ConstructionProgressCoalition

COMMON DATA EXCHANGE

Workflow Topics

Centralizing Project Inspection

Seamless RFI Collaboration

4D Imaging Data Exchange

Safety Documentation for Pre-Mobilization

Schedule-to-Field Integration

2021 CDX RESEARCH REPORT

CDX COMMON DATA EXCHANGE

BLUEBEAM A NEMETSCHEK COMPANY

2021 RESEARCH SCHOLARSHIP

If at any point throughout the document you need to know the definition for an acronym or CDX term, click the info icon at the bottom of the page to go directly to the appendix.

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1. Background

About the Construction Progress Coalition

The Construction Progress Coalition (CPC) is a 501c3 Professional Organization established in 2017 with the merging of Construction PDF Coalition (est. 2014) and the Construction Open Standards Alliance (est. 2013).

Our vision is to foster industry-wide consensus on the performance benchmarks for project delivery in the digital age. Our mission is to improve project delivery by connecting stakeholders through Common Data Exchange (CDX) initiatives.

The Construction Progress Coalition Guiding Principals

At CPC, we seek to collaborate with diverse perspectives to resolve the most pressing challenges facing the Architecture / Engineering / Construction (AEC) industry. Every initiative that CPC supports must align with one of the following pillars:

- **Care for People** Innovation requires empathy, not ego. Connect with external influencers to uncover multi-win opportunities.
- **Fix the Process** Don't blame people or technology when the process is broken. Make waste the united front we can all rally around.
- **Advance Our Industry** Equip AEC professionals with the tools to have the crucial conversations required to address #SharedPains and achieve #SharedGains.

As part of the Interoperability Initiative, CPC recognized the need for real-world research and testing. In 2020, CPC began a new partnership with Bluebeam to engage young construction technologists and encourage them to tackle our #SharedPains with data interoperability. We're back in 2021 with a new set of research from some leading-edge thinkers who we expect will shape the AEC industry in the decades to come.

Sophie Macks
Academic Specialist, Bluebeam

"Congratulations to each of the winners of the Bluebeam CDX Scholarship! We have been so honored to be a part of these students' journeys as they dedicated their time to solving real industry problems. Thanks to the CPC for partnering with us to provide a platform that recognizes these students as true industry heroes!

CDX COMMON DATA EXCHANGE
BLUEBEAM A NEMETSCHEK COMPANY
2021 RESEARCH SCHOLARSHIP

Bluebeam CDX Research Advisory Panel of AEC Technology Experts

Dan Smolilo
The Walsh Group

Dr. Fernanda Leite
University of Texas

Kellie Ward
Bluebeam

Sophie Macks
Bluebeam

Todd Sutton*
Zachry Construction

Bluebeam CDX Scholarship Fund

Despite technology advancements, data interoperability remains a critical barrier to streamlining construction processes. Bluebeam Inc graciously donates $20,000 annually in scholarships to support young construction technologists as they prepare for a career in the AEC industry. In return, these scholarship recipients focused both their summer internships and their collegiate studies on researching their selected real-world CDX workflows.

The CDX Intern Class of 2021 included nine (9) undergraduate students from across the country. They were independently challenged to research an AEC interoperability workflow and document their findings via the CDX Playbook provided to them. Researchers investigated workflows focusing on topics like Centralized Project Inspection, Seamless RFI Collaboration, 4D Imaging Data Exchange, Safety Documentation for Pre-Mobilization, and Schedule-to-Field Integration. Each researcher worked with an industry mentor and received feedback throughout the process from a CDX Advisory Panel of AEC technology experts.

Delegates Mentoring CDX Researchers

Alison Hart
Mortenson

Eric Whobrey
ARCO/Murray

Michael Flynn
ARCO/Murray

Lilian Magallanes
DPR Construction

Rob Sloyer
Kast Construction

Benjamin Crosby
Yates Construction

** Todd Sutton participated as both a CDX Advisory Panel member and CPC Mentor*

CDX Research Assignment & Overview

Each researcher was provided with a consistent framework and set of visual tools to document their research findings. Upon completion, each presented their findings to the committee using the CDX Playbook template.

Their six week research assignment culminated with a final presentation following the 4 Ds: Digest ("How Might We" statement), Debate (Identify Stakeholders & Personas, and their interest in the key Systems & Documents), Decide (Illustrate 1-3 Shared Pains and 1-3 Shared Gains), and Deliver (Summary of Shared Pains and Shared Gains). The CDX Scholarship Class of 2021 had a record-high nine (9) students representing six (6) AEC companies. The top five (5) were selected to be featured in this report. Their profiles and topic summaries can be found on the following pages.

2021 CDX Researchers

Cole Stansbury
Electrical Engineering
University of Minnesota
Mortenson Construction

William Martin
Building Construction
Mississippi State
Yates Construction

Weston Bohne
Engineering Technology
Texas A&M University
Zachry Construction

Montana Williams
Mechanical Engineering
Duke University
DPR Construction

Chisler Joseph
Construction Management
University of Florida
KAST Construction

Megan Flanigan
Computer Science & Econ
Duke University
ARCO/Murray

Jacob Timmins
Structural Engineering
University of Alabama
ARCO/Murray

Jesus Ramirez Zependa
Electrical Engineering
Arizona State University
Mortenson Construction

Paola Valdivia
Civil Engineering
University of Georgia
DPR Construction

2. Research Findings

Common Data Exchange (CDX) 101

What is a CDX, Anyway?

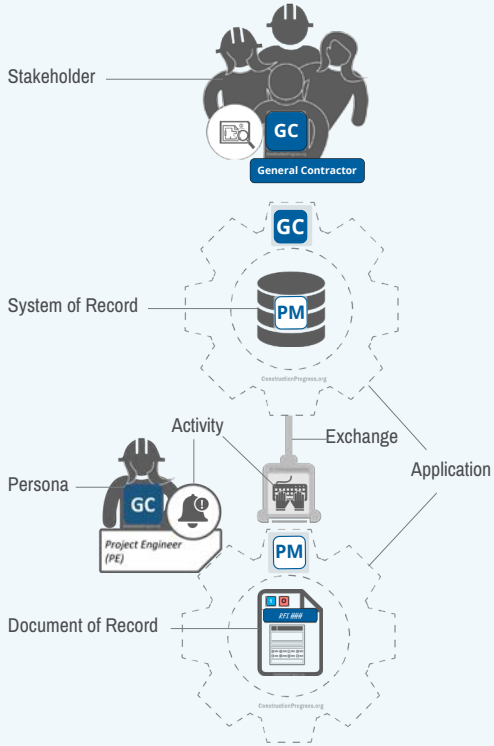
A common data exchange (CDX) scenario supports the graphical documentation of current pain points and the desired future state of a specific information transaction between two or more project stakeholders. Following the framework of CDX, impacted **stakeholders** will gather to discuss the **document of record (DoR)** in question by inviting the individual **personas** that utilize **applications** to generate, regulate, store, or share the DoR at different **points of exchange (PoE).** At a given PoE, the persona is either sharing data internally with their stakeholder's **system of record (SoR),** or externally with another stakeholder's SoR. Applying this shared language and approach to integration standards will unlock new industry benchmarks that focus on the leading indicators of project performance.

Key terms to know:

- A **stakeholder** is a business or government entity involved in the project.
- A **persona** is any individual employed by or under contract with any stakeholder.
- A **document of record** is a project-level form, report, or certification. It may or may not be updated as the project progresses.
- A **system of record** is the location where a stakeholder stores documents and data for all of their projects.
- A **point of exchange** occurs when a document of record is shared by one persona with another, either on its own or within a system of record; when documents of record are input into systems of record; or when one system of record shares documents with another system of record.
- An **exchange activity** can be generated manually by a persona (analog), or it can be automated using a template or formula (digital). The advent of XML and API connectors now allows for data to auto-exchange between separate stakeholder systems (integrated) using conditional logic that was agreed upon at project kickoff.

CDX
COMMON **DATA** EXCHANGE

CDX provides a visual language for project teams to define their collaboration standards. Using:



