

15 - 16 November, Wembley Stadium, UK

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

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 **Project Controls**
EXPO
London, UK

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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.

DOWNLOADS

[Article \(PDF-1MB\)](#)

McKinsey
& Company

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Project failures and Productivity Challenges

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

Capital-expenditure overrun
(% of original quoted capital expenditure)

● Mining ■ Oil and gas ◆ Infrastructure



- 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

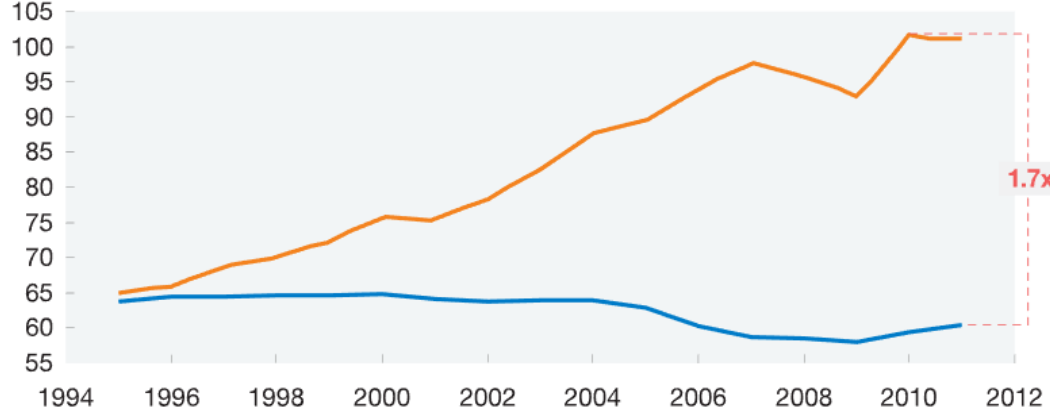
Productivity in manufacturing has nearly doubled, whereas in construction it has remained flat.

Overview of productivity improvement over time

Productivity (value added per worker), real, \$ 2005

— Manufacturing
— Construction

\$ thousand per worker



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

McKinsey&Company



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



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

Source: McKinsey analysis of expert conversations

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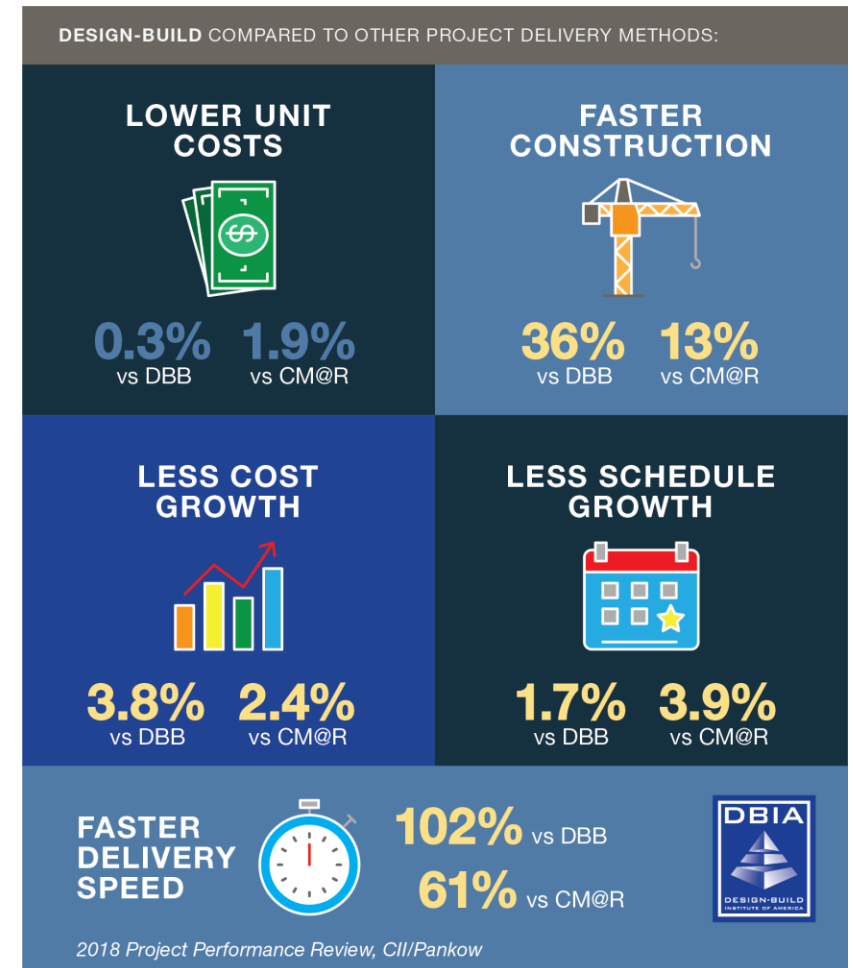
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Contracting and Procurement

