.00%
06												
0700	Primary Center HRP		10.00	100.00	%	1,000.00	100.00	1,000.00	0.00	0.00	0.00	100.00%
07	Wires and Term Buffers RA											
0800	Secondary Center HRP		10.00	100.00	%	1,000.00	0.00	0.00	0.00	0.00	1,000.00	0.00%
08	Term Buffers RA											
0900	General Electrical RA		20.00	100.00	%	2,000.00	100.00	2,000.00	0.00	0.00	0.00	100.00%
09												
1000	H2S Gas Detector		15.00	100.00	%	1,500.00	100.00	1,500.00	0.00	0.00	0.00	100.00%
10	Control Center 2RA											
1100	H2S Equipment submitted RA		15.00	100.00	%	1,500.00	100.00	1,500.00	0.00	0.00	0.00	100.00%
11												

Change order proposals

PCO # 13
Unit 1 Upgrade
Printed 06/05/2014 Page 1 of 5

Submerged Fasteners
Type: RFQ - Request for Quote
Contract: 1000
Contractor:
ISO Currency Code:

Submitted: 06/05/2014
Submitted To:
Revision Date:
Status: Pending
Priority: High
Internal Priority: High
Pending On Org:

Created By:
Created: 07/11/2014

Reason: Design Errors
Requested By: Owner

Change Date: 06/05/2014
Schedule ID:
Not to Exceed \$: 0.00
Set:

Approved Thru Last: 10,730.00
Amount Added: 64,222.31
New Approved Amount: 104,952.31
Current Contract Duration: 330
Days Added: 0
New Contract Duration: 330

Budget:
Funding:
Cost Item:

Challenge: Documentation – tracking

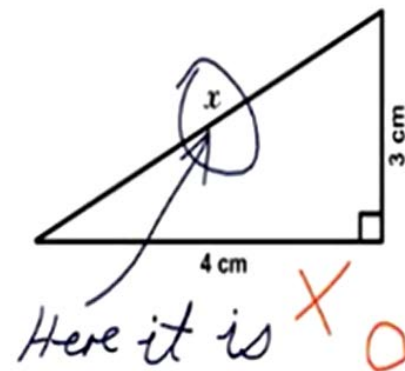
❑ Small projects:

- ❖ Poor data quality
- ❖ Lack of resources
- ❖ Short duration does not allow for lengthy implementation

❑ Large projects:

- ❖ Large number of participants
- ❖ Large volume of information
- ❖ Numerous geographic locations
- ❖ Multiple systems to handle difference scope of work items

3. Find x .



Solution: Documentation – tracking

❑ Small projects:

- ❖ Drop-down and check box fields
- ❖ Short learning curve
- ❖ Eliminates redundant data entry

❑ Large projects:

- ❖ Must handle all project data
- ❖ Flexible for client-specific requirements
- ❖ Must support unlimited users
- ❖ Must cover all or most of the CM scope of work items

Solution: Documentation – tracking

RFI with risk notes

Document status logs

RFI # 36

Created By: General Contractor, Ron
Date Created: 09/06/2012
Date Submitted: 09/06/2012

Subject: Clarification on fiber termination mountings
Folder: Construction

Request:
The specifications require all fiber terminations in outdoor cabinets with a Nema 4X rating. The specifications require that the strain relief be 12 inches outside the cabinet and 4 inches into the cabinet. This type of strain relief is not weatherlight and does not meet the requirement of Nema 4X. Typically a rubber strain relief included with the box connector is used to maintain the 4X rating of the box. Please advise.

Legitimate RFI

Locations
Elm Fork WTP

Materials
Chemical Metering Pump Control Panel (PMP-121C)

Links

Document	Note	Status
Specification 17300	Published	
Drawing 0000300	Closed	

Responses

Type	Number	Revision	Subject	Created By User	Created By Org
Official	1		Owner/Construction Manager Response to RFI # 36	Andrew de Boer	Metro Vancouver

