15 - 16 November, Wembley Stadium, UK

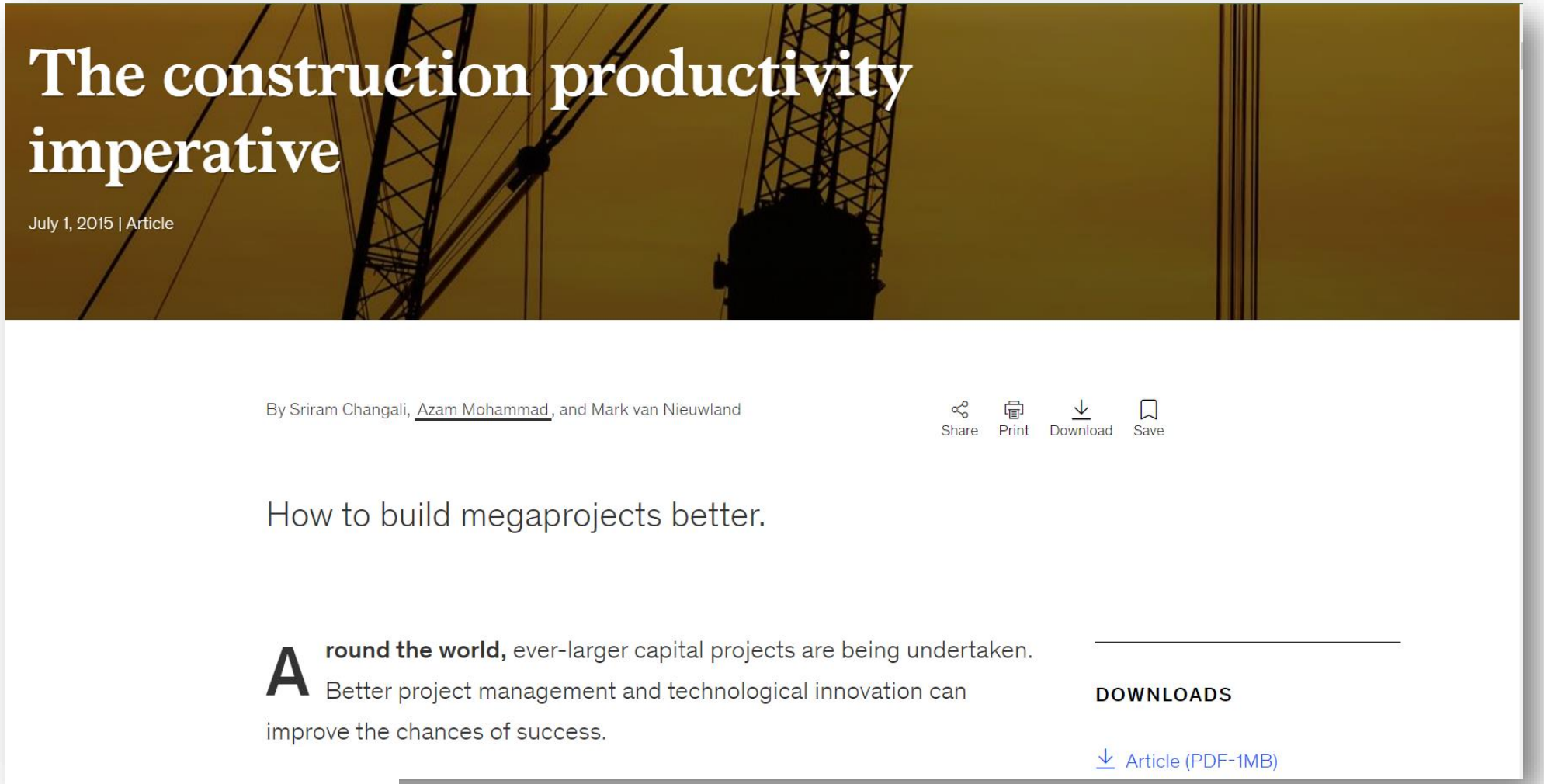
Evergreen Digital Twins from Design through Construction Execution to increase Schedule and Cost Performance

Hugh Hofmeister – Executive Advancement Director Construction
Ryan Posnikoff – Director Product Management, Construction

Project Controls EXPO London,UK

Bentley

Industry challenges to Infrastructure delivery



The construction productivity imperative

July 1, 2015 | Article

By Sriram Changali, Azam Mohammad, and Mark van Nieuwland

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How to build megaprojects better.

Around the world, ever-larger capital projects are being undertaken. Better project management and technological innovation can improve the chances of success.

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Article (PDF-1MB)

McKinsey & Company

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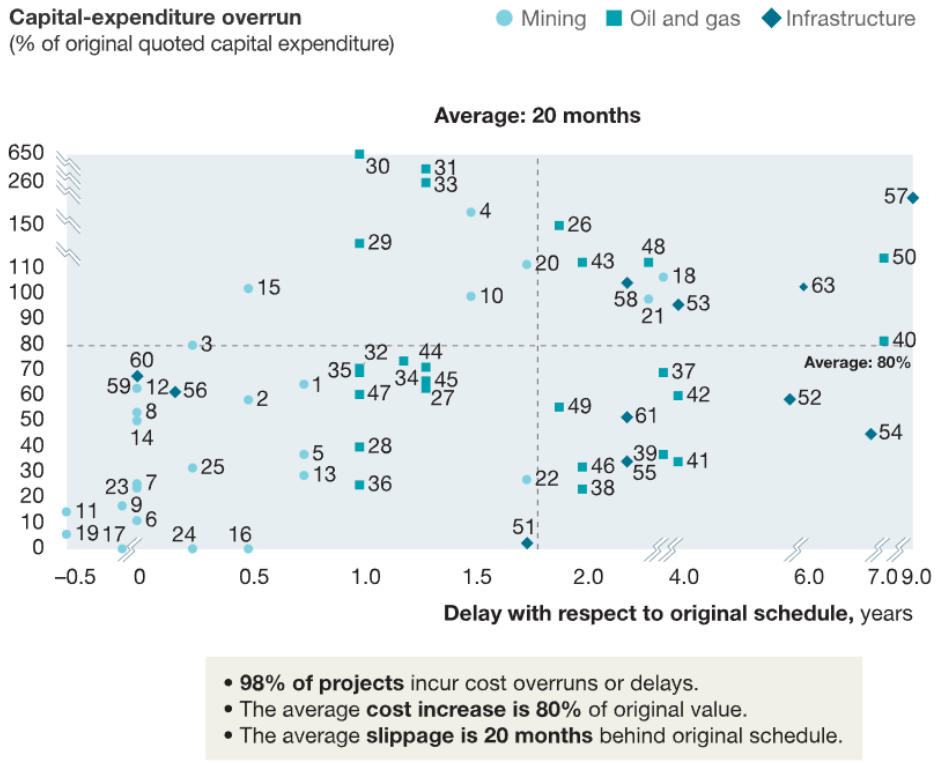
Reference: https://www.mckinsey.com/capabilities/operations/our-insights/the-construction-productivity-imperative

Project failures and Productivity Challenges

Ninety-eight percent of megaprojects face cost overruns or delays.