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

Design Build

- 1/4 of European Projects are Design Build
- Overall, design-build is anticipated to represent up to 47% of construction spending in the assessed segments



Concept and Design Phase

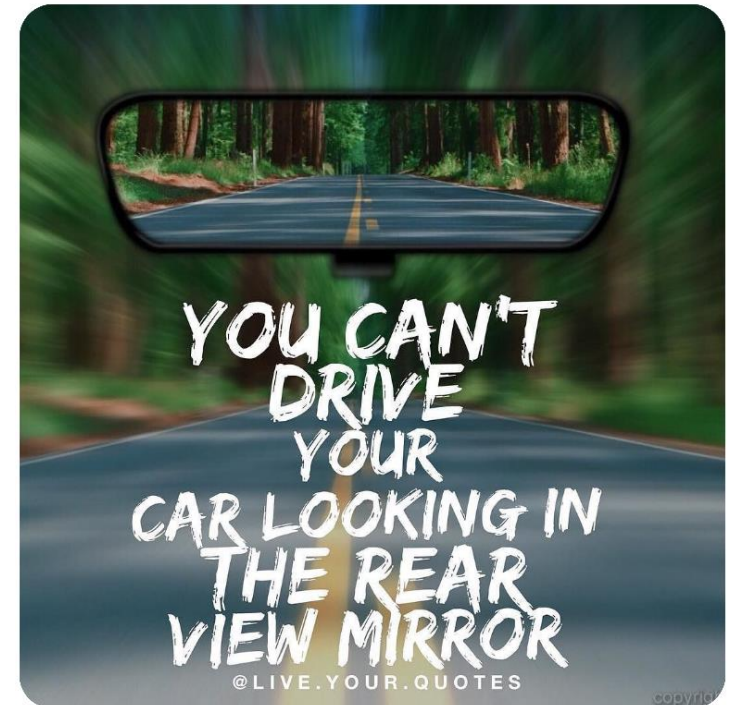
- Create early alignment between Engineering and Construction teams
- Provide frequent and fastest possible feedback between design changes and the impact it has on other disciplines, constructability, construction sequencing, construction quantities, cost and risk profile so that design can be optimized

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.

- 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



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

Detailed Design



Engineering Work In Progress (ProjectWise)

Design Consultant #1

MicroS

OpenBuildings D

OpenPlant M

OpenRoads De

Select Elements

Design

5/27/2021 9:00:00 AM

200 m

190 m

180 m

170 m

15+340.00 15+440.00 15+540.00 15+640.00 15+740.00 15+840.00

VPC STA = 15+628.48

VPT STA = 15+757.41

-2.60 %

-5.63 %

K: 75.2002 m

230.9232 m

VPI ELEV = 179.8055 m

VPI STA = 15+641.95

Tasks

- Civil Tools
- Civil Classic
- Print Preparation
- Subsurface Utilities
- Drawing
- Drawing Composition
- Salids Modeling
- Surface Modeling
- Feature Modeling
- Visualization
- Animation

Others

Edit

Delete

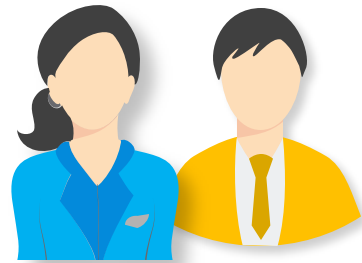
When are design quality issues identified?

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

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

\$\$\$\$\$\$

Head office



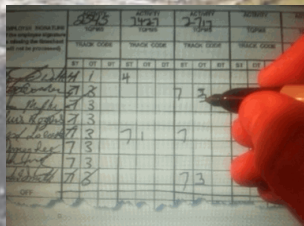
ERP Cost Accounting
Blackout until end-of-month progress, cost, and accruals updates

Field

- Daily diaries
- Progress
- Timecards