View: Default Customize Save Page Size: 6

Name: Submittals-All
Description: List of All Project Submittals
Shared

Number	Subject	Status	Submitted By Organization	Date Submitted
01010-10-1-A	O&M Knife Gate Valves	Pending	Spess Construction, Inc.	10/06/2014
40059-20-01-1-D	Fabricated Stainless Steel Swing Gates	Pending	Spess Construction, Inc.	10/07/2014
01010-10-1-A	O&M Telescoping Valves	Pending	Spess Construction, Inc.	10/07/2014
02010-10-1-B	Concrete Accessories	Pending	Spess Construction, Inc.	10/07/2014
40057-13-01-1-C	Pipe Supports for Ductile Iron Pipe	Pending	Spess Construction, Inc.	10/07/2014
01111-02-1	Requests for Substitutions	Closed	Spess Construction, Inc.	10/07/2014
01124-02-1	Construction Photographs - 05	Closed	Spess Construction, Inc.	09/25/2014
00000-01-2-A	Alternate Blast Media	Closed	Spess Construction, Inc.	09/25/2014
00000-01-2	Alternate Blast Media	Closed	Spess Construction, Inc.	09/25/2014
02010-10-1-A	Concrete Accessories	Closed	Spess Construction, Inc.	09/12/2014
01010-17-1-A	O&M Resilient Seated Gate Valves	Closed	Spess Construction, Inc.	09/12/2014
01010-12-1	O&M Escamtec Plug Valves	Closed	Spess Construction, Inc.	09/12/2014
01010-12-1	O&M Escamtec Plug Valves	Closed	Spess Construction, Inc.	09/12/2014
01010-13-1	O&M Fabricated Stainless Steel Slide Gates	Closed	Spess Construction, Inc.	09/12/2014
03010-08-01-1-A	Concrete Crack & Spall Repair Procedures and Materials	Closed	Spess Construction, Inc.	09/09/2014
03000-01-1-D	Concrete Mix Designs	Closed	Spess Construction, Inc.	09/09/2014
01124-02-1-A	Schedule Update 03	Closed	Spess Construction, Inc.	09/09/2014
01010-10-1	O&M Submersible Horizontal Propeller Pumps	Closed	Spess Construction, Inc.	09/09/2014
03000-01-1-C	Concrete Mix Designs	Closed	Spess Construction, Inc.	09/09/2014
00021-01-1-A	FRP Grating	Closed	Spess Construction, Inc.	09/09/2014
01124-04-1	Construction Photographs - 04	Closed	Spess Construction, Inc.	09/09/2014
01010-10-1	O&M Knife Gate Valves	Closed	Spess Construction, Inc.	09/09/2014
01010-17-1	O&M Resilient Seated Gate Valves	Closed	Spess Construction, Inc.	09/09/2014
03000-01-1-B	Concrete Mix Designs	Closed	Spess Construction, Inc.	09/09/2014
03000-01-2	Concrete Reinforcing - Electrical Duct Bank	Closed	Spess Construction, Inc.	09/09/2014
40059-02-3-A	Ductile Iron Pipe - Lay Drawings	Closed	Spess Construction, Inc.	09/09/2014
01010-10-1	O&M Telescoping Valves	Closed	Spess Construction, Inc.	09/09/2014
02010-10-1	Concrete Accessories	Closed	Spess Construction, Inc.	09/09/2014
03000-01-1	Concrete Reinforcing	Closed	Spess Construction, Inc.	09/09/2014
01010-20-1	O&M Variable Frequency Drives	Closed	Spess Construction, Inc.	09/09/2014
01111-02-1	Contractor's Initial Inspection - Bar 09	Closed	Spess Construction, Inc.	09/04/2014
01111-02-1	Contractor's Initial Inspection - Bar 08	Closed	Spess Construction, Inc.	09/03/2014
01111-02-1	Contractor's Initial Inspection - Bar 07	Closed	Spess Construction, Inc.	09/03/2014
01111-04-1	Contractor's Initial Inspection - Bar 04	Closed	Spess Construction, Inc.	09/03/2014
01111-02-1	Contractor's Initial Inspection - Bar 03	Closed	Spess Construction, Inc.	09/03/2014
01111-02-1	Contractor's Initial Inspection - Bar 02	Closed	Spess Construction, Inc.	09/03/2014
03001-01-1	Hydrostatic Testing Schedule and Procedure	Closed	Spess Construction, Inc.	09/01/2014
07000-01-1-A	Joint Sealant	Closed	Spess Construction, Inc.	09/09/2014
4321-23-24-1-E	(RECORD) Section 4321-23-24-1-E Submersible Horizontal Propeller Pumps	Closed	Spess Construction, Inc.	09/07/2014
40059-02-3	Ductile Iron Pipe - Lay Drawings	Closed	Spess Construction, Inc.	09/06/2014
01124-02-1	Schedule Update 03	Closed	Spess Construction, Inc.	09/05/2014
03000-01-1-A	Concrete Mix Designs	Closed	Spess Construction, Inc.	07/29/2014
00000-01-1-B	FRP Troughs, Launchers and Items	Closed	Spess Construction, Inc.	07/29/2014
03010-08-01-1	Concrete Crack & Spall Repair Procedures and Materials	Closed	Spess Construction, Inc.	07/28/2014

Challenge: Documentation – referencing

❑ Small projects:

- ❖ Information quality at closeout
- ❖ Document relevancy

❑ Large projects:

- ❖ Exponentially greater document relevancy issues
- ❖ Tough to validate duplicate contractor claims
- ❖ Difficult to recreate the story for an issue without the original parties



Solution: Documentation – referencing

❑ Small projects:

- ❖ Turn over relevant, high-quality data that was efficient to produce
- ❖ All the referencing benefits of a “large project document control system” without the added cost