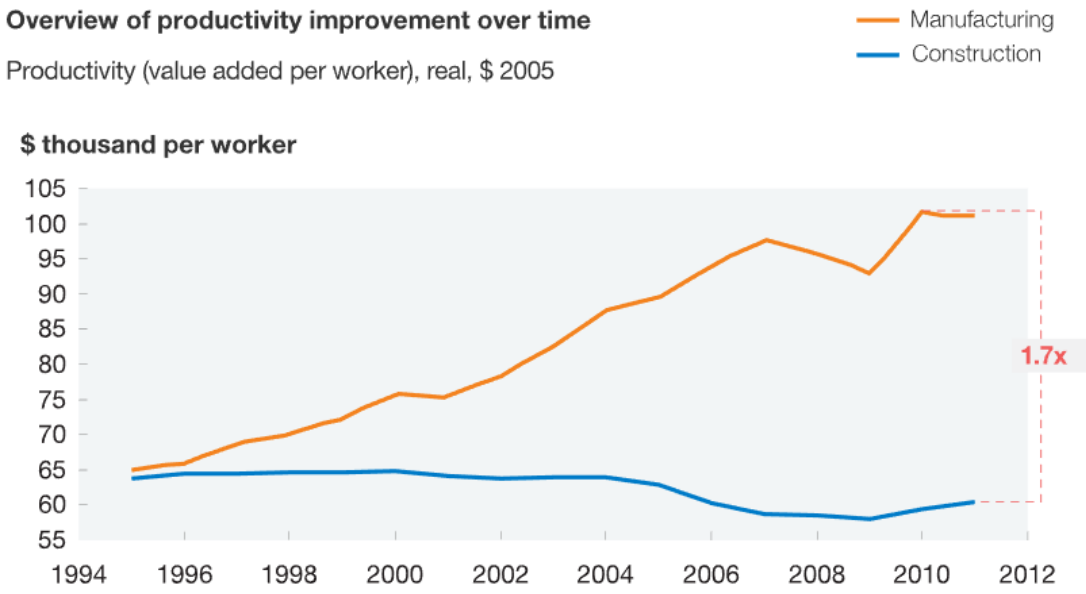
- **98% of projects** incur cost overruns or delays.
- The average **cost increase is 80%** of original value.
- The average **slippage is 20 months** behind original schedule.

Source: Companies' public annual reports; IHS Herold Global Projects Database, November 19, 2013; press releases

McKinsey&Company

Exhibit 3

Productivity in manufacturing has nearly doubled, whereas in construction it has remained flat.



Source: Expert interviews; IHS Global Insight (Belgium, France, Germany, Italy, Spain, United Kingdom, United States); World Input-Output Database

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Reference: https://www.mckinsey.com/capabilities/operations/our-insights/the-construction-productivity-imperative

Key focus areas for improvement

Contracting & Procurement

- Integrate risk allocation
- Create efficient claims & change-order management process
- Align the interests of all supply chain
- Develop owner's perspective on costs

Concept & Design

- Build only what is needed
- Maintain life-cycle perspective
- Strengthen Scenario Planning
- Optimize around site constraints
- Modular design & standardization
- Early design engagement with supply chain
- Optimize engineering processes & choices.

Project Execution

- Prioritize planning investment
- Use prefabrication and preassembly
- Build structures to cooperate on project performance
- Minimize waste

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Reference: https://www.mckinsey.com/capabilities/operations/our-insights/the-construction-productivity-imperative

Why the time is right to reinvent capital-project delivery

December 3, 2020 | Article

Today's delivery model for capital projects suffers from multiple sources of value loss.

Project lifecycle	Concept →	Feasibility and engineering →	Execution →	Commissioning and ramp-up
Major sources of value loss	Choosing the wrong projects Myopic contracting arrangements Siloed, transactional relationships Misalignment and dynamically changing customer needs Poorly developed feasibility and front-end engineering design (FEED) studies	Lack of effective planning Siloed approach to project delivery: individual custodians of knowledge and risks Reinvention rather than reuse: underemphasis on modular, prefab, precast, and offsite construction techniques Insufficient focus on constructability Limited crowdsourcing of ideas from vendors Little use of predictive analytics Few proactive risk-management procedures and tools	Unclear criteria for vendor approval; insufficient use of standardized rate cards Overuse of low-skilled contractors and labor forces with high churn Poor measurement and capturing of real-time progress Last-minute, unplanned design changes Poor communication protocols Weak or nonexistent claim-management systems	Incomplete or poor-quality handovers (often via paper records) from construction Operational ease and efficiency not considered

Source: McKinsey analysis of expert conversations

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Contracting and Procurement

- Enable collaboration between Owner and Contractor
- Drive closest possible alignment and collaboration between Engineering and Construction from the earliest stages

Design Build

- ¼ of European Projects are Design Build
- Overall, design-build is anticipated to represent up to 47% of construction spending in the assessed segments

https://www.usp-research.com/a-quarter-of-european-contracting-firms-do-design-build-projects/
https://dbia.org/what-is-design-build/
https://live-dbia.pantheonsite.io/wp-content/uploads/2021/09/FMI-DB-Market-Research-2021_2025.pdf

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Concept and Design Phase

- Create early alignment between Engineering and Construction teams
- Provide frequent and fastest possible feedback between design changes and the impact it has on other disciplines, constructability, construction sequencing, construction quantities, cost and risk profile so that design can be optimized

In software development teams this practice is called Continuous Integration (CI) – with the purpose of providing frequent feedback to developers.

The sooner a developer finds out that they have caused a problem the easier, faster and cheaper it is to fix.

https://www.usp-research.com/a-quarter-of-european-contracting-firms-do-design-build-projects/
https://dbia.org/what-is-design-build/
https://live-dbia.pantheonsite.io/wp-content/uploads/2021/09/FMI-DB-Market-Research-2021_2025.pdf

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Project Execution

- Start planning process at earliest point in alignment with design
- Harness the power of the team with collaborative feedback by democratizing plans
- Create continuous feedback on schedule and cost performance so problems can be identified early and mitigated

Traditional monthly Cost Management without daily feedback

https://www.usp-research.com/a-quarter-of-european-contracting-firms-do-design-build-projects/
https://dbia.org/what-is-design-build/
https://live-dbia.pantheonsite.io/wp-content/uploads/2021/09/FMI-DB-Market-Research-2021_2025.pdf

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Design Build – Contract Award
- Concept Design
- Agreed Contract Cost & Schedule
- Construction Strategy
- Risk Register

Detailed Design

Engineering Work In Progress (ProjectWise)