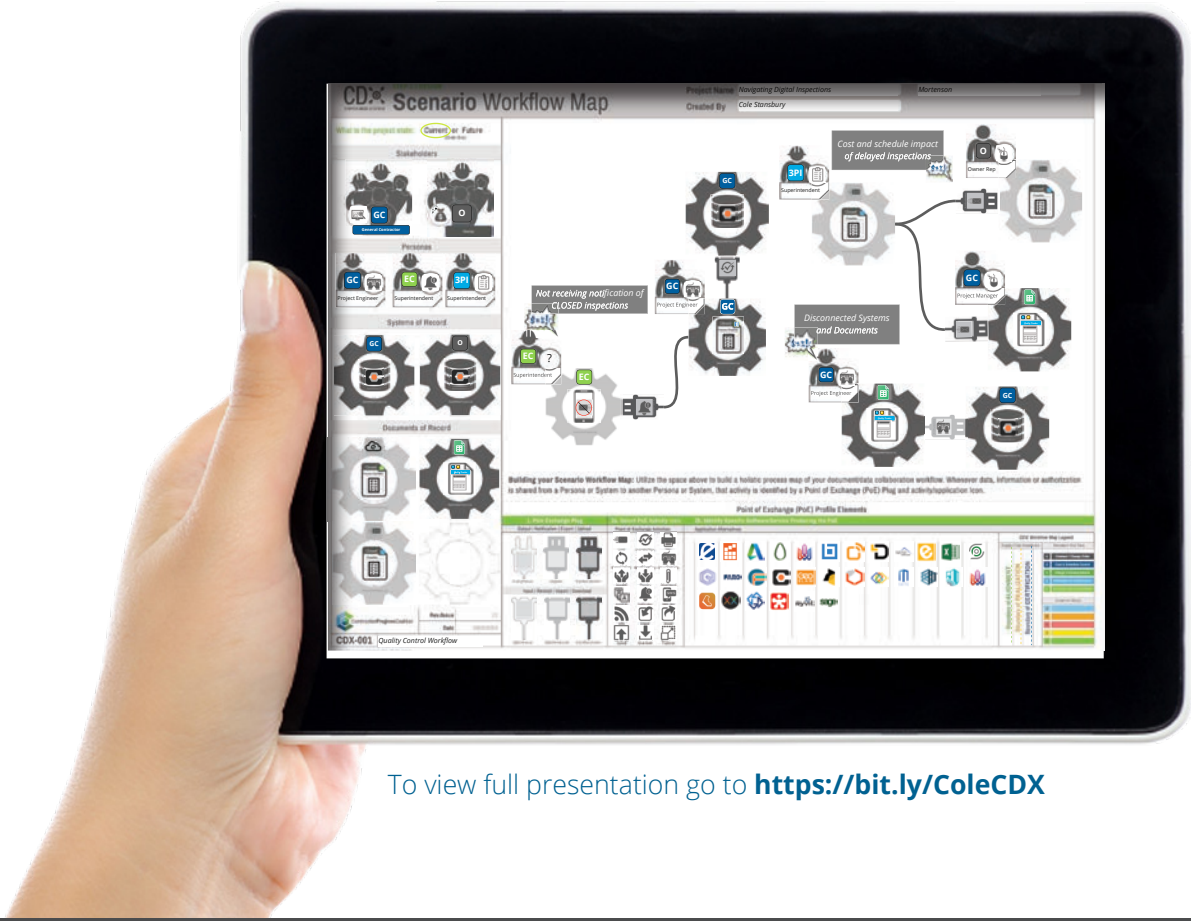
Cole Stansbury

Electrical Engineering Undergraduate Student, University of Minnesota
Mentor: Alison Hart, Mortenson Construction

Cole won the $2,000 Innovation bonus for a total scholarship of $4,000. Congratulations, Cole!

Navigating Digital Inspections

At the outset, these stakeholders were managing quality reports using three different systems of record, including two separate instances of Procore - one managed by the GC and another by the owner. The GC's onsite project manager and engineer were also using a Google Sheet.



To view full presentation go to **https://bit.ly/ColeCDX**

What the Judges Said

Amanda Wieting, Senior Technical Account Manager at Bluebeam and one of our judges, explained why, saying, "[Cole] had a really good understanding of the shared pains within the current state and really did a great job of addressing those — and the shared gains. We really like that he had the consideration for the human aspect in the process, too." The judges also congratulated Cole on his choice of a realistically implementable solution.

Shared Pains

- ☐ Too many system resulting in double data entry
- ☐ Risk of working with outdated information
- ☐ Administrative burden is high

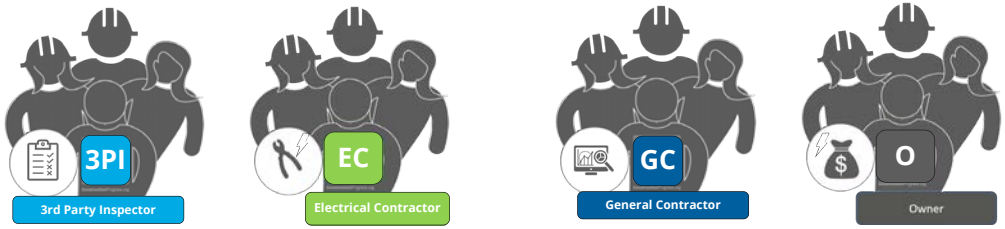
Shared Gains

- ☑ Visual access to quality database information
- ☑ Consolidation into a single system (ArcGIS)
- ☑ Single point of reference, but each stakeholder will maintain their own system of record (i.e. Procore)

Stakeholders & Systems

In his example, Cole identified four key stakeholders:

- > The owner (O)
- > The third-party inspector (3PI)
- > The electrical contractor (EC)
- > The general contractor (GC)



SHARED GAINS PAINS Challenge Statement

HOW MIGHT WE...
centralize project inspection reporting

IN WAYS THAT...
eliminate duplicate efforts between stakeholder systems

SO THAT...
a single, map-based visualization of quality tracking reports can be realized

At the outset, these stakeholders were managing quality reports using three different systems of record, including two separate instances of Procore - one managed by the GC and another by the owner. The GC's onsite project manager and engineer were also using a Google Sheet.

SHARED PAIN

Too much administrative rework

From the start, Cole identified that the separate quality tracking systems created issues because they didn't communicate clearly with one another. Disconnected systems and documents led to excess rework and opportunities for data loss.

Specifically, Cole said the GC project engineer and EC superintendent struggled to communicate notifications effectively to each other. At the same time, information wasn't properly reaching the third-party inspector. As a result, the inspector might examine - and reject - work that was completed weeks before. This creates a domino effect that is to blame for many of the mega-project failures over the past decade.

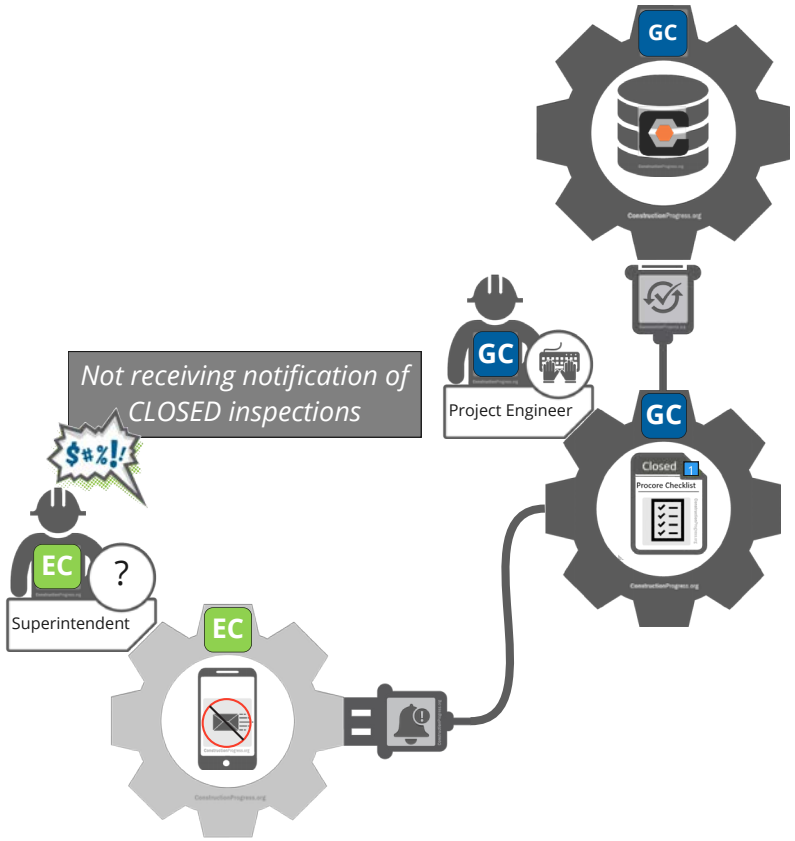


FIGURE 1 Current State: Navigating Digital Inspections

With so many disconnected systems, too much time was being spent on both administrative tasks and rework. While the GC and EC are feeling the brunt of the impact on productivity and team morale, it's often the owner that ultimately pays for it.

SHARED GAIN

Google Maps for Project Quality Inspection

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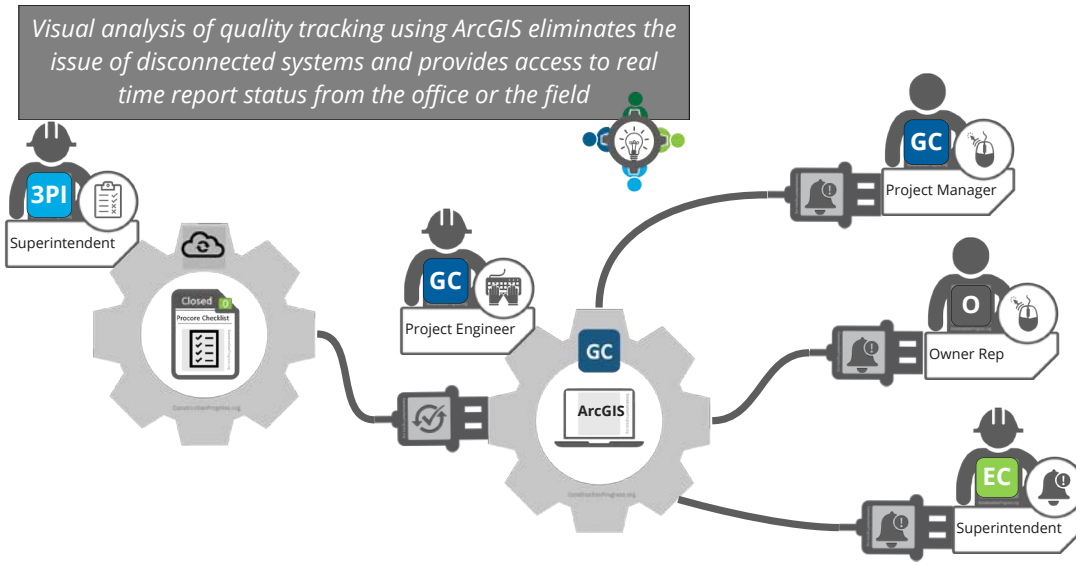