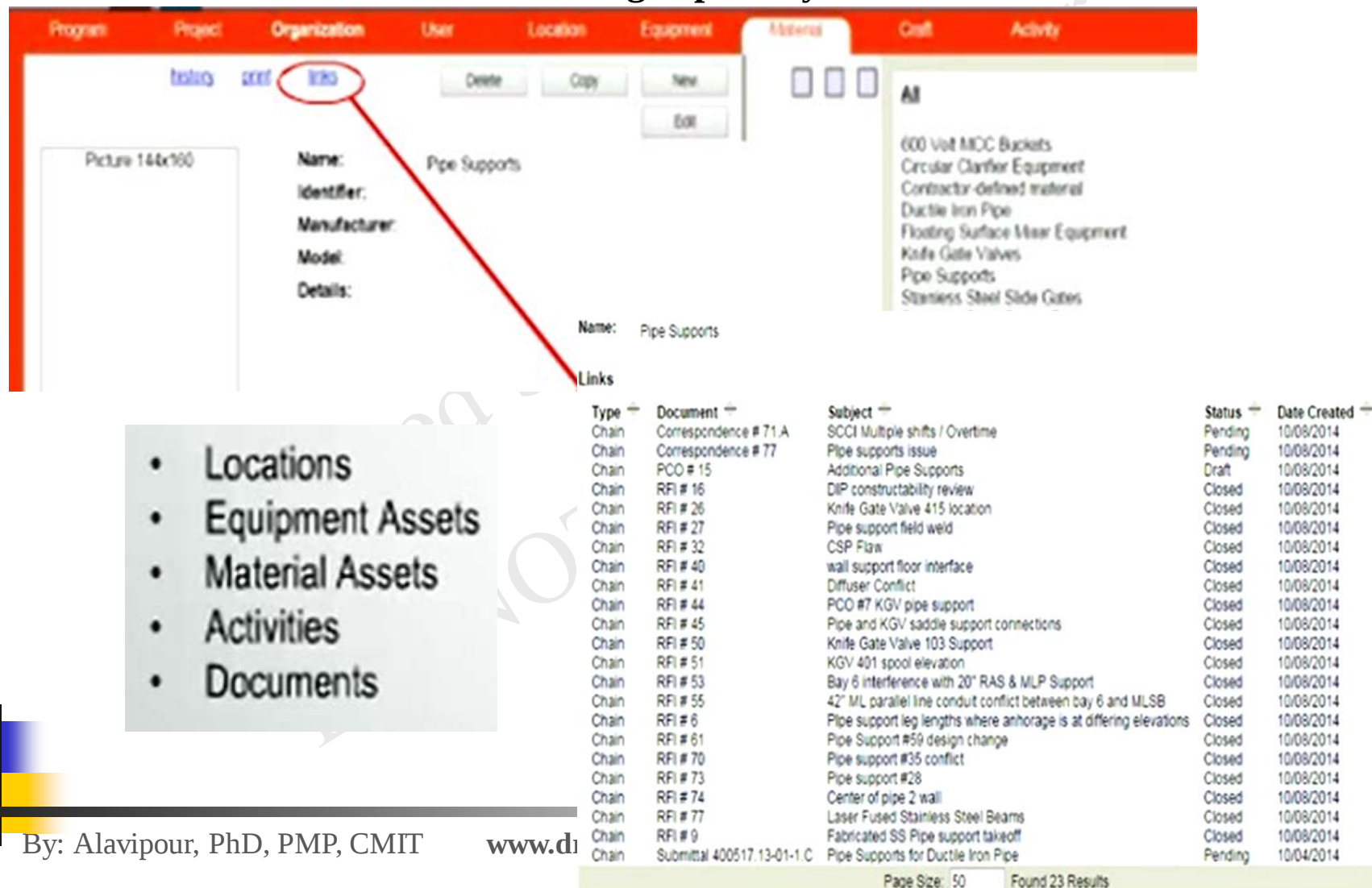
❑ Large projects:

- ❖ Link information to assets
- ❖ Link information to contract documents
- ❖ Ability to quickly and accurately develop and portray the “story” behind any project issue



Solution: Documentation – referencing

Referencing capability



Picture 144x100

Name: Pipe Supports

Identifier:

Manufacturer:

Model:

Details:

Name: Pipe Supports

Links

- Locations
- Equipment Assets
- Material Assets
- Activities
- Documents

Type	Document	Subject	Status	Date Created
Chain	Correspondence # 71.A	SCCI Multiple shifts / Overtime	Pending	10/08/2014
Chain	Correspondence # 77	Pipe supports issue	Pending	10/08/2014
Chain	PCO # 15	Additional Pipe Supports	Draft	10/08/2014
Chain	RFI # 16	DIP constructability review	Closed	10/08/2014
Chain	RFI # 26	Knife Gate Valve 415 location	Closed	10/08/2014
Chain	RFI # 27	Pipe support field weld	Closed	10/08/2014
Chain	RFI # 32	CSP Flaw	Closed	10/08/2014
Chain	RFI # 40	wall support floor interface	Closed	10/08/2014
Chain	RFI # 41	Diffuser Conflict	Closed	10/08/2014
Chain	RFI # 44	PCO #7 KGV pipe support	Closed	10/08/2014
Chain	RFI # 45	Pipe and KGV saddle support connections	Closed	10/08/2014
Chain	RFI # 50	Knife Gate Valve 103 Support	Closed	10/08/2014
Chain	RFI # 51	KGV 401 spool elevation	Closed	10/08/2014
Chain	RFI # 53	Bay 6 interference with 20" RAS & MLP Support	Closed	10/08/2014
Chain	RFI # 55	42" ML parallel line conduit conflict between bay 6 and MLSB	Closed	10/08/2014
Chain	RFI # 6	Pipe support leg lengths where anchorage is at differing elevations	Closed	10/08/2014
Chain	RFI # 61	Pipe Support #59 design change	Closed	10/08/2014
Chain	RFI # 70	Pipe support #35 conflict	Closed	10/08/2014
Chain	RFI # 73	Pipe support #28	Closed	10/08/2014
Chain	RFI # 74	Center of pipe 2 wall	Closed	10/08/2014
Chain	RFI # 77	Laser Fused Stainless Steel Beams	Closed	10/08/2014
Chain	RFI # 9	Fabricated SS Pipe support takeoff	Closed	10/08/2014
Chain	Submittal 400517.13-01-1.C	Pipe Supports for Ductile Iron Pipe	Pending	10/04/2014