Design Cons

MicroS

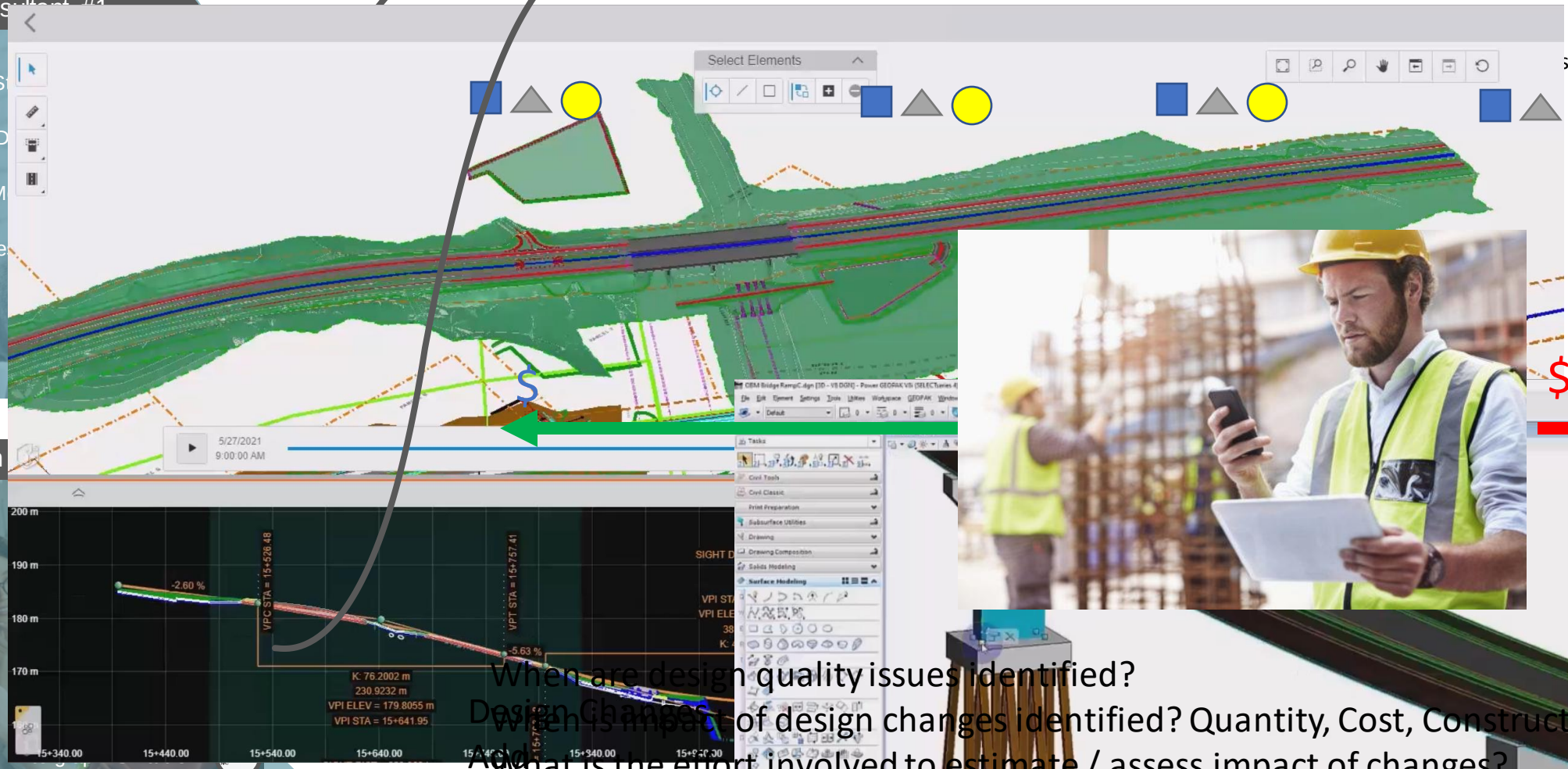
OpenBuildings D

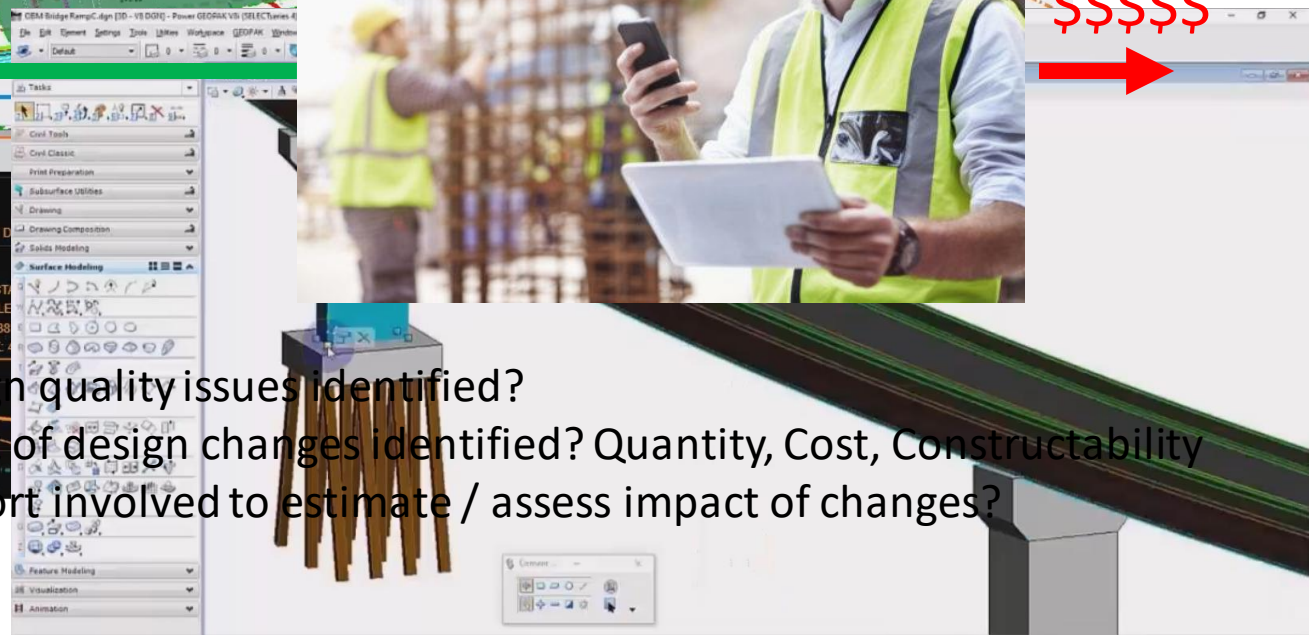
OpenPlant M

OpenRoads De

Design

Others





$$$$$

When are design quality issues identified?

When is impact of design changes identified? Quantity, Cost, Constructability

What is the effort involved to estimate / assess impact of changes?

Design Changes

Add

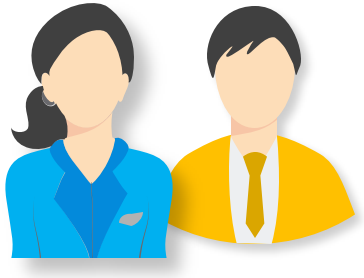
Edit

Delete

Industry challenges | Project execution - daily insight for teams and leaders

SYNCHRO

Head office



ERP Cost Accounting

Blackout until end-of-month progress, cost, and accruals updates

Field

Daily diaries

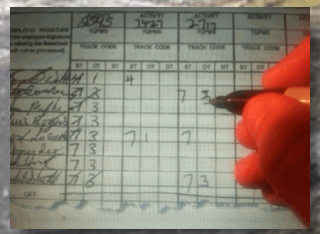
Progress

Timecards

Monitor safety

Direct work

Collect field data



Site office

Manage budgets, contracts, change orders and pay applications

Track performance and make decisions to optimise schedule and cost

Delayed feedback and lost time

Work happens

Decision-making

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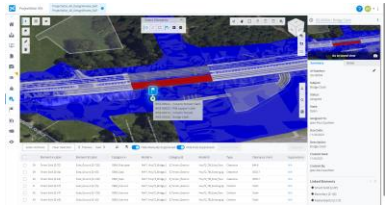
Pre-Bid | Pre-Construction Planning | Construction Execution | Closeout

SYNCHRO Construction
Web | Mobile | Cloud

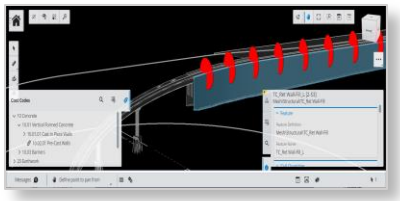
Frequent integration and federation of design updates

ProjectWise DI
Third Party and
Bentley Design Tools

- MicroStation
- OpenBuildings Designer
- OpenPlant Modeler
- OpenRoads Designer
- Revit
- Civil 3D
- 3D Studio(.3ds)
- AVEVA Diagrams
- Intergraph Smart 3D
- Others