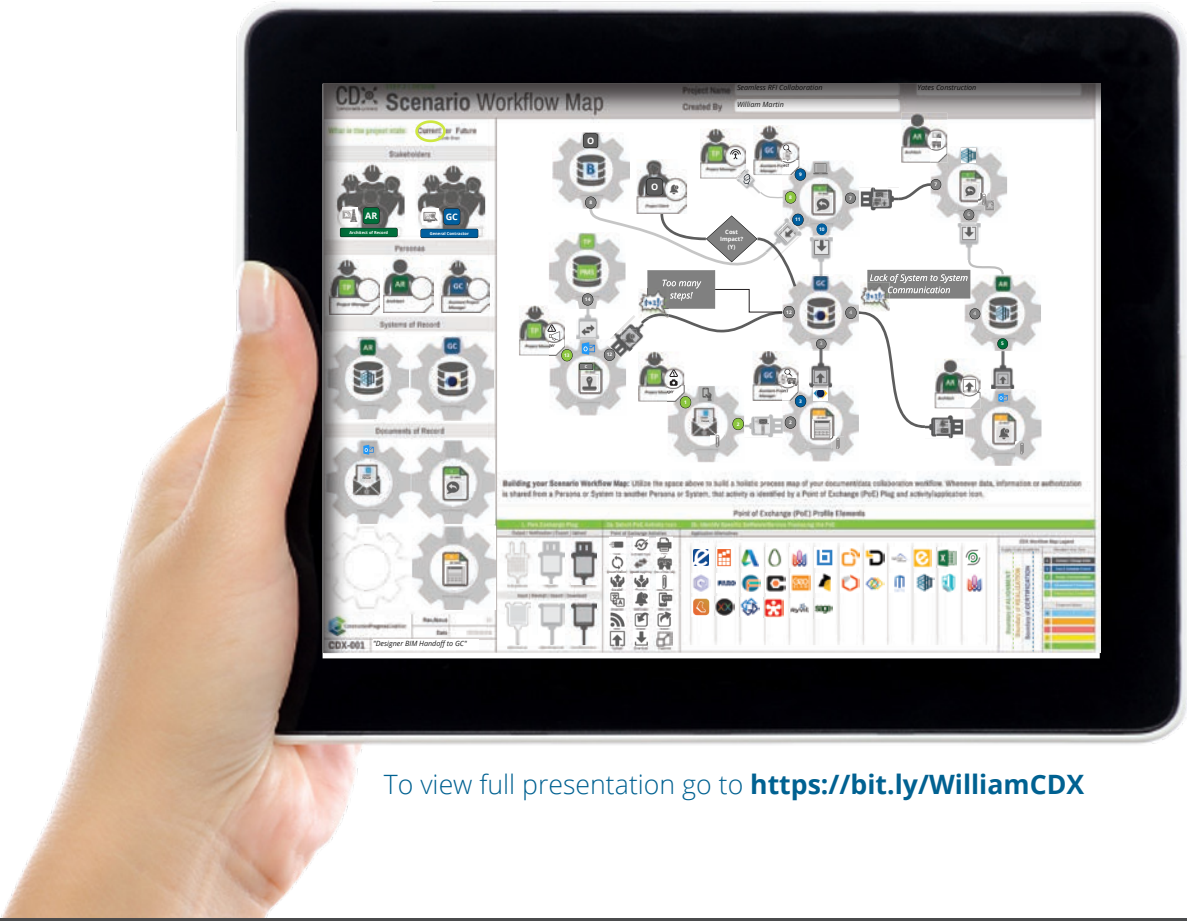
FIGURE 2 Future State: Navigating Digital Inspections

William Martin

Building & Construction Sciences Undergraduate Student, Mississippi State University
Mentor: Benjamin Crosby, Yates Construction

Seamless RFI Collaboration

William explored ways to improve RFI workflow efficiency, aiming to eliminate data duplication and enable all users to access up-to-date data from their chosen system of record.



To view full presentation go to **https://bit.ly/WilliamCDX**

What the Judges Said

Peg Landry, Content Marketing Strategist at Newforma, along with our entire judging panel, praised William for going above and beyond. “I was looking at somebody that did a little bit extra and that was William,” she said. “I really liked that he was able to quantify the cost savings.”

Congratulations William and enjoy your $2,000 scholarship courtesy of Bluebeam, Inc.

Shared Pains

- ☐ Manual Entry/Email of Tier 1 Issue [TP > GC]
- ☐ Lack of System-to-System Communication
- ☐ Too many steps between Too Many Systems

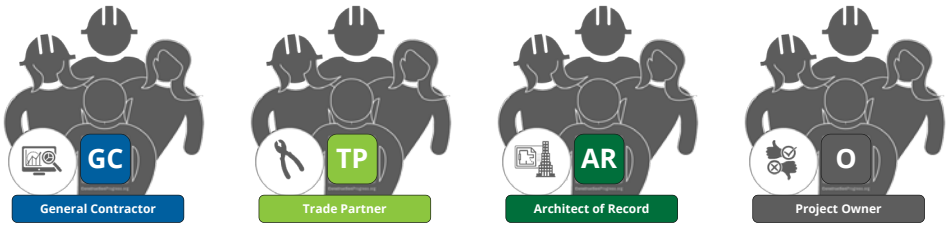
Shared Gains

- ☑ Stakeholders maintain their internal System of Record
- ☑ Decreased Number of Steps in Process
- ☑ Centralization

Stakeholders & Systems

In his example, William identified four key stakeholders:

- The general contractor (GC)
- The trade partner (TP)
- The architect of record (AR)
- The project owner (O)



SHARED GAINS PAINS Challenge Statement

HOW MIGHT WE...
improve RFI workflow efficiency

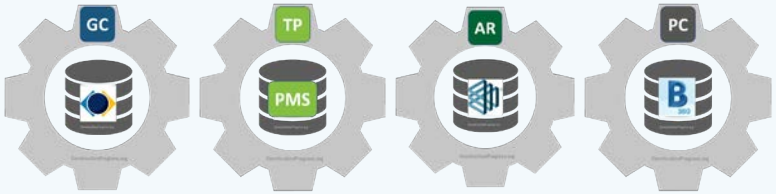
IN WAYS THAT...
eliminate duplicate data entry between key stakeholders

SO THAT...
everyone can access the same data from their own system

As a case study, he delved into the situation at hand if the trade partner finds a problem on the jobsite. In the current state, the trade partner has to compose an email to the GC, who then elevates it to an RFI (assuming the situation calls for it).

The GC has to create the RFI and upload it to their project site, which pings the architect with a notification about the new RFI. Then, the architect responds to the RFI and uploads their answer into their own system, which alerts the GC.

Assuming the response is sufficient, the GC changes the RFI to closed. They then need to upload the closed RFI into a separate, third system: the owner's document repository software. Finally, the closed RFI gets distributed to the trade partner, who uploads it into their own project management solution.



SHARED PAIN

Too many systems, too many steps

Throughout this RFI process, William documented 14 distinct steps. Each comes with its own point of data reentry.

He identified a shared pain between the GC and architect where a lack of system-to-system communication requires RFI form fields to be re-typed manually from one system to another, voiding a key benefit going digital in the first place: automation.

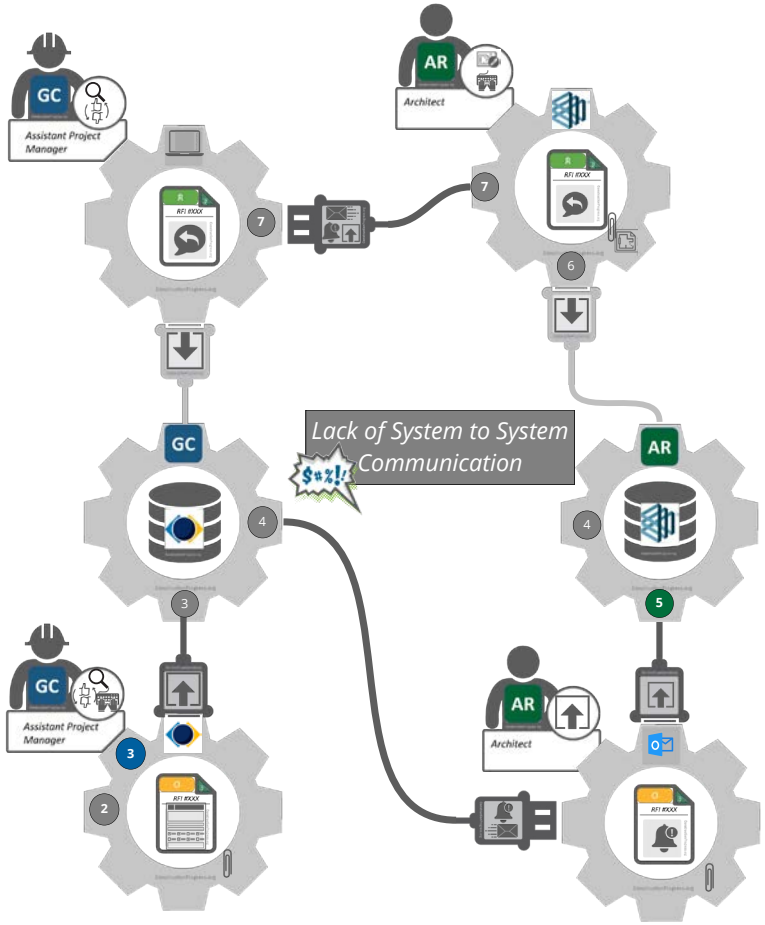


FIGURE 3 Current State: Seamless RFI Collaboration

Williams calculated that based on a $75,000 salary and roughly 10 minutes per exchange (moving an RFI from one system to another), the cost per exchange is around $6. Since each RFI requires seven exchanges in the current state workflow,the cost of data re-entry per RFI goes up to $42. Since this project has seen 483 RFIs to date, the project could have saved an estimated $20,286 by streamlining RFI data exchanges between project stakeholder systems of record.

SHARED GAIN

A common data environment

Acknowledging that each stakeholder will almost definitely want to maintain their own system of record, William suggested creating a shared data environment. This common, central system would allow various stakeholders to make updates and push information to the appropriate parties while maintaining their independent systems. At the same time, it could ensure data in each stakeholder's own recordkeeping system stays up-to-date.

Ultimately, this would allow stakeholders to maintain their own independent systems while removing trivial steps in the RFI process - and costs for the owner - by providing a central source of information.