Page Size: 50 Found 23 Results

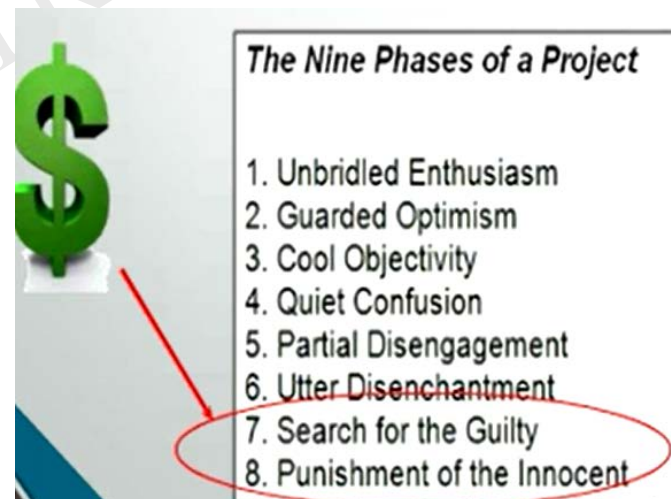
Challenge: High claim & litigation costs

❑ Small projects:

- ❖ Small claim can quickly balloon
- ❖ Small CM team lack extra capacity to address claims

❑ Large projects:

- ❖ Small delay claim can have high cost impact
- ❖ Evaluating claim merits is difficult



Solution: High claim & litigation costs

❑ Small projects:

- ❖ Single tool for all documents and communication
- ❖ Spend time weekly reviewing issues
- ❖ Identify extra resources that could be called in quickly if needed

❑ Large projects:

- ❖ Single tool for documents, communication, and schedule
- ❖ Track risk and corresponding docs, communication and schedule activities
- ❖ Review issues multiple times a week



Challenge: Misunderstanding of risks

❑ Small projects:

- ❖ Insufficient resources to evaluate
- ❖ Insufficient time to identify and mitigate risks

❑ Large projects:

- ❖ Over-analyze risks
- ❖ Easily miss project red flags
- ❖ Larger the team, the tougher it is to have a comprehensive view



Solution: Misunderstanding of risks

❑ Small projects:

- ❖ Start early with project plans and procedures for identifying and tracking risk items
- ❖ Increase in administrative efficiency allows for more project management

❑ Large projects:

- ❖ Identify and track specific risk items
- ❖ Summarize risks from each contract into a project level summary
- ❖ Use alerts, reporting, and dashboards to monitor risk metrics

Solution: Misunderstanding of risks

Project risk

Number	Project	Description	Contract	Delay (Days)	Amount	Probability	Expected
1	Annadis Digester Project	Unmarked water line	Design Contract	0	10,000.00	50.00%	5,000.00
3	Annadis Digester Project	Clearing elevation change	GC Inc construction	0	30,000.00	85.00%	25,500.00
29	Annadis Digester Project	Grinder pump change	GC Inc construction	0	15,000.00	50.00%	7,500.00
36	Annadis Digester Project	Change in pipe joints	GC Inc construction	0	25,000.00	75.00%	18,750.00
48	Annadis Digester Project	Change in survey control	GC Inc construction	0	0.00	0.00%	0.00
62	Annadis Digester Project	Change in SCADA screens	GC Inc construction	0	12,000.00	90.00%	10,800.00
63	Annadis Digester Project	Change in water stop	GC Inc construction	0	25,000.00	50.00%	12,500.00
66	Annadis Digester Project	Change in sludge grinders	GC Inc construction	0	12,000.00	50.00%	6,000.00
69	Annadis Digester Project	Change in pipe	GC Inc construction	0	20,000.00	75.00%	15,000.00
72	Annadis Digester Project	Change in wall board	GC Inc construction	0	15,000.00	50.00%	7,500.00
75	Annadis Digester Project	Change in grounding grid	GC Inc construction	0	20,000.00	50.00%	10,000.00
77	Annadis Digester Project	Environmental issue	Design Contract	0	20,000.00	25.00%	5,000.00
80	Annadis Digester Project	Contractor change to risk	Design Contract	1	30,000.00	50.00%	15,000.00

Risk # 6

Contract: 1599

ISO Currency Code: USD

Created By

Date Created: 08/08/2014

Subject: (PO0 005) Horizontal Survey Control

Folder:

Reason: Design Errors

Reference Number:

Notes

Created By

EADOC-SB01+

08/08/2014

EADOC-SB01+

08/08/2014

EADOC-SB01+

09/12/2014

Links

Document

PO0 # 5 Horizontal survey control

Note

Status

Pending

Status: Pending

Priority:

Due Date:

+ Additional Send & Assignment Information

Delay (Days)	Amount	Probability
0.00	5,000.00	100.00%
0.00	10,000.00	50.00%
0.00	20,000.00	50.00%

Challenge: Project team changes

❑ Small projects:

- ❖ Small change in team has a dramatic effect
- ❖ Resources may only be assigned part time

❑ Large projects:

- ❖ There will be turnover and changes to personnel
- ❖ Consistently following processes and procedures



Solution: Project team changes

❑ Small projects:

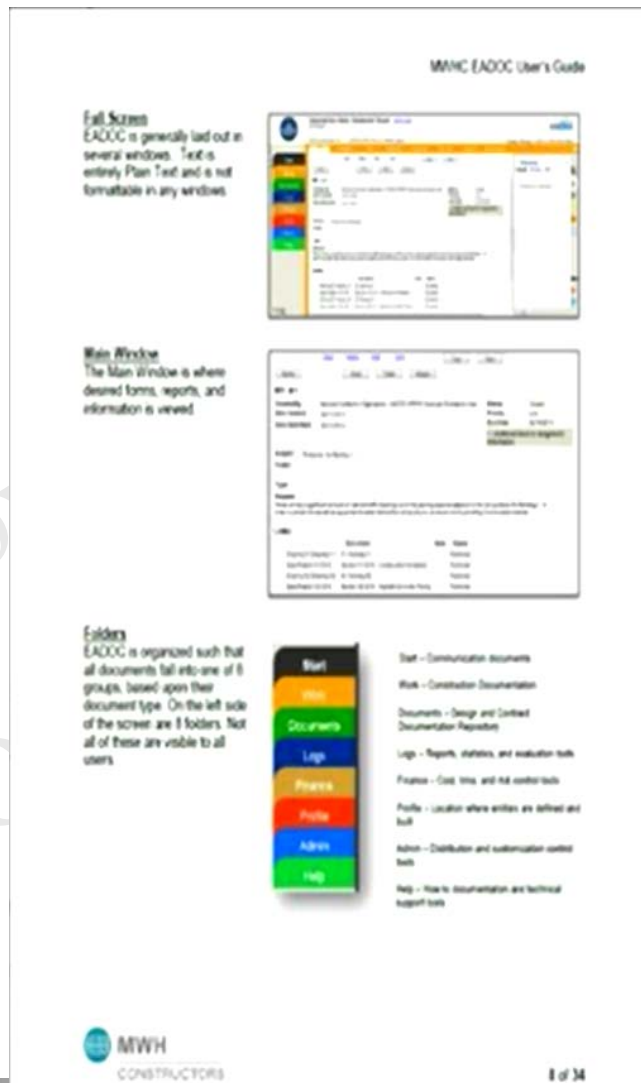
- ❖ Everyone on the team should be familiar with the tools
- ❖ Part time resources should have access via the web

❑ Large projects:

- ❖ Documented processes and software training guides
- ❖ Software is great for enforcing processes
- ❖ Monitor exceptions, reports, and alerts



Solution: Project team changes



Challenge: O&M documentation

❑ Small projects:

- ❖ Resources to track assets and docs during the project
- ❖ Very little documentation is typically turned over

❑ Large projects:

- ❖ Quality of documentation
- ❖ Tagging documentation to appropriate communication
- ❖ Usability of O&M documentation



Solution: O&M documentation

❑ Small projects:

- ❖ Use of database style eliminates duplicate entry and permits fewer staff to compile more usable information

❑ Large projects:

- ❖ Use of drop-downs, check boxes, and master lists enhances quality
- ❖ Interlinked references in a digital format makes the information that is turned over more useful



Solution: O&M documentation

Name: Knife Gate Valves

Links

Type	Document	Subject	Status	Date Created
Chain	Submittal 400564-01-1.A	Knife Gate Valves	Closed Approved	10/04/2014
Chain	Submittal 019310-16-1.A	O&M: Knife Gate Valves	Pending	10/08/2014
From	Picture # 3739	Daily Report #1-153 09/29/2014	Published	
From	Picture # 3738	Daily Report #1-153 09/29/2014	Published	
From	Picture # 3737	Daily Report #1-153 09/29/2014	Published	
From	Picture # 3736	Daily Report #1-153 09/29/2014	Published	
From	Picture # 3735	Daily Report #1-153 09/29/2014	Published	
From	Picture # 3734	Daily Report #1-153 09/29/2014	Published	

Status	Date Created
Pending	10/08/2014
Pending	10/08/2014
Draft	10/08/2014
Closed	10/08/2014
Closed	10/08/2014
Closed	10/08/2014
Closed	10/08/2014
Closed	10/08/2014
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Closed	10/08/2014

Chain	RFI # 27	Pipe support field weld
Chain	RFI # 32	CSP Flaw
Chain	RFI # 40	wall support floor interface
Chain	RFI # 41	Diffuser Conflict
Chain	RFI # 44	PCO #7 KGV pipe support
Chain	RFI # 45	Pipe and KGV saddle support connections
Chain	RFI # 50	Knife Gate Valve 103 Support
Chain	RFI # 51	KGv 401 spool elevation
Chain	RFI # 53	Bay 6 interference with 20" RAS & MLP Support
Chain	RFI # 55	42" ML parallel line conduit conflict between bay 6 and MLSB
Chain	RFI # 6	Pipe support leg lengths where anchorage is at differing elevations
Chain	RFI # 61	Pipe Support #59 design change
Chain	RFI # 70	Pipe support #35 conflict
Chain	RFI # 73	Pipe support #28
Chain	RFI # 74	Center of pipe 2 wall
Chain	RFI # 77	Lower Support Steel Deck

Key take away

- ☐ Select a software solution
- ☐ That can be deployed following company standards on small projects
- ☐ That can be customized to meet larger client requirements
- ☐ Follows your firms standard practices and procedures with configuration options for incorporating client specific needs.