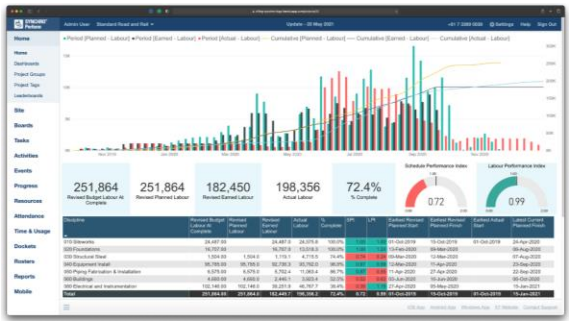


Design review validation / Clash

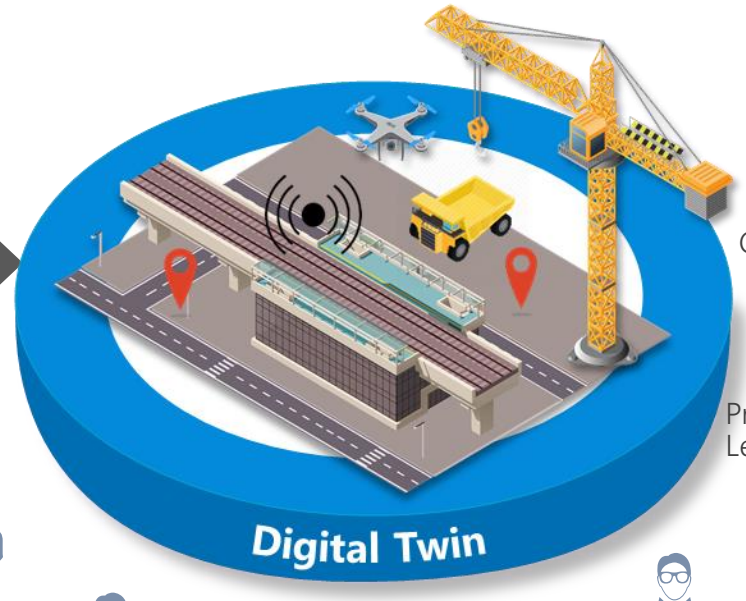


Construction model splits & 5D QTO

4D Plan Development

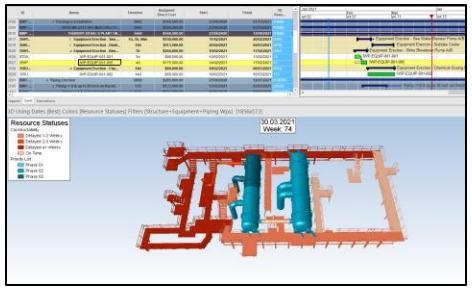


Performance Management



Client / Owner

4D Constructability review



Project Director / Leaders

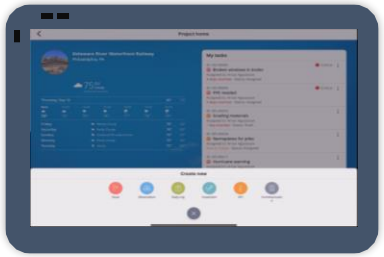
Engineer Designers

Planner Estimator

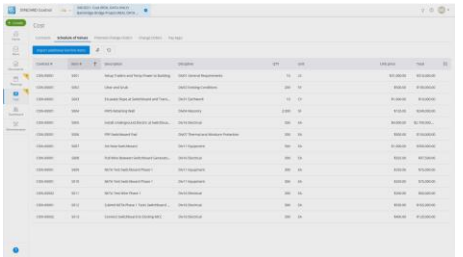
Construction

Superintendents

Project Engineers



Field Data Capture & Issue's / RFI's



Contracts & Change Orders

Solution

Federate models

Bring together and normalize disparate models

Create construction models

Breakdown federated model into constructible components (by phase and means/methods) and assign established cost codes and WBS for construction workflows

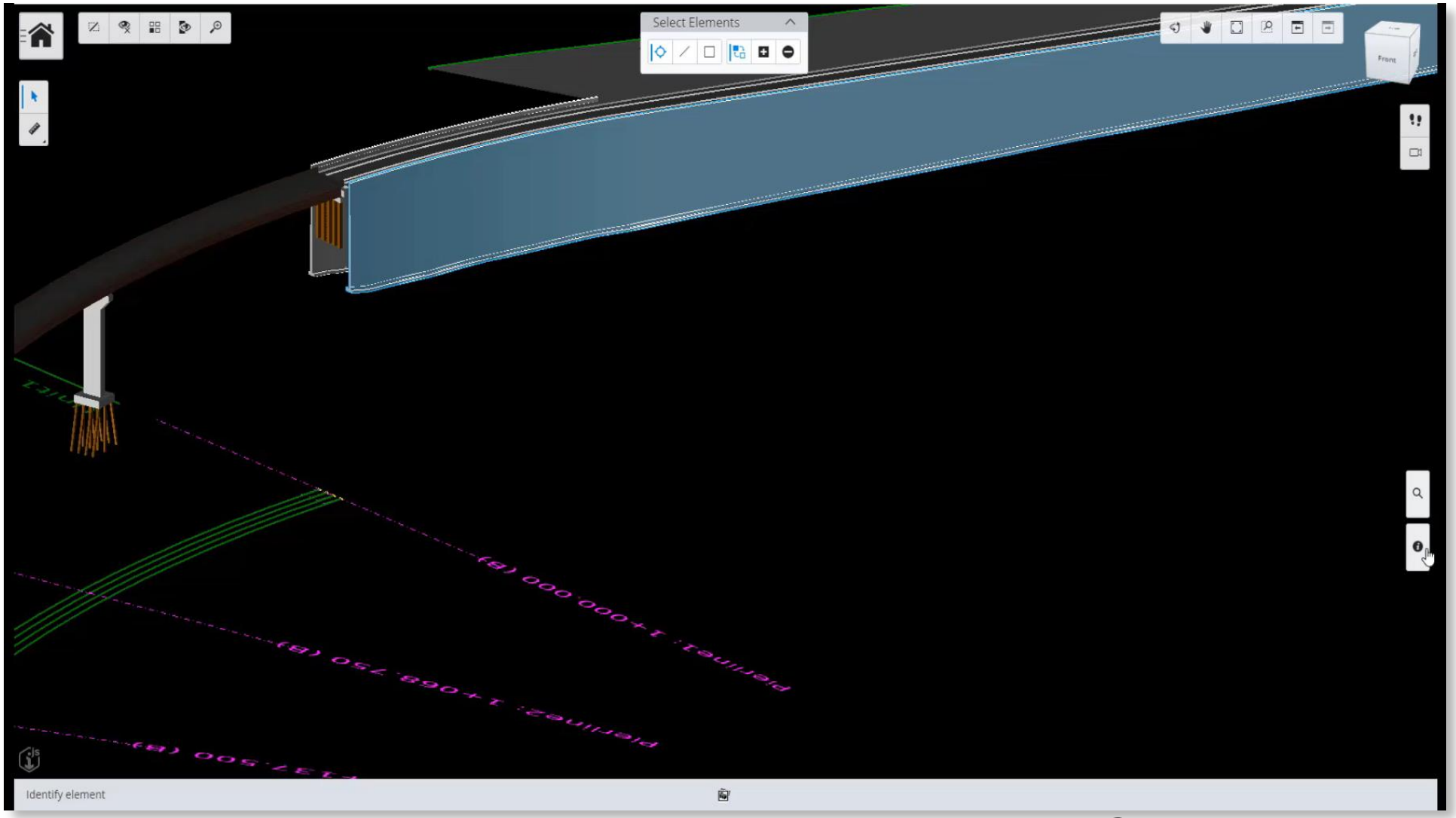
Model-based take-off

Derive quantity reports from the model and updates quickly when the model changes

Downstream workflows

Data exchange driving downstream workflows and processes such as scheduling and quantity growth.

| Construction modelling and quantity take-off



Solution

4D Planning & Communication

Model-based scheduling

Use constructible model and assign schedule tasks, resources, and logic to create 4D models. Work natively in SYNCHRO or exchange data with common industry CPM tools.