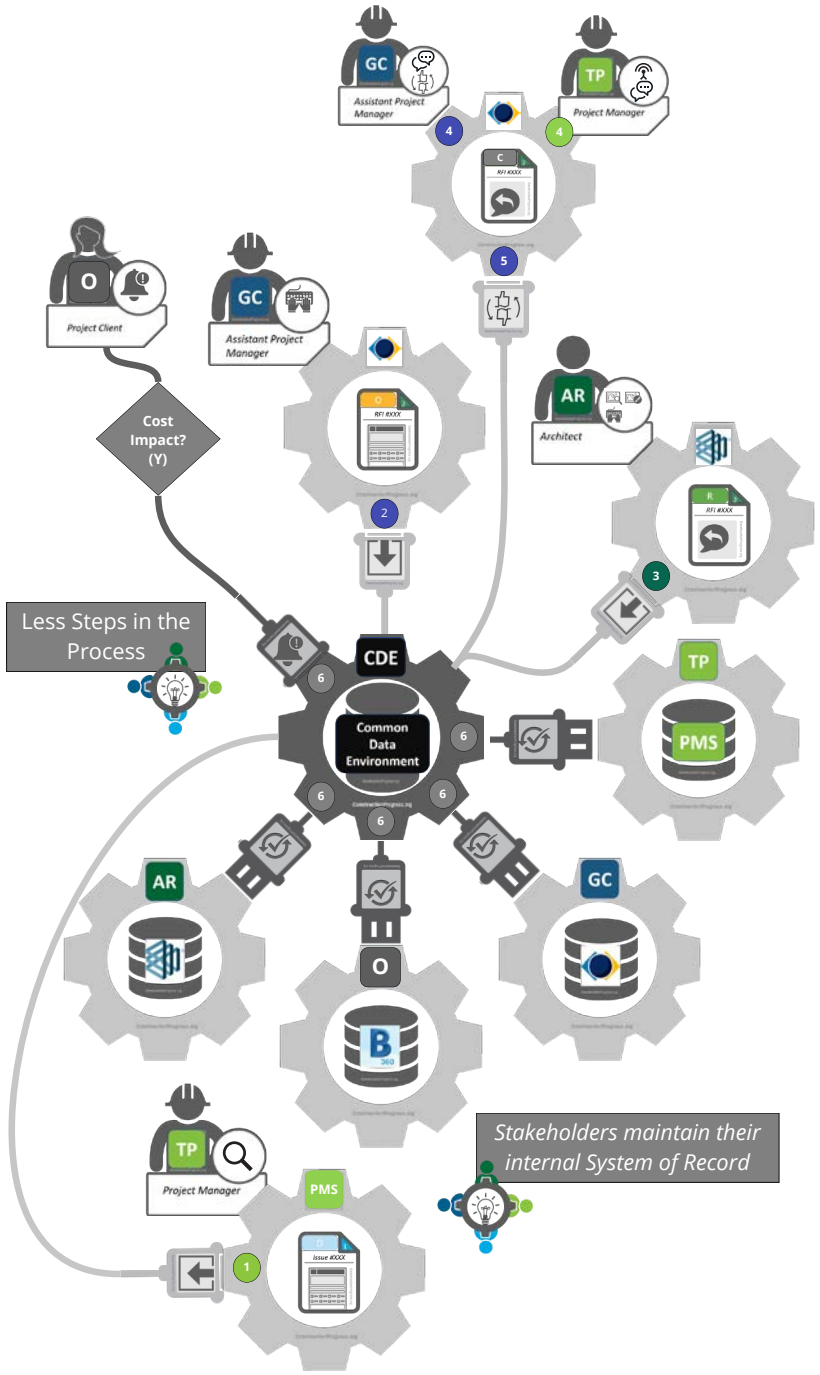


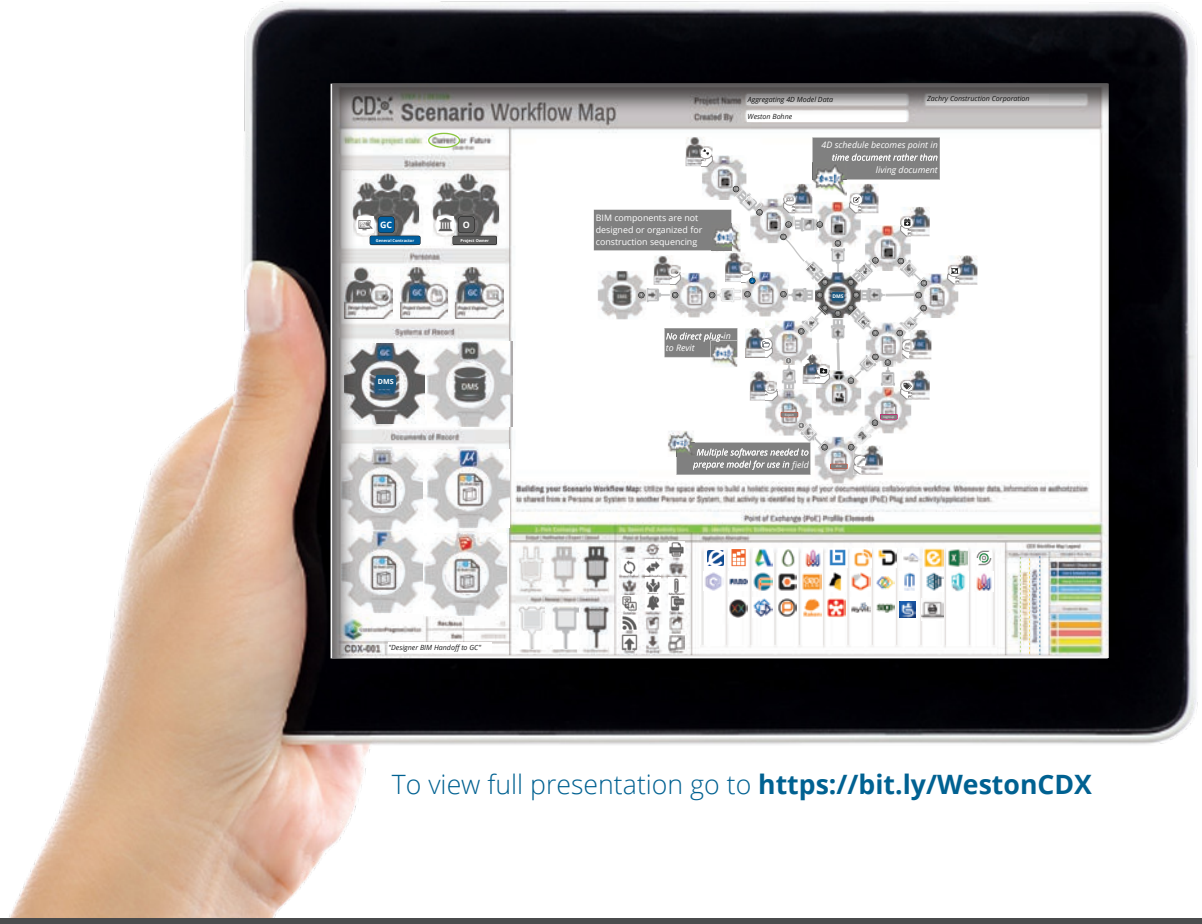
FIGURE 4 Future State: Seamless RFI Collaboration

Weston Bohne

Multidisciplinary Engineering Tech: Mechatronics Undergraduate Student, Texas A&M University
Mentor: Todd Sutton, Zachry Construction Corporation

Aggregating 4D Model Data

Weston used the CDX framework to document his evaluation of the steps required to produce a 4D model that integrates schedule data from Primavera P6 and design data from different BIM authoring tools. By comparing two separate infrastructure projects (one state highway and one dam), Weston's objective was to reduce the number software applications and individual activities required to condition the designer's BIM for construction schedule integration.



To view full presentation go to **https://bit.ly/WestonCDX**

What the Judges Said

Jared Coelho, Senior Manager of Strategic Partnerships in Construction at Autodesk, gave Weston kudos, saying, "I think one of the parts that stood out the most to me was just the sheer complexity of the problem that Weston was trying to solve — and the clearly articulated solution that ended up with a process that would yield a lot of value."

Congratulations Weston and enjoy your $2,000 scholarship courtesy of Bluebeam, Inc.

Shared Pains

- ☐ Unusable 3D Model from PO
- ☐ Inefficient Path to Process Model for Field Use
- ☐ 4D Model Created as Point in Time Document

Shared Gains

- ☑ Stakeholders maintain their internal System of Record
- ☑ Decreased Number of Steps in Process
- ☑ Centralization

Stakeholders & Systems

While their accessibility varies widely between the Weston's two case projects, the impacted stakeholders focus on:

- > The engineer of record (ER)
- > The general contractor (GC)
- > The project owner (O)

SHARED GAINS PAINS Challenge Statement

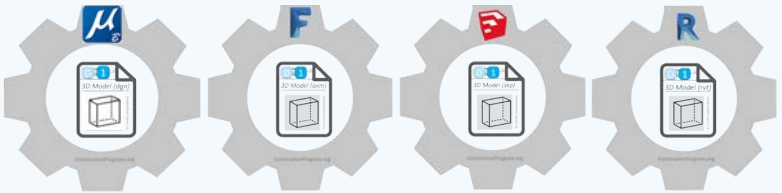
HOW MIGHT WE...
improve the quality of 3D model data exchanges from owners or design engineers to the GC

IN WAYS THAT...
eliminate the need for multiple BIM applications to prepare the model for schedule simulation

SO THAT...
we may improve the efficiency and reliability of upstream design information and construction sequencing

For the GC to connect the design BIM to their P6 schedule, they utilize Revit as their internal BIM system of record, and connect the two data sources together using Synchro. They also utilize ELO as their company-wide document management system (DMS).