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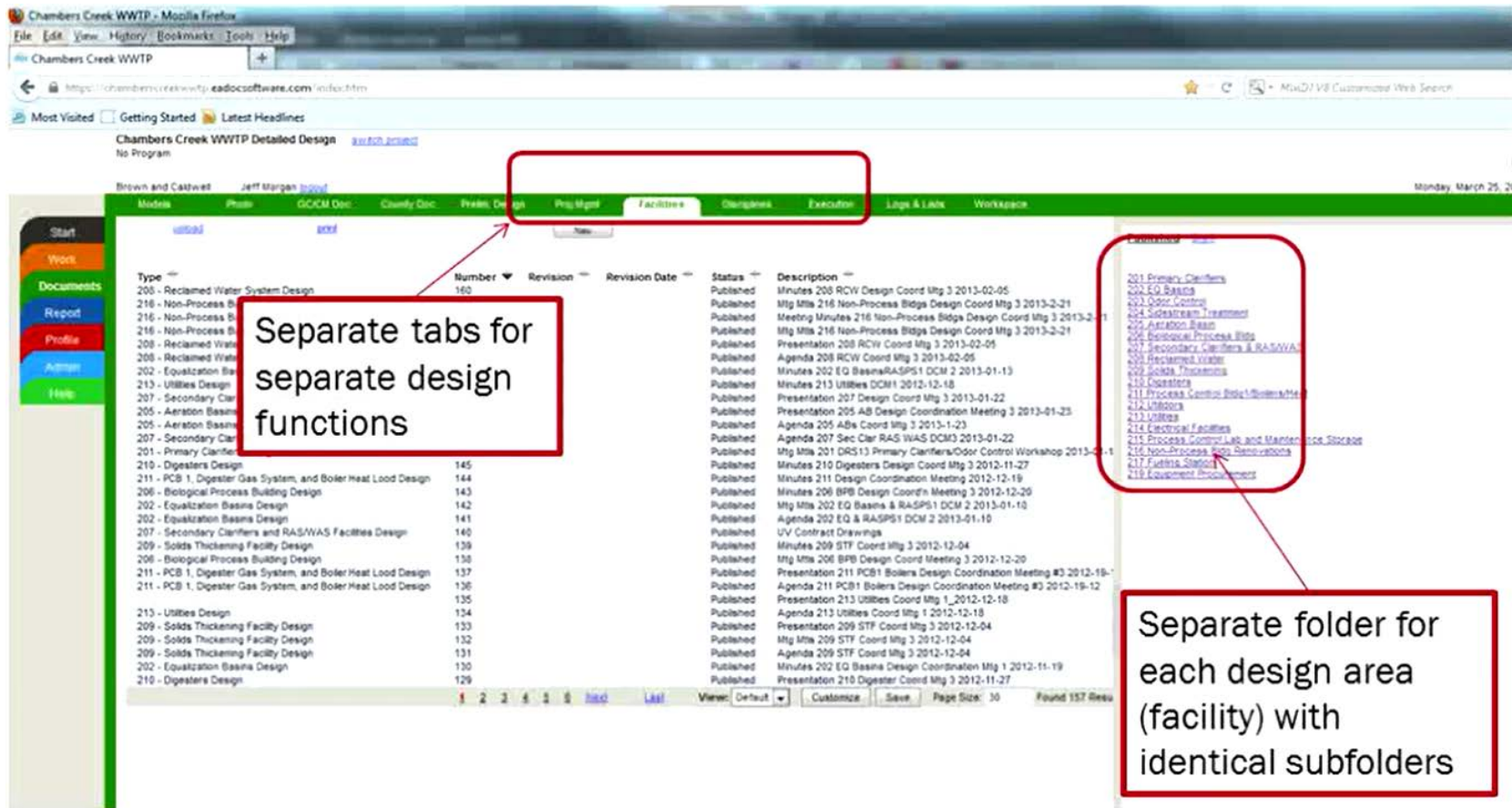
Key take away

- ☐ More than just a repository - a full database
- ☐ Covers all CM Scope of Work items
- ☐ Tracks document, location, and asset relationships
- ☐ Interlinked reference capability
- ☐ Auditable History Trail
- ☐ Provides a valuable deliverable at the end of the project

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Implementing WBS

مدیریت فناوری‌های دیجیتال در صنعت ساخت
فصل دوم: فرآیند استاندارد برای مدیریت فناوری‌های دیجیتال در پروژه
بخش هفتم: مطالعات موردی (Case Studies)



The screenshot shows a web-based project management interface for the Chambers Creek WWTP. The interface includes a top navigation bar with tabs for 'Models', 'Phase', 'GOCM Doc', 'County Doc', 'Prelim Design', 'Proj Mgmt', 'Facilities', 'Designs', 'Execution', 'Logs & Lists', and 'Workspace'. A red box highlights the 'Facilities' tab, with a callout stating: "Separate tabs for separate design functions".

Below the navigation bar, there is a list of design tasks and folders. A red box highlights a folder named '201 Primary Clarifiers', with a callout stating: "Separate folder for each design area (facility) with identical subfolders". The folder contains a list of tasks, including '201 Primary Clarifiers', '202 EQ Basins', '203 Odor Control', '204 Solidstream Treatment', '205 Aeration Basin', '206 Biological Process Building', '207 Secondary Clarifiers & RAS/WAS', '208 Reclaimed Water', '209 Solids Thickening', '210 Digesters', '211 PCB 1, Digester Gas System, and Boiler Heat Load Design', '212 Utilities Design', '213 Utilities', '214 Electrical Facilities', '215 Process Control, Log and Maintenance Storage', '216 Non-Process High Reliability', '217 Future Station', and '218 Equipment Procurement'.