4D sequencing/staging

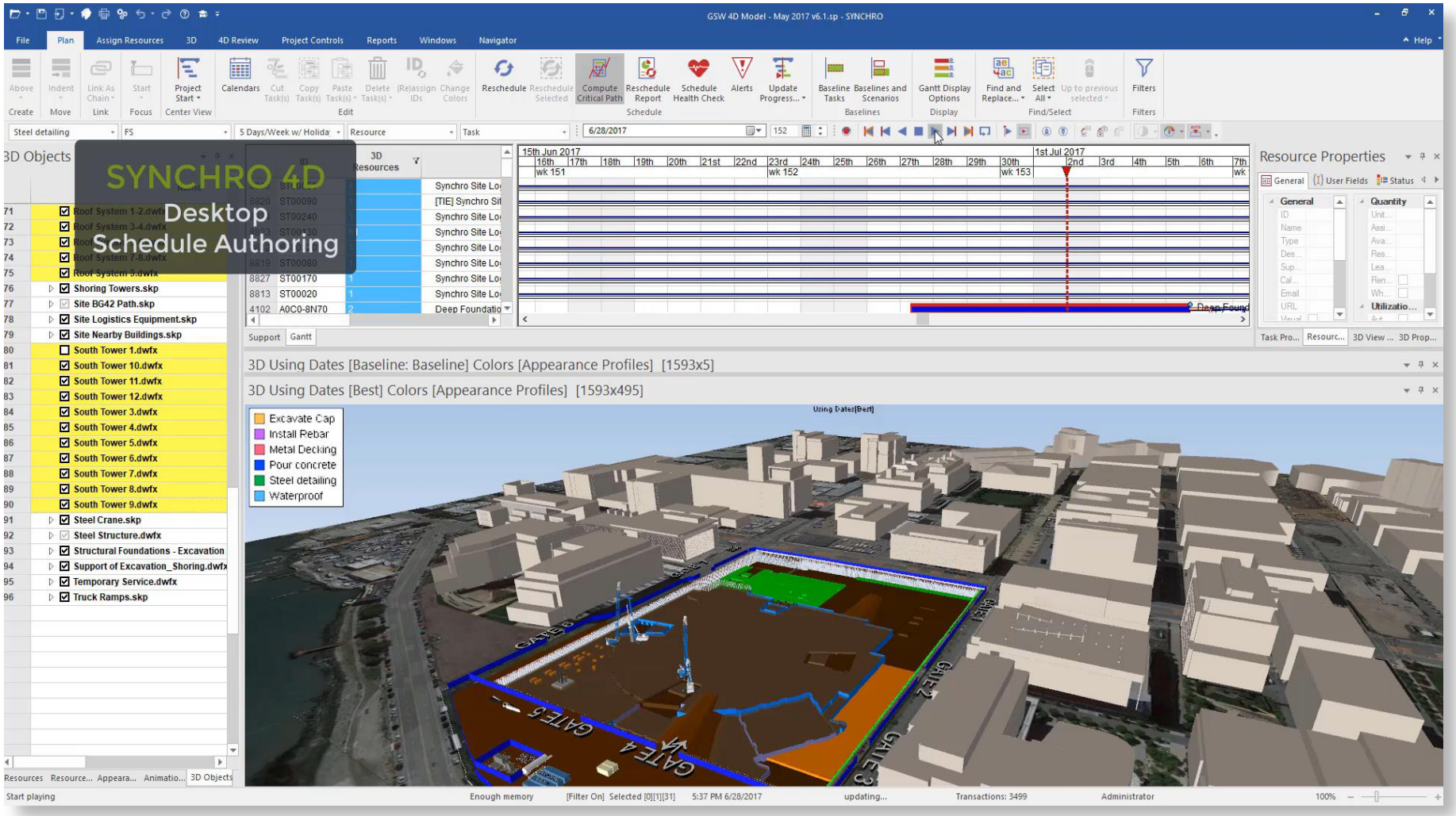
Optimize path of construction and adding construction equipment and other model objects

4D simulations

Optimize CPM schedule by running schedule simulation comparisons.

4D visualization

Communicate your plans on desktop, web and mobile including high end renderings.



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Solution

4D Model reviews

Web-based constructability reviews from anywhere in the world with the context of time

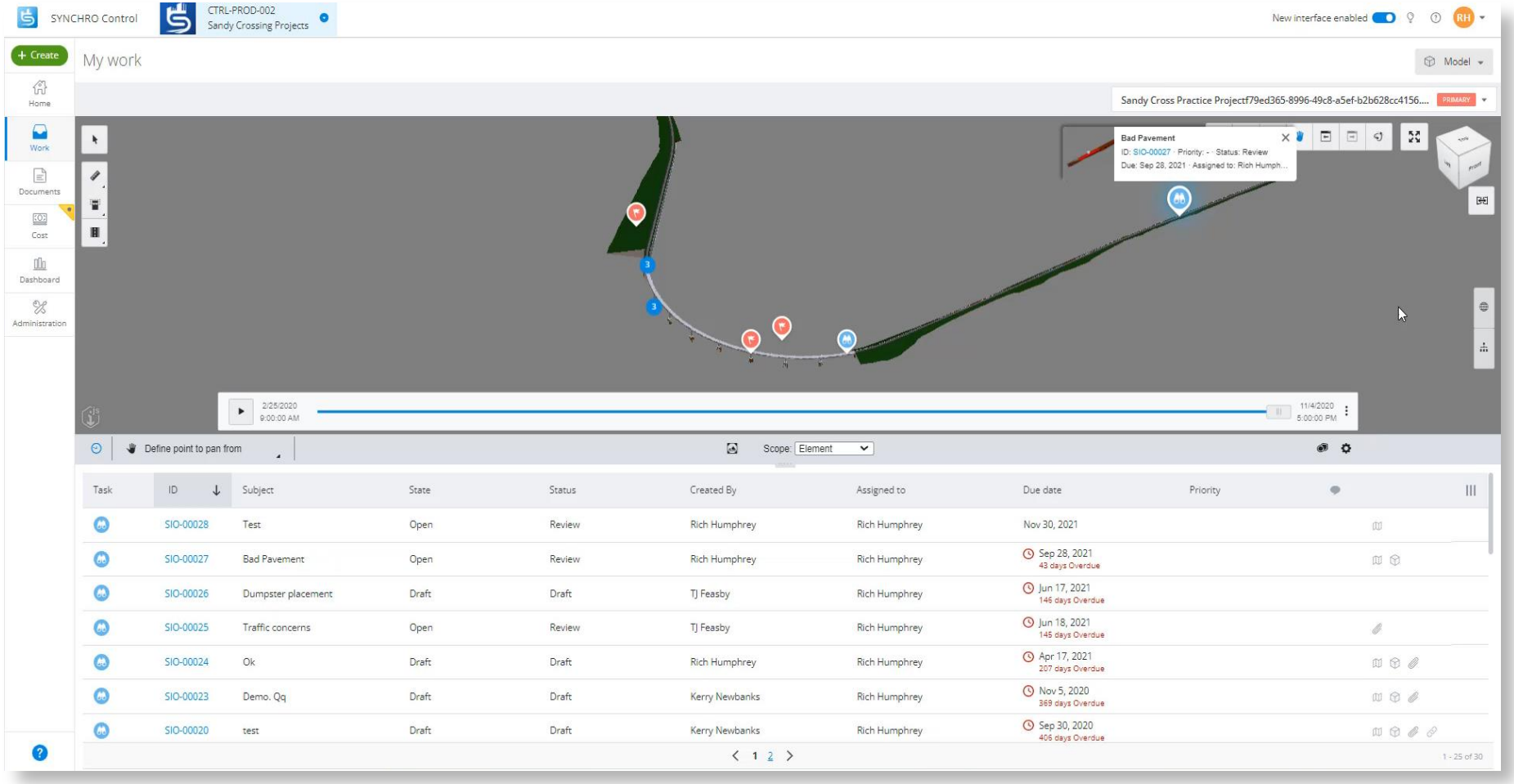
Communicate through forms

Linked to the model and in context of time

4D Schedule Review

Communicate your plans on desktop, web and mobile including high end renderings.

| Design & Constructability Review



Solution

Manage documents and models

Manage latest files, PDF plan sets, models, photos and more to keep everyone on they same page