On both projects, the GC receives a BIM design file that is produced by the engineer of record. On the State Highway project, the GC receives it via the department of transportation (DOT) as a Microstation Design File (.DGN) without any direct contact with its author. On the Dam project, the GC is contracted directly with the engineer of record who authored and shared their design BIM as a Revit (.RVT) file.



SHARED PAIN

BIM Software Compatibility

The process for an engineer to develop their design in BIM does not - and should not - equal the process a GC uses to break down quantities, phases, or production rates. When the design BIM is not organized with a logic that can be broken down easily, the resulting #SharedPains are duplicate data entry, which leads to human errors and omissions, which ultimately - lead to reliability and trust issues.

To make matters worse for the highway project, the design BIM file was authored using a software (MicroStation) that's not easily

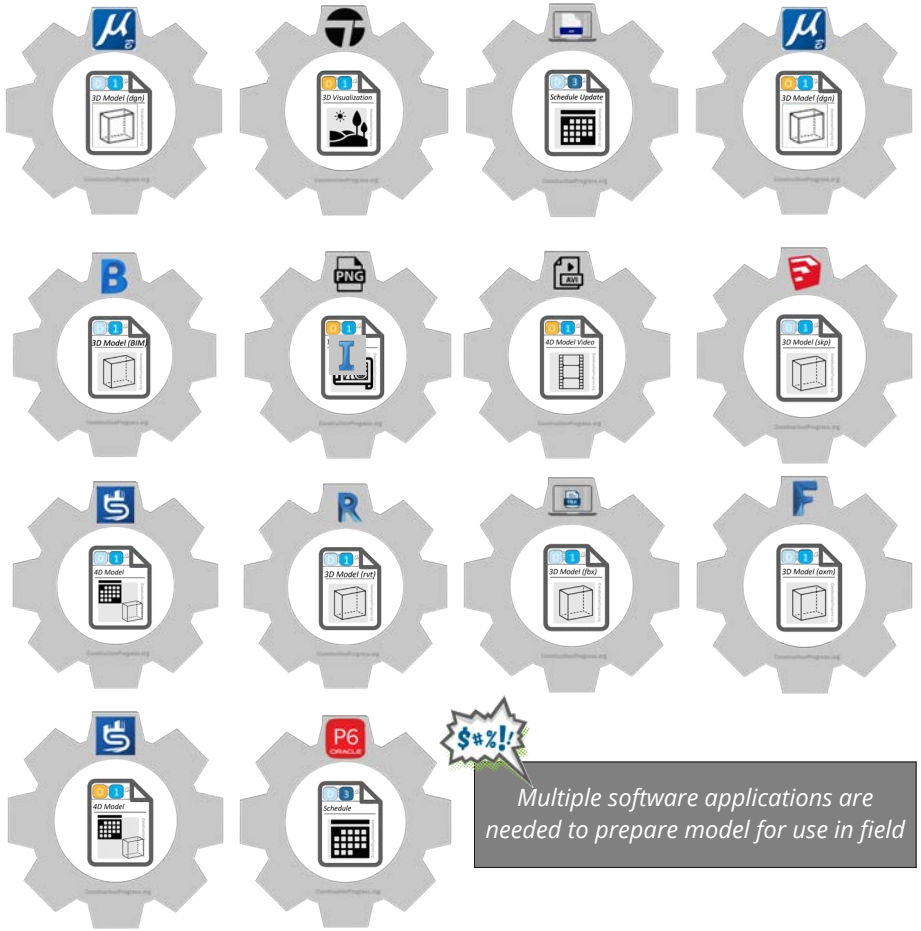


FIGURE 5 Current State: BIM files and applications required

compatible with the GC's software (Revit). As a workaround, Weston used a third software with a plugin that allows him to export a SketchUp file (.SKP) from MicroStation. While better than the alternative, even the .SKP export comes with its share of challenges.

Finally, the solution came together when Weston introduced a fourth software - Autodesk FormIt - to accept the Filmbox (.FBX) export from MicroStation. FormIt is used to "slice" the model objects according to construction sequencing, before exporting a .SKP file into SketchUp for object grouping and sequence tagging (which is already an internal standard established by the GC).

Four BIM applications and five file types later, the GC's Revit model is now 'conditioned' and ready for transfer into Synchro via their Plugin. In reality, these efforts to maintain real-time updates between design and schedule can be more investment than return.

Jobsite Technology Adoption

The Dam project proved that a closer contract relationship between engineer and GC, combined with native BIM file sharing (.RVT, in this case) leads to significant time savings when prepping the model for 4D integration. However, Weston found an even bigger problem: the model never gets used in the field. Why?

Instead of serving as a living document, the 4D schedule stagnates. Changes in schedule that were made in P6, exported to PDF, and saved to the DMS are not likely to go the last mile to updated Synchro - unless they didn't physically have to "go the last mile".

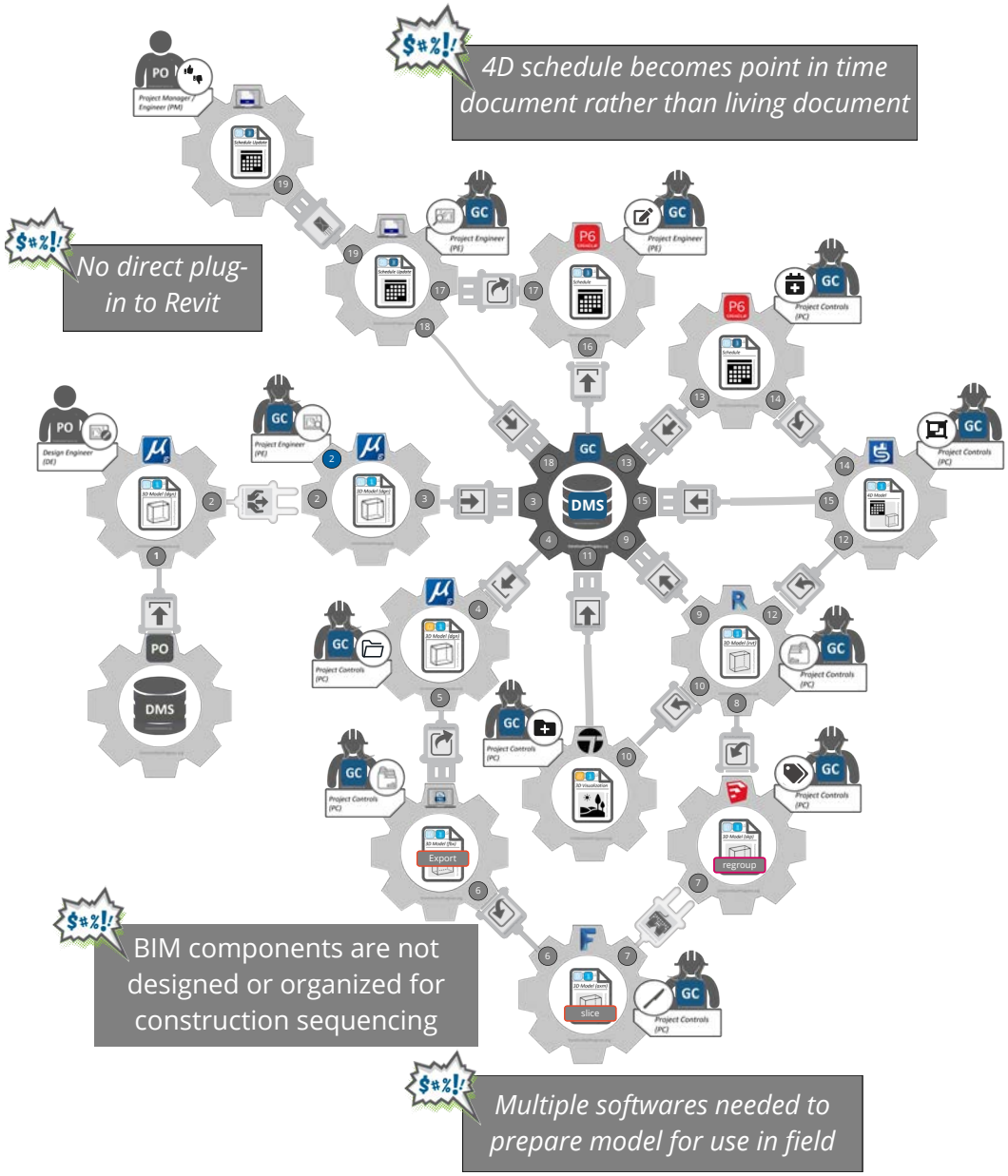


FIGURE 6 Current State: Aggregating 4D Model Data

SHARED GAIN Qualify BIM data prior to acceptance

Having the schedule breakdown areas - aka work breakdown structure (WBS) - incorporated by design stakeholders in their source application allows Synchro to provide near real-time updates on how design changes or delays might impact the critical path of construction.