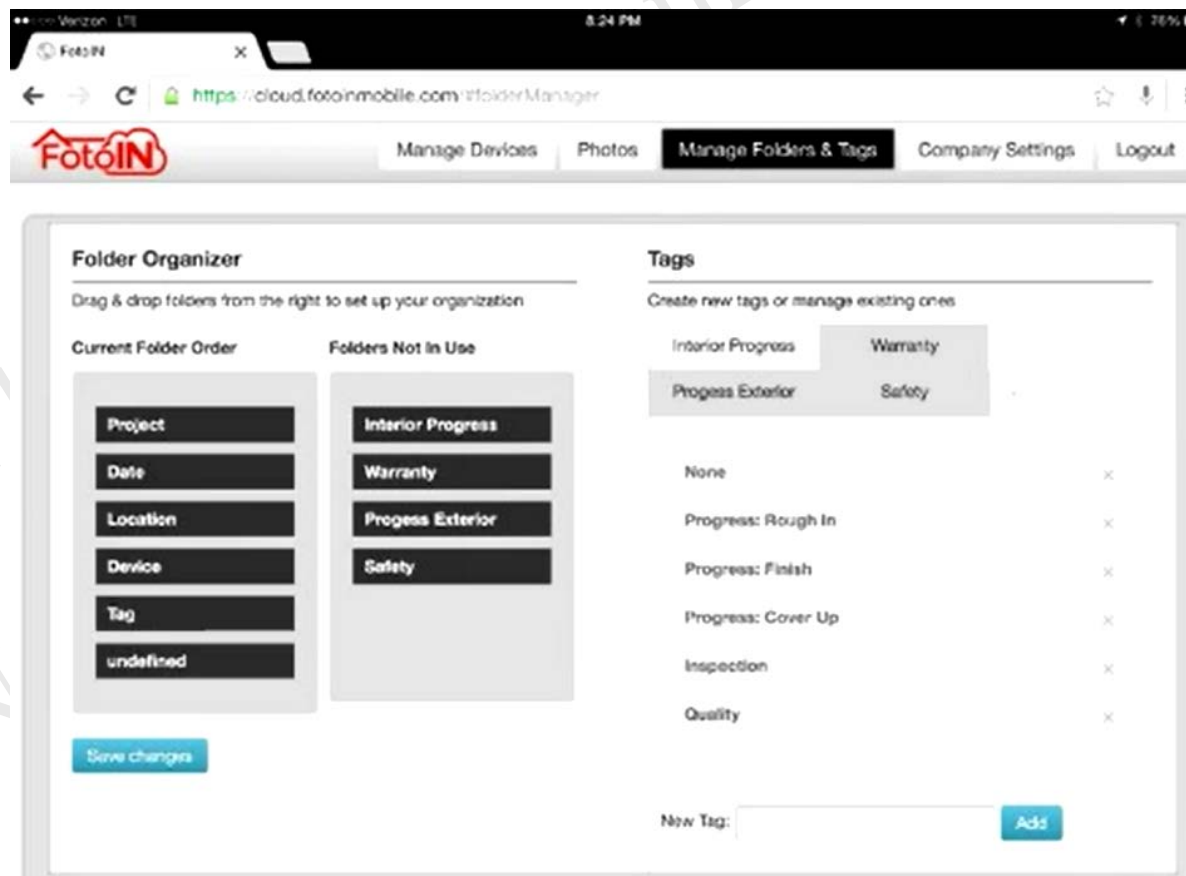
Progress photos – FotoIn Mobile

- ☐ App works on IOS and Android.
- ☐ Users can...annotate, tag, and label photos.
- ☐ Photos auto sync to your server through a cloud.
- ☐ Create custom tags.