Media and PDF indexing

Use AI to quickly index media to better orgainize data and access more quickly

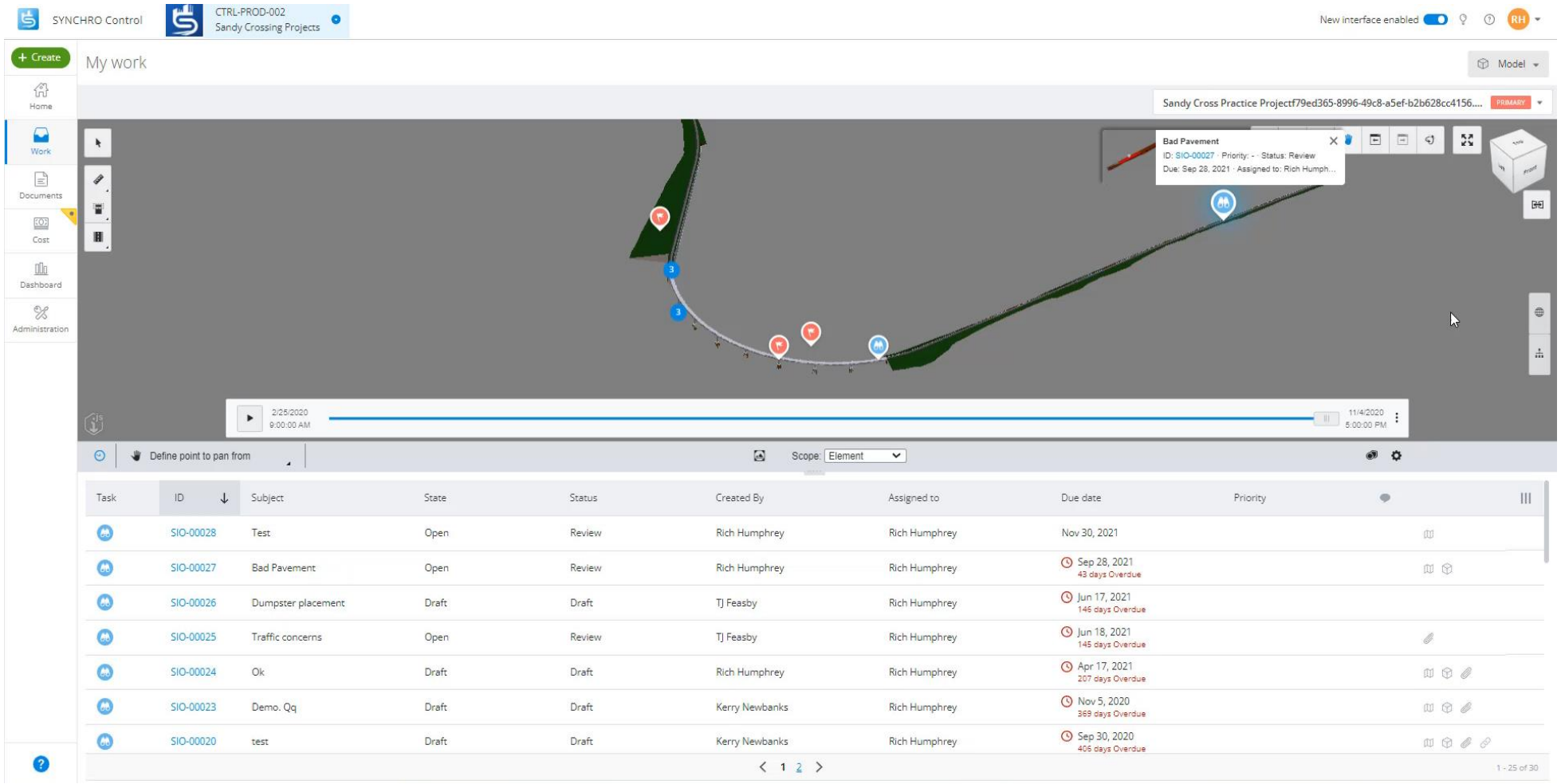
Task management and collaboration

Manage forms-based workflows in one place and in context (of dashboards, maps, and models)

Schedule collaboration

Maintain visibility into the 4D schedule, so projects stay in control

| Project management – Task Management in Context



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Solution

Bid management

Manage latest files, PDF plan sets, models, photos and more to keep everyone on they same page

Contract and budget management

Use AI to quickly index media to better organize data and access more quickly

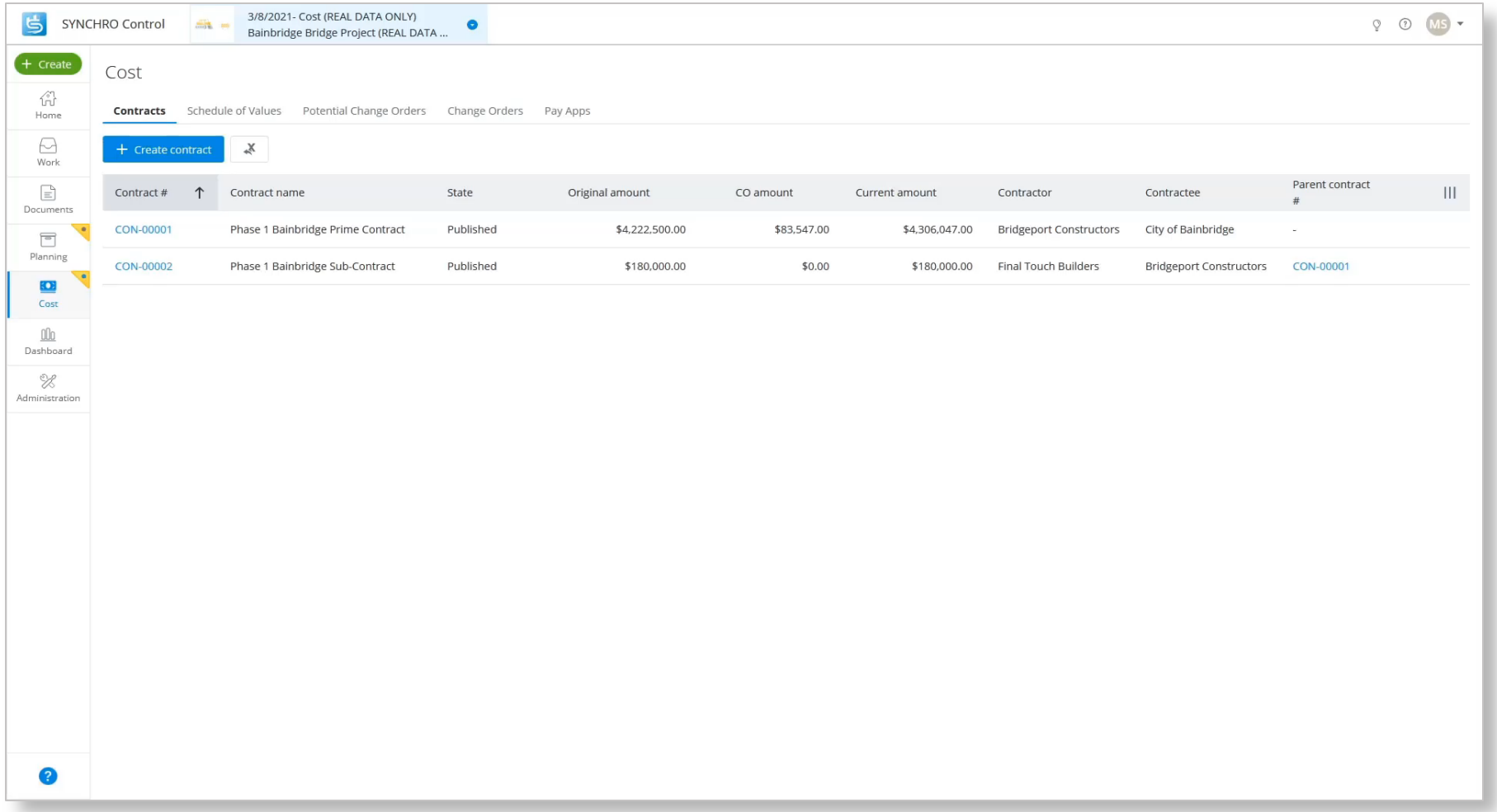
Manage change orders

Manage forms- based workflows in one place and in context (of dashboards, maps, and models)