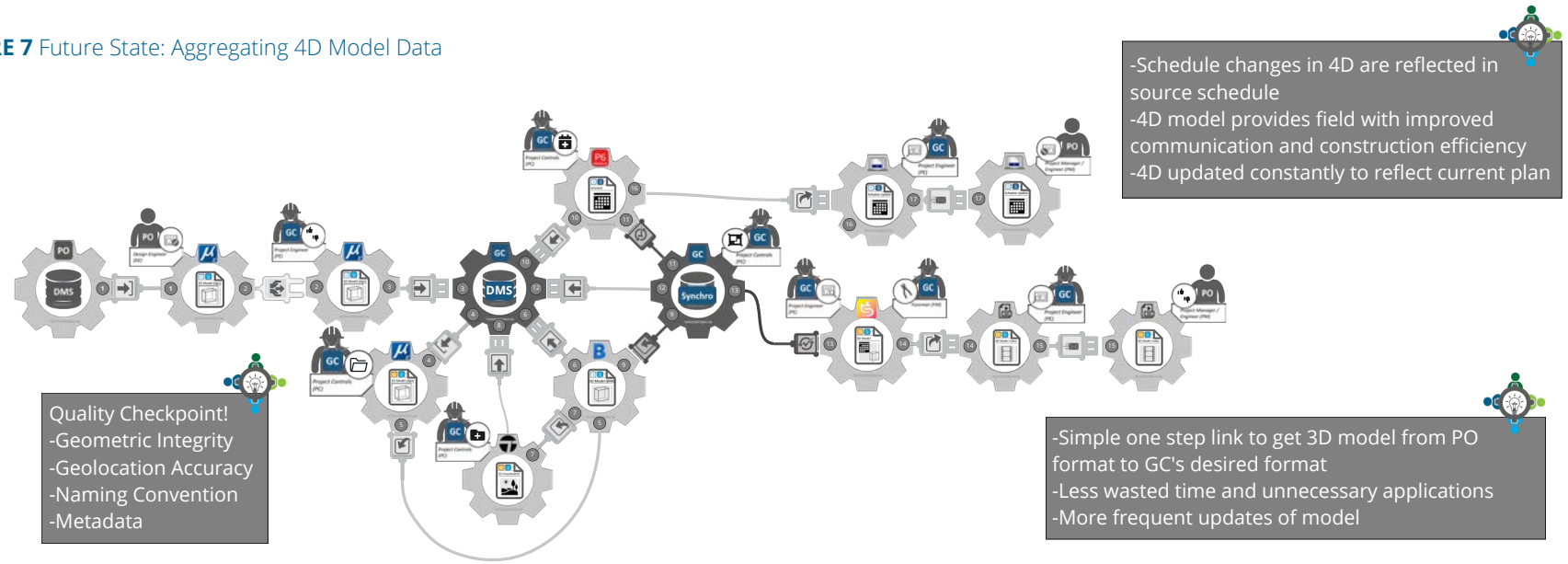
Having CDX project kickoff conversations earlier can allow each designer's BIM to be developed using a unified WBS logic. Leveraging a common WBS across the construction and operation phases of a project are cornerstones in the foundation of "smart" infrastructure and buildings.

For adoption of real-time 4D schedules that provide value to the field, they need to trust it. The concept of sharing project information via a "live link" rather than file attachment will be an important step in gaining that trust, but a hard one to achieve until reliable internet access across the jobsite is standard.

To implement this transformation of process and paradigm, Weston suggested having every design BIM go through a quality acceptance checkpoint. This requires the GC to either approve or reject the designer's BIM submission based on the criteria established together during the CDX kickoff. At this key point of exchange, the GC Project Engineer should be checking the designer's BIM file for: ☑ Geometric integrity ☑ Geolocation accuracy ☑ Metadata ☑ Naming conventions ☑ Usable formatting

By assigning a single person responsible for checking BIM data quality, their acceptance can trigger the auto-import of updates into Revit, Synchro, etc. and auto-notify anyone tagged as being impacted. This strategy would serve to address both the data quality/trust and the resource redundancy issues. At the point where Synchro becomes a "live" 4D system of record, foremen and project engineers will have the confidence to rely on 4D schedule information from an iPad the same way we rely on The Last Planner System ® for lookahead scheduling. Finally, a continually updated, living, 4D system of record could make the handoff to the owner for final approvals cleaner and more accurate.

FIGURE 7 Future State: Aggregating 4D Model Data

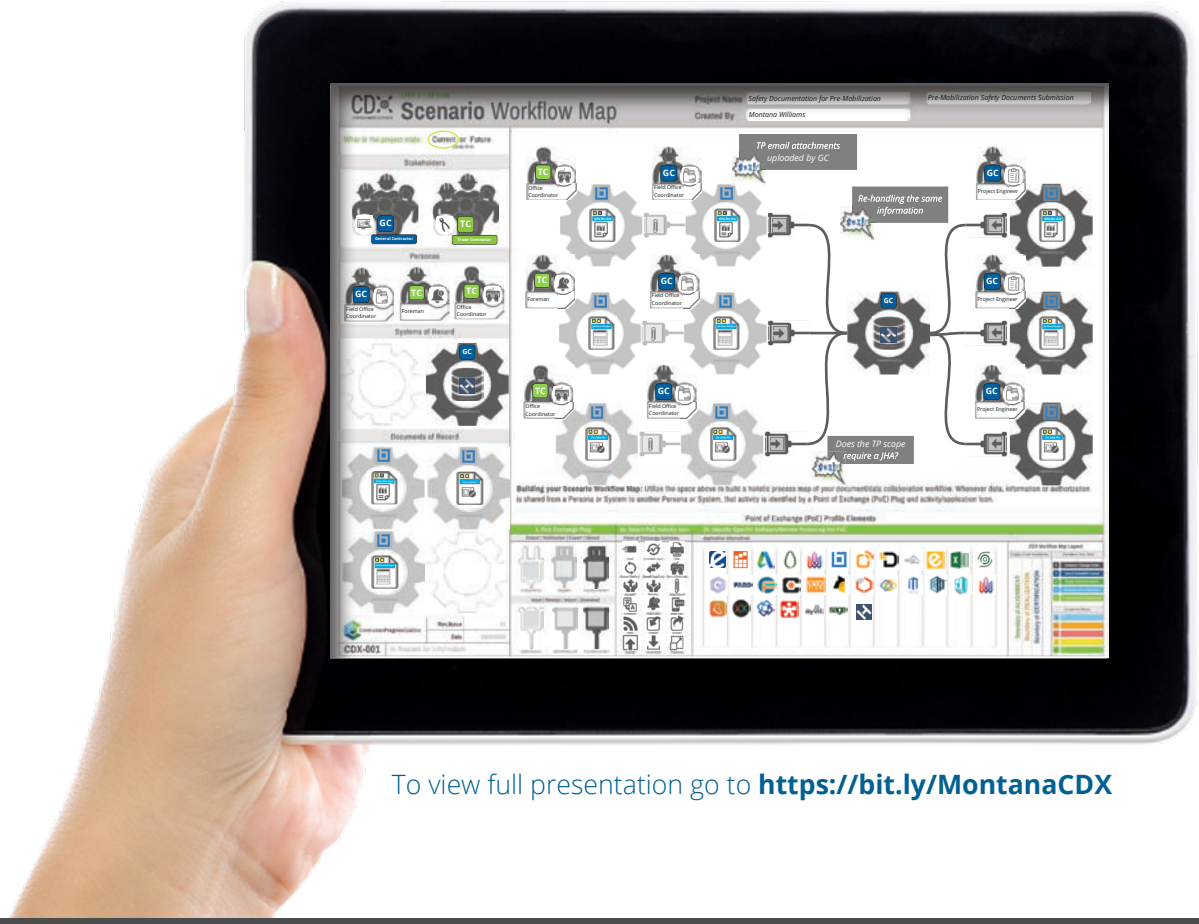


Montana Williams

Mechanical Engineering Undergraduate Student, Duke University
Mentor: Lilian Magallanes, DPR Construction

Safety Documentation for Pre-Mobilization

In order to reduce time expenditure for both general and trade contractors, Montana looked at ways to streamline data collection as it relates to pre-mobilization safety onboarding.



To view full presentation go to **https://bit.ly/MontanaCDX**

What the Judges Said

Jeremiah McNicholas, Product Marketing Manager at Sage Construction & Real Estate, said he thought Montana did the best job of conveying the current state of the problem and demonstrating a solid understanding of the terms and processes involved. He said, “The solution was simple and could be easily implemented in the field.”

Congratulations Montana and enjoy your $2,000 scholarship courtesy of Bluebeam, Inc.

Shared Pains

- ☐ Revisitation of safety information
- ☐ Use of email to facilitate software
- ☐ JHA retrieval

Shared Gains

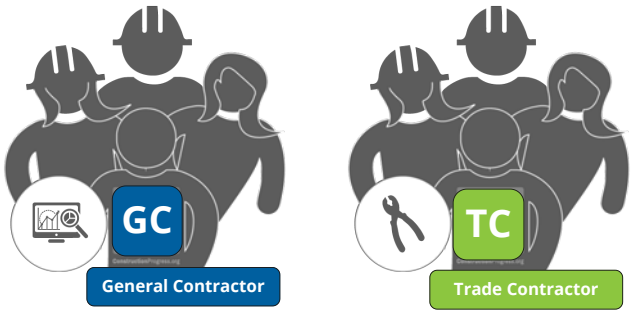
- ☑ "Upstream" safety data onboarding
- ☑ JHA prompting according to trade

Stakeholders & Systems

In his example, William identified four key stakeholders:

> The general contractor (GC)

> The trade contractor (TC)



SHARED GAINS PAINS Challenge Statement

HOW MIGHT WE...
streamline the pre-mobilization document process

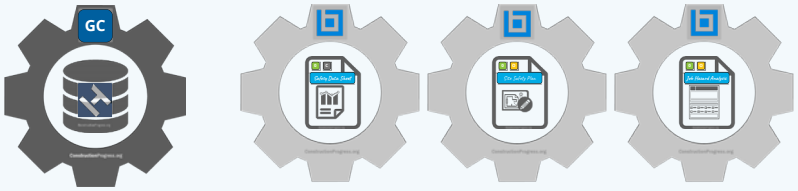
IN WAYS THAT...
simplify data collection for onboarding site operations

SO THAT...
time expenditure is reduced for both the GC and Trade Subcontractors

He looked at safety specific pre-mobilization documents of records, including the:

- Safety data sheet (SDS)
- Job hazard analysis (JHA)
- Site safety plan (SSP)

Combined, Montana dubbed these documents the pre-mobilization package. In the current state, the GC field office coordinator reaches out to TC's office coordinators or foremen via email to prepare the documents below. The GC's coordinator then uploads the documents into their own system of record, where key players like superintendents and project engineers can access, review, and approve them.



Safety Documentation System of Record

Pre-mobilization Package
Safety Documents

SHARED PAIN

Redundant and unnecessary work

Montana identified a handful of pain points in the current state, including:

Required Redundancy. In many cases, the trade contractor already provided the information that is required in the SDS or SSP during the bid prequalification stage. They might feel understandably annoyed about being asked to resubmit these documents a second time.