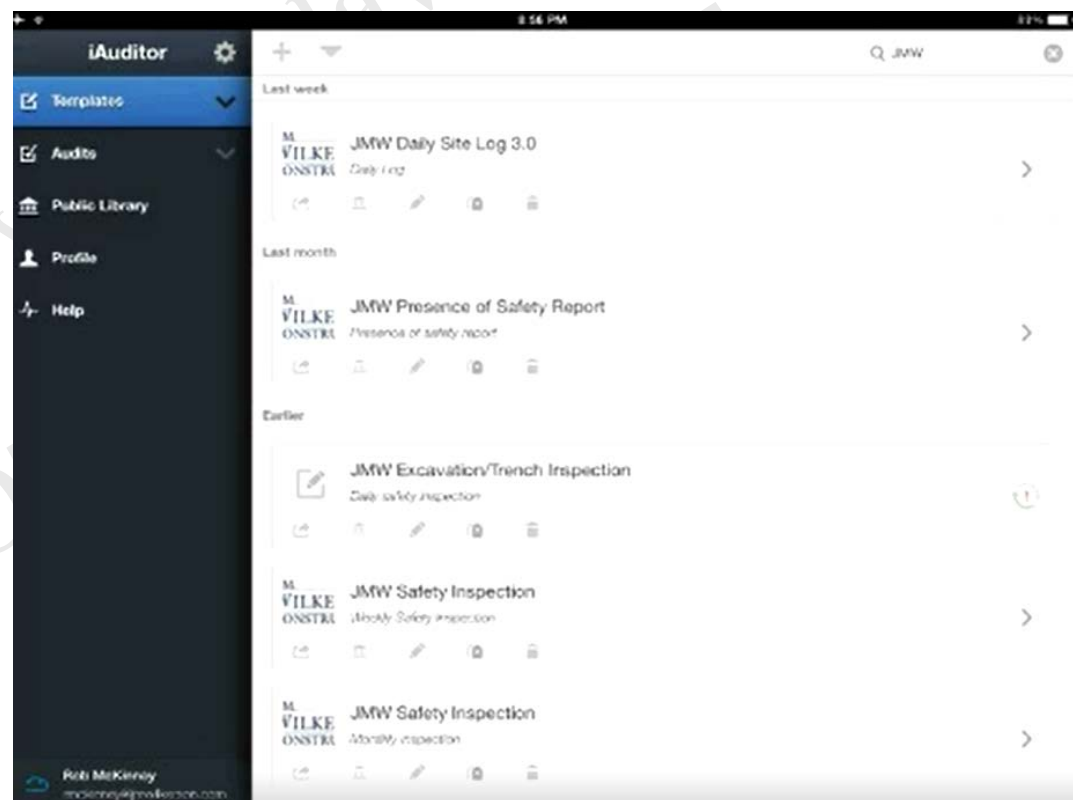
Progress photos – FotoIn Mobile (web portal)

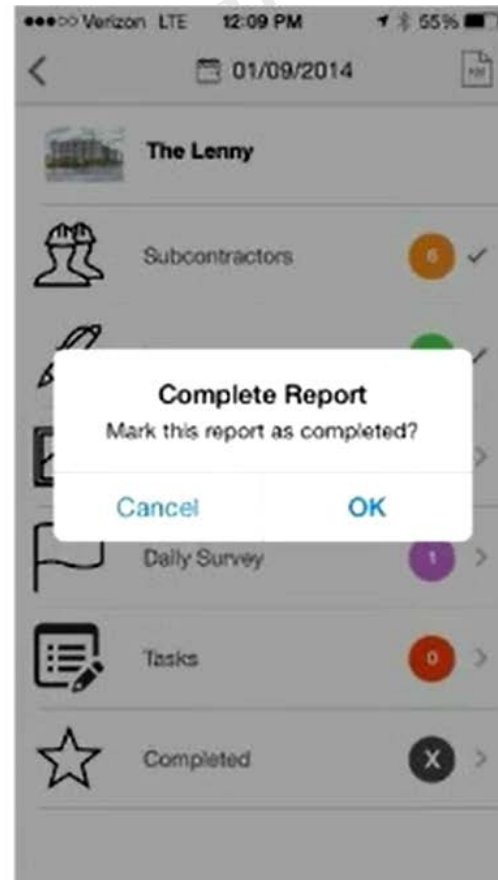
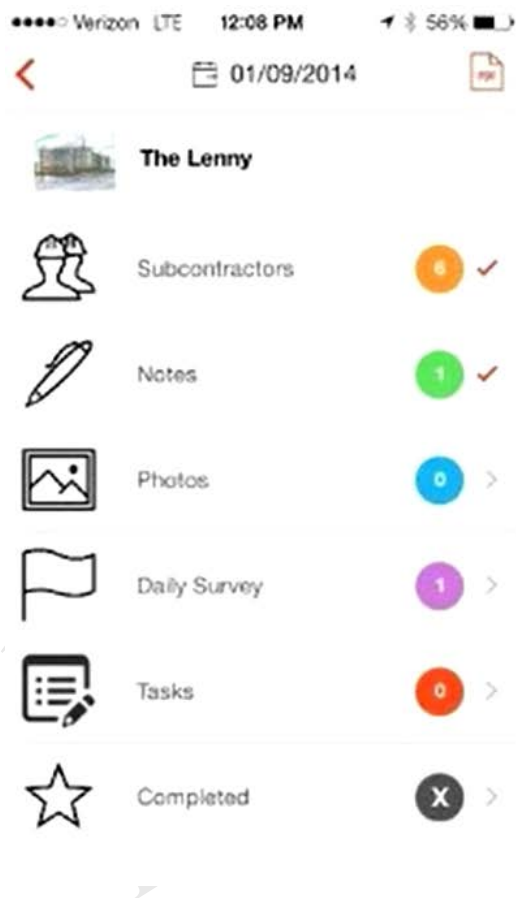
- ❑ Web portal allows you to manage devices, create tags, and grant permissions



Safety documentation - iAuditor

- ❑ App works on IOS, Android, and Web.
- ❑ App is a form generator
- ❑ App converts forms into PDF files





❑ Rakne:

- ❖ App works on IOS and Android
- ❖ Users update project info daily (hourly)
- ❖ Can add photos, voice notes
- ❖ Can send as PDF report
- ❖ Website portal to view report metrics

Prepared by Dr. Alavipour
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موسسه مهندسی و مدیریت ساخت علوی پور (ACEMI)

دفتر آموزش



تهران، بلوار فردوس شرق، مجتمع آبگینه، طبقه سوم اداری، واحد C42



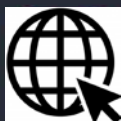
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+۹۸ ۲۱ ۴۶ ۱۰۰ ۴۵۰



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