Make payment apps

Maintain visibility into the 4D schedule, so projects stay in control

Cost management



Solution

Document and model review

View and mark-up models and PDFs in the field based on location

Issues and observations

Use AI to quickly index media to better organize data and access it more quickly

4D status tracking

Maintain visibility into the 4D schedule, so that projects stay in control

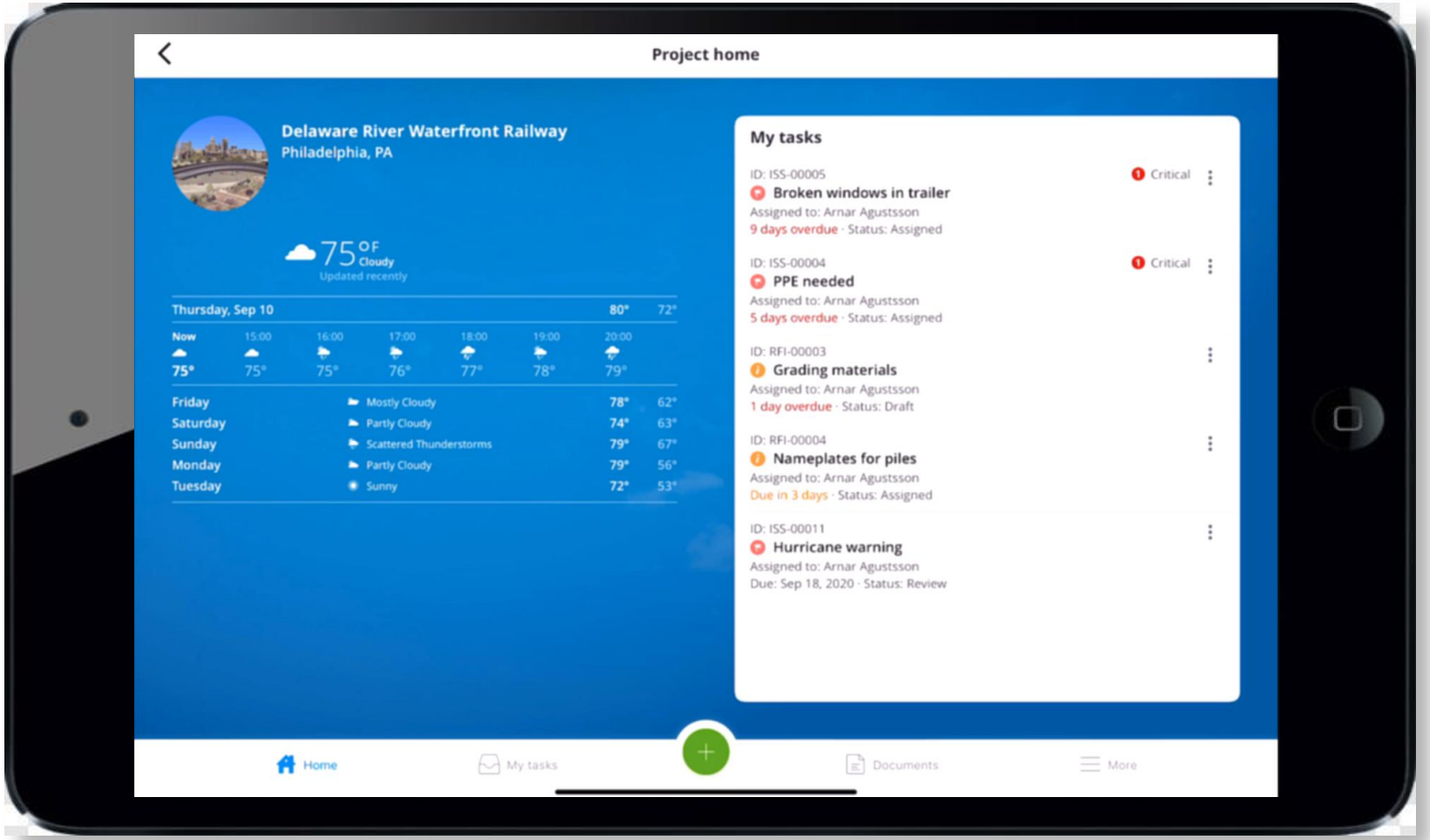
QA/QC inspections

Maintain visibility into the 4D schedule, so projects stay in control

Civil Design Tools

Profiles, Sections, Measurements in the Field

| Field data access & capture



Solution

Daily logs and time tracking

Manage forms-based workflows in one place and in context (dashboards, maps, and models)

Resource management

Better organize data and access more quickly

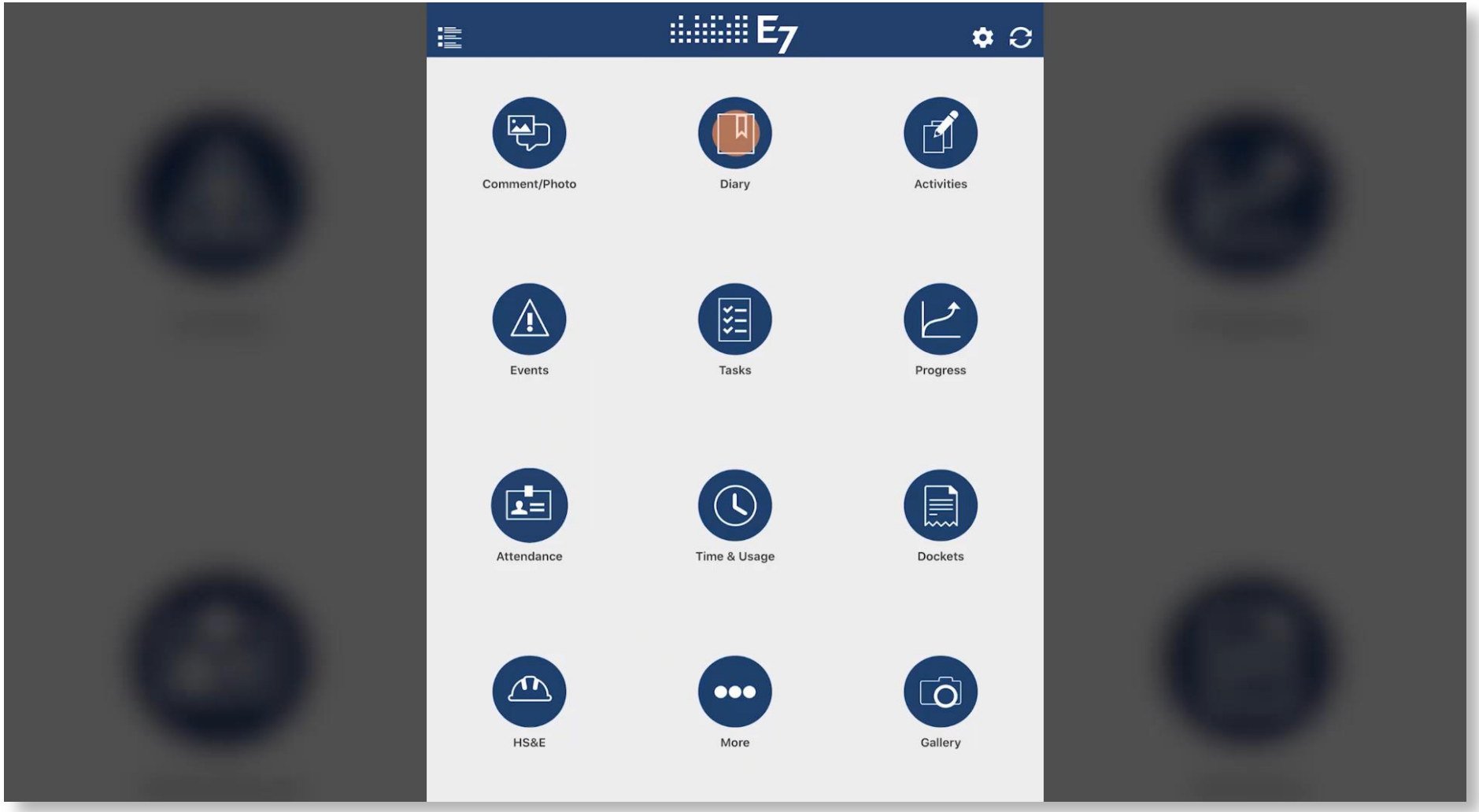
Earned value

Manage forms-based workflows in one place and in context (of dashboards, maps, and models)