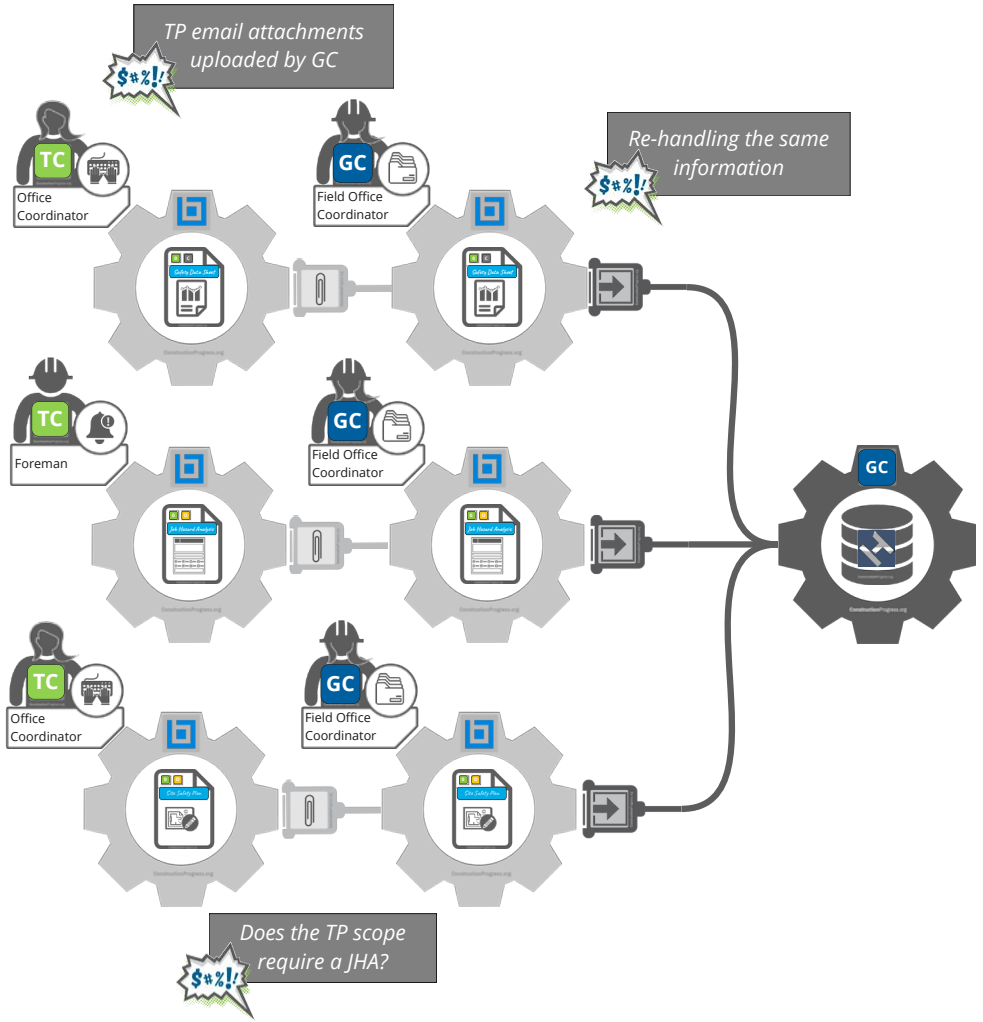


FIGURE 8 Current State: Safety Documentation for Pre-Mobilization

Email as a middleman. Because the exchange of these documents is primarily as an email attachment, this adds steps to download, upload, and rename the document package.

Unclear requirements. Too much information can be a bad thing. In some cases, documentation is submitted that may be irrelevant. Lower-risk subs like painters might be asked for a JHA even when one isn't truly required, leaving them scrambling to gather documentation and potentially holding up the project onboarding process.

SHARED GAIN

Get data upstream to the mouth of the river

To address these pain points, Montana suggested breaking the pre-mobilization package into two components: **initial agreement documents** and **time-of-work documents.**

He recommended feeding the SDS and SSP into the appropriate software as these details are agreed upon during contract negotiations. Since the GC vets a TC's safety protocols during their bid prequalification process, this is a natural time to request — and record — this data.

Then, Montana suggested prompting the relevant TCs to prepare their JHAs closer to when the time-of-work approaches. This allows them to provide a more realistic evaluation of existing site conditions to properly identify jobsite hazards that may not have been noticed when reviewing the drawing and construction schedule. The only challenge this would pose is ensuring the TC has sufficient notice to submit the just-in-time JHAs.

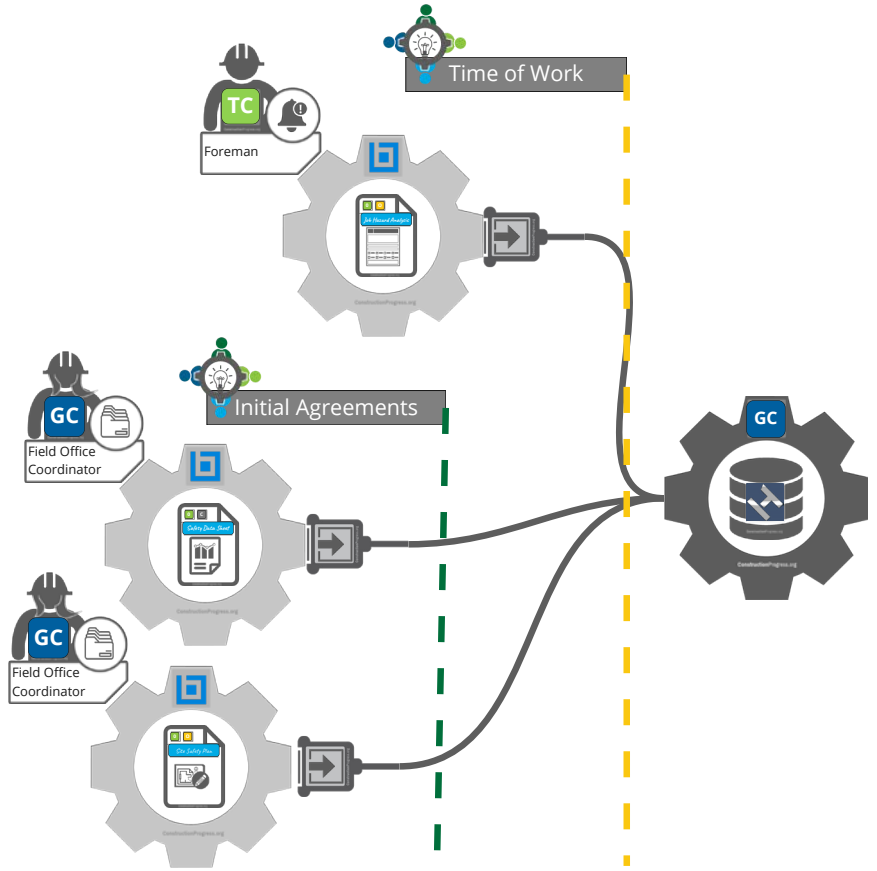


FIGURE 9 Future State: Safety Documentation for Pre-Mobilization

Chisler Joseph

Construction Management Graduate Student, University of Florida
Mentor: Rob Sloyer, Kast Construction

Schedule-to-Field Integration

Chisler explored how to improve access to updated, real-time project schedule information in order to reduce communication redundancy and latency.

To view full presentation go to **https://bit.ly/ChislerCDX**

What the Judges Said

DJ Phipps, Strategic Product Consultant for BIM and VDC at Procore, said Chisler's research showed some of the biggest potential in terms of project impact, largely because schedules are so key. As he said, "Schedule is one of those things that's really critical when it comes to being successful at your project or having an early indicator if the project's in trouble." DJ liked the ability Chisler's research demonstrated to "get that feedback and be predictive instead of reactive to what's going on in the field."

Congratulations Chisler and enjoy your $2,000 scholarship courtesy of Bluebeam, Inc.

Shared Pains

- ☐ Information Overload
- ☐ Lag in time schedule is updated and received
- ☐ Document travels through several mediums

Shared Gains

- ☑ Process is more synchronized
- ☑ More variety of display of complex information
- ☑ Reduction in schedule file logging for PM & Super-No more chasing revisions

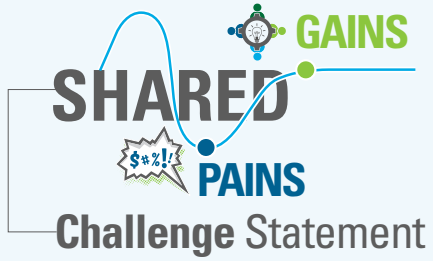
Stakeholders & Systems

For his case study, Chisler identified four stakeholders.

> The project owner (O)

> The general contractor (GC)

> The trade contractor (TC)



HOW MIGHT WE...
improve access to updated project schedule information

IN WAYS THAT...
eliminate redundancy (Kast) and schedule latency (Owner and Subcontractors)

SO THAT...
all project stakeholders have reliable, real-time access to a single source for both milestone and lookahead schedules.

The GC utilizes Procore as their Project Management (PM) system of record, but the original schedule information is produced and managed within Primavera P6.

SHARED PAIN

Redundancy and blind spots

Despite challenges to maintaining updates for a single project schedule, Chisler discovered that there are actually three stages in the evolution of a project plan:

- The original (milestone) schedule
- The look-ahead schedule
- The updated schedule

When the original schedule is generated in Primavera, the scheduler will upload it into their PM system of record (Procore). They also export a PDF of the schedule that is emailed to the project owner and trade contractors.

The superintendent may then convert the original schedule into a more granular look-ahead schedule that provides the TCs with a 2-4 week outlook.

Chisler identified repeat work and communication through the scheduling process, primarily when sharing the PDF schedule.

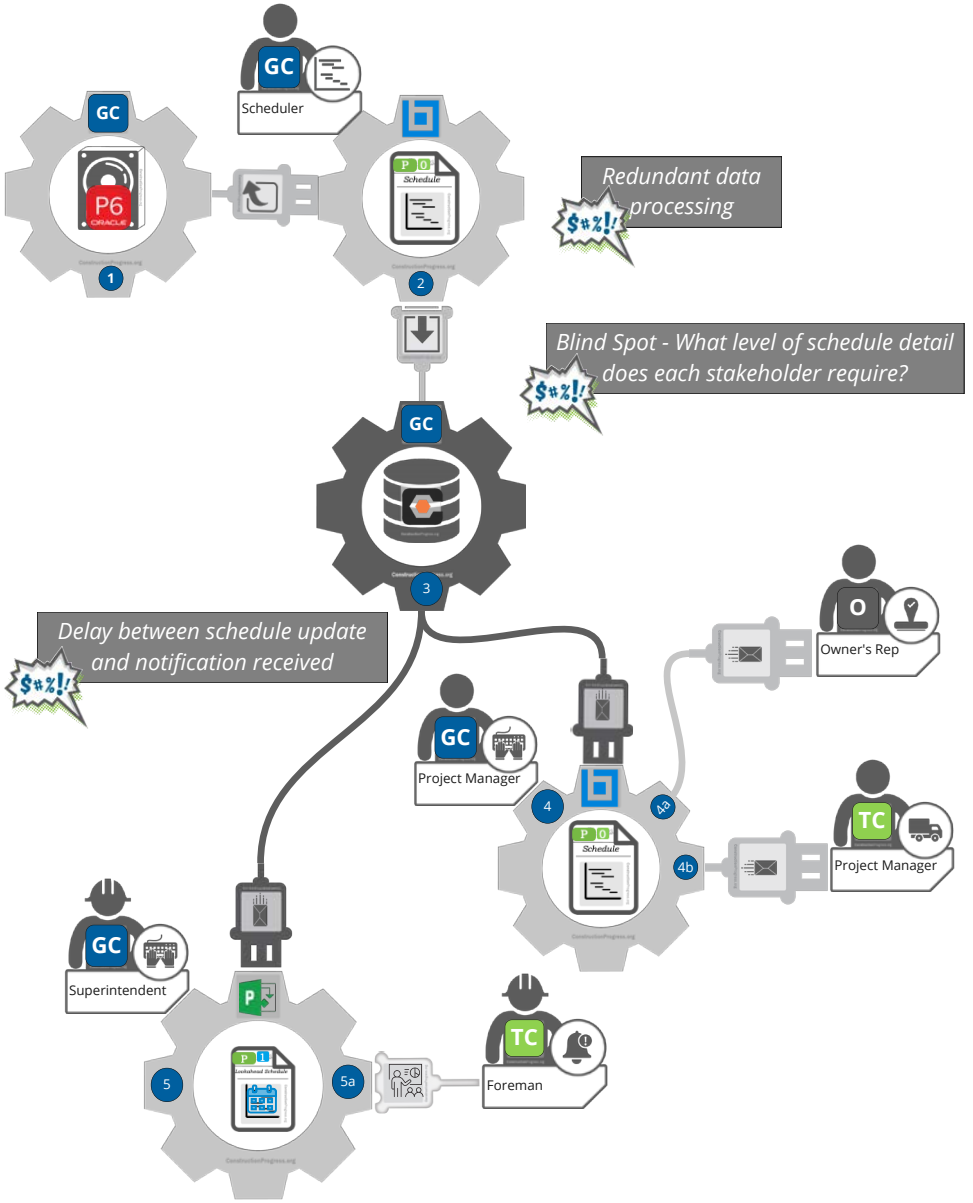


FIGURE 10 Current State: Schedule-to-Field Integration

The GC scheduler has to send that PDF to people within their organization GC, who may also need to convert and redistribute it to impacted TCs. This generates unnecessary lag time and can lead to information overload as new versions of multiple schedule types get pushed out. At the same time, the owner is left out of the loop. The schedule might get updated by the GC, but those updates don't always reach the owner in real-time. Instead, they're left to wait for the next OAC meeting to learn about it.

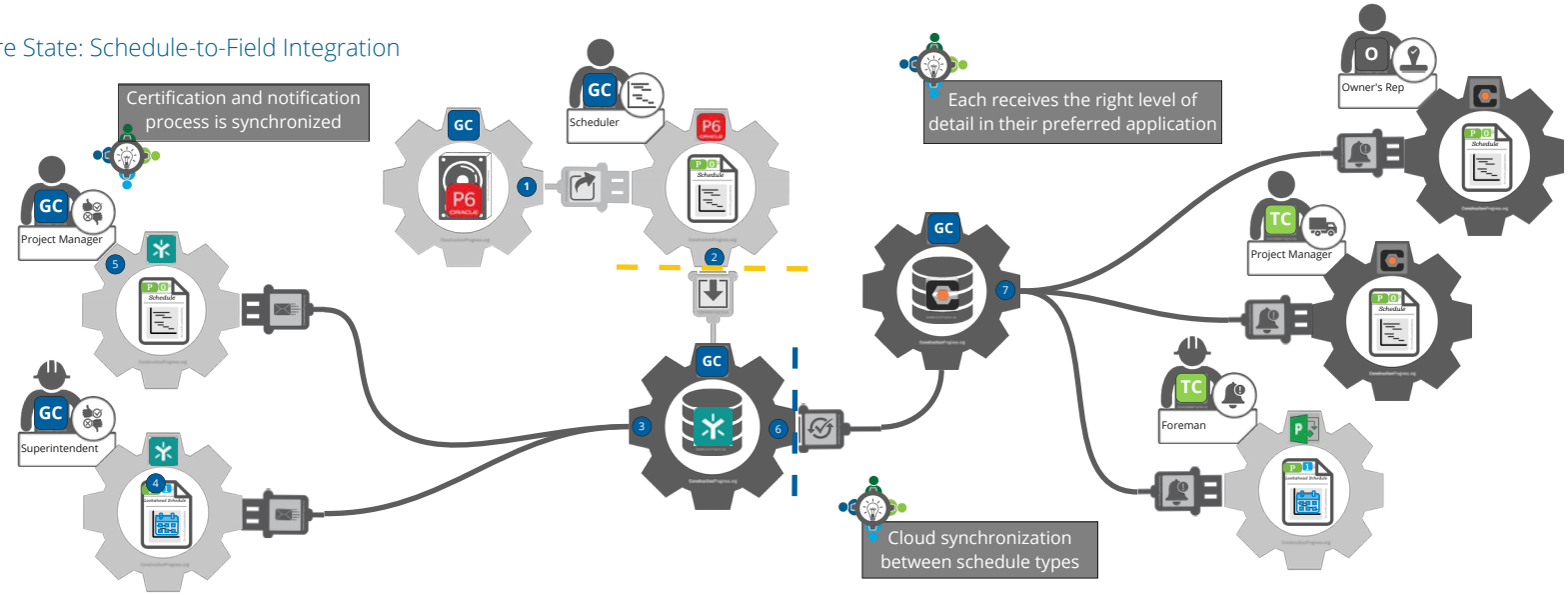
SHARED GAIN

Maintain schedule reliability before providing access

Chisler identified that at the project level, having a PDF export of the milestone or look ahead schedule is sufficient. The challenge was always how to provide simple and easy access to schedule information for the field (sound familiar...?). His recommendation is for the GC to distribute access to both PDF schedules in the app they feel more comfortable in. That way, anytime a PDF is updated with a new version, all assigned personas from each impacted stakeholder can be notified in real-time. When it comes to daily and weekly planning at the jobsite, The Last Planner (R) system is typically managed using whiteboards hung in the office trailer. But for the lookahead and master schedules, having digital access in the field would help keep everyone on the same page.

Providing access to a "live" schedule rather than email notifications to download PDF exports would improve schedule reliability and help to avoid breakdowns that impact cost and schedule. Plus, this would prevent superintendents and project managers from the headache of chasing file revisions, or worrying if they are looking at the latest version. Ultimately, the benefits of improved schedule access and synchronization is felt by the TC, GC, and project owner. Chisler also pointed out that using cloud-connected solutions like Procore can provide useful visualization benefits, allowing the GC to more easily communicate a broad dataset using a variety of dashboard and table formats that extend far beyond the traditional Gantt chart. However, extracting that level of schedule detail and logic requires the native Primavera P6 file (.XER).

FIGURE 11 Future State: Schedule-to-Field Integration



3. CDX Glossary

- **Stakeholder (n):** - A businesses or government entity with vested interest in one or more pieces of information involved with the CDX scenario.
- **Document of Record (DoR) (n):** The contractually-required package of project-sensitive information that is exchanged from one stakeholder to another.
- **Stage (adj):** the progression of a DoR from one status to the next.
- **Boundary (n):** The formal documentation of a risk or responsibility transfer from one Stakeholder to another.
- **Activity (v)** - a contractually significant action, performed by that generates information for the purpose of sharing with other project stakeholders.
- **Application (n):** The hardware and software tools (gears) that are conditionally provisioned or manually maintained to generate, certify, retain, or exchange information.
- **Persona (n):** an individual role or named person that is identified by the stakeholder they are employed by, their name and role/title on the project, and the action they perform in the designated DoR stage
- **System of Record (SoR) (n):** A project information retention source that may or may not include integrated applications. Each stakeholder will maintain at least one SoR at the enterprise level.
- **Point of Exchange (PoE) (n):** the documented transaction of information between multiple containers (DoR or SoR). A PoE (plug) is shown in the vertical direction when information is transferred internally (within the Stakeholder environment). If the plug is horizontal, information is being transmitted externally (to other Stakeholders within the Project environment).
- **Metadata (n):** specified pieces of information that are contained within a DoR or SoR. The exchange of metadata between stakeholders can occur via open-standard file sharing, or API connectors.

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