Performance analysis

Maintain visibility into the 4D schedule so that projects stay in control

Field performance management



Solution

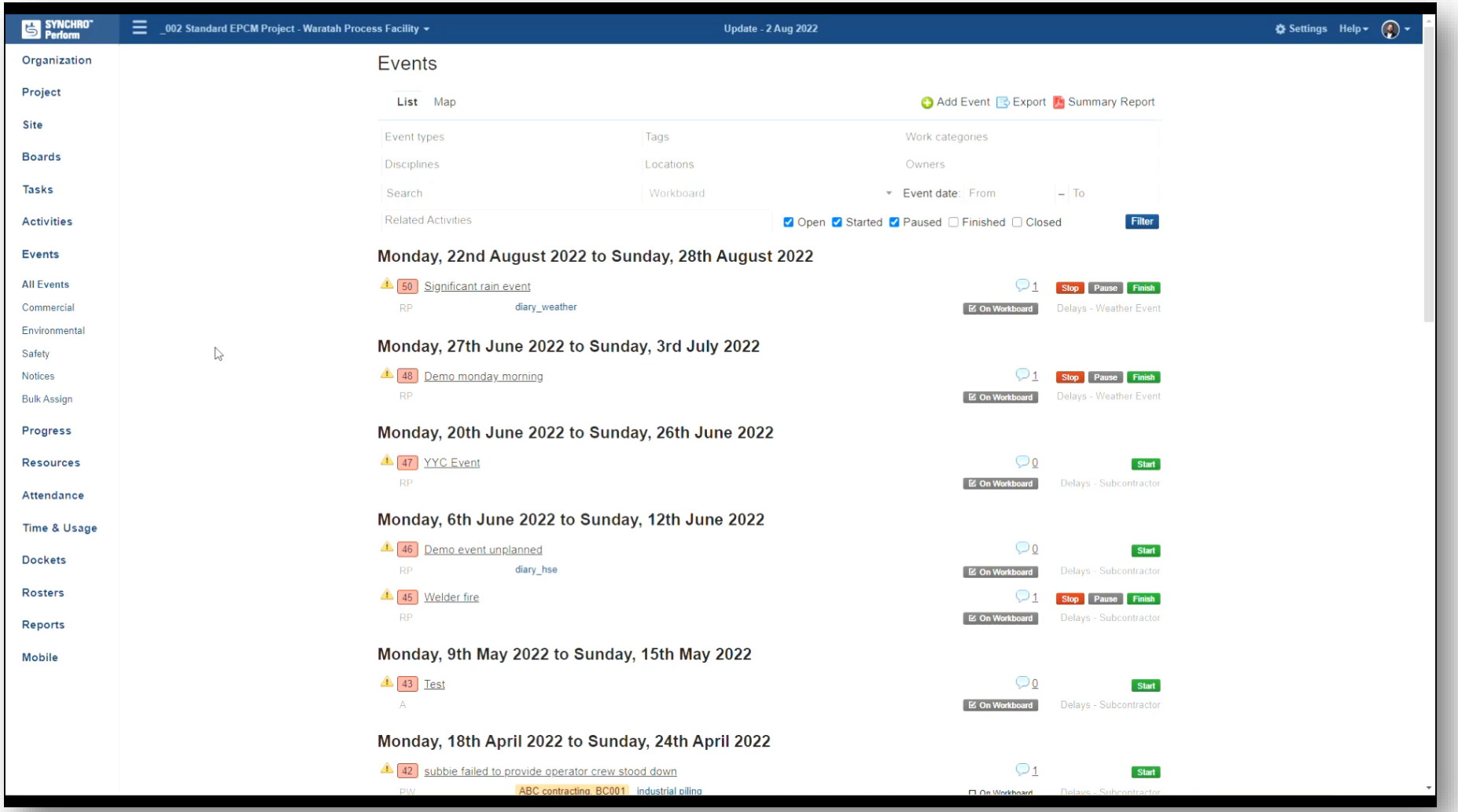
Manage change in real-time

Capture the impact of an event when and where it occurs

Notify of impact

Quickly determine impact to cost and schedule and notify stakeholders efficiently

Event & Change Management



Solution

Generate reports

From real-time field data, know where your project is today and not last week

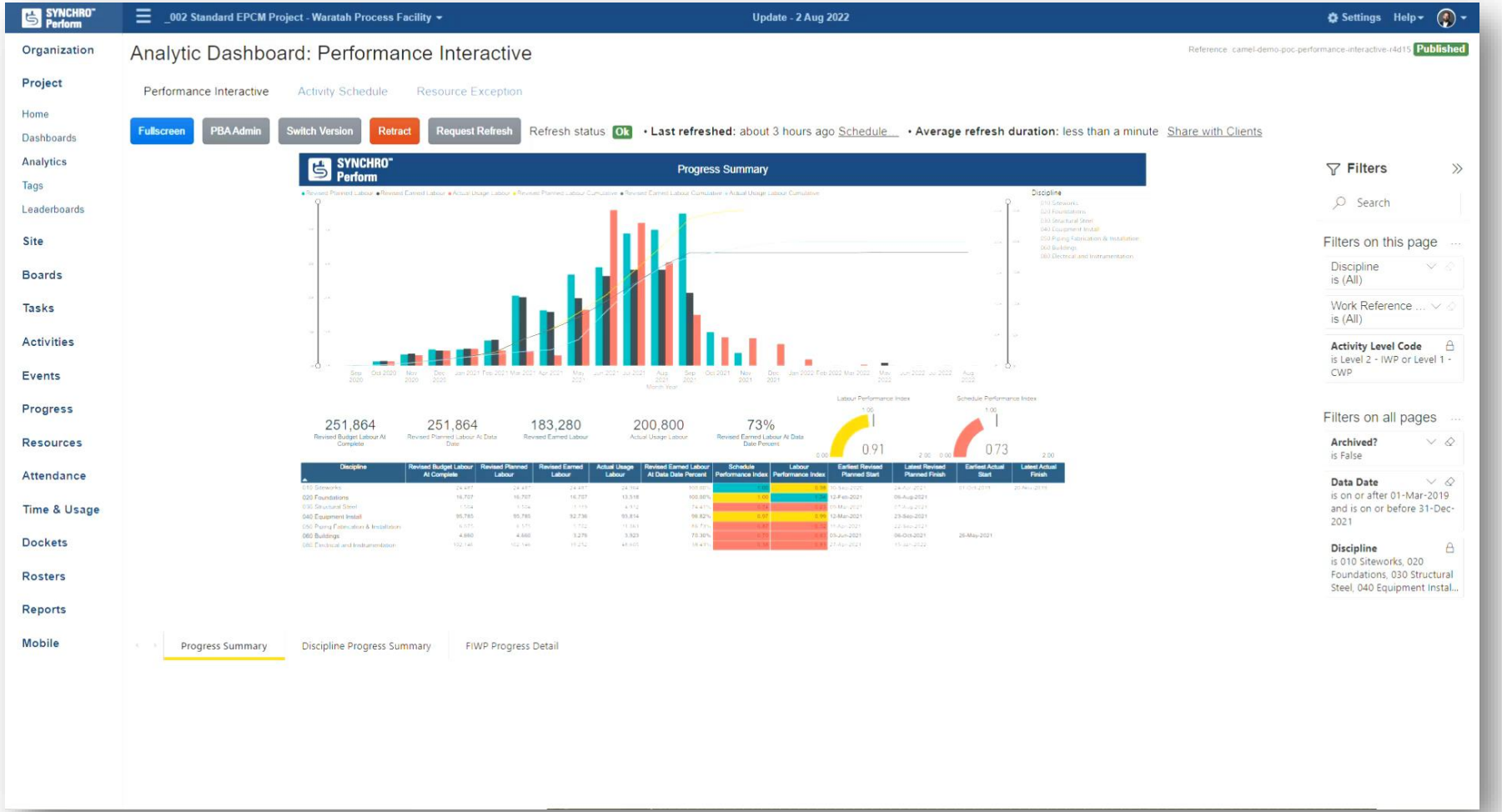
Analytics

Analyze project data by sub-contractor, discipline, location, and others.

Dashboards

For quick review of your project health and where it is going tomorrow

| Clear line of sight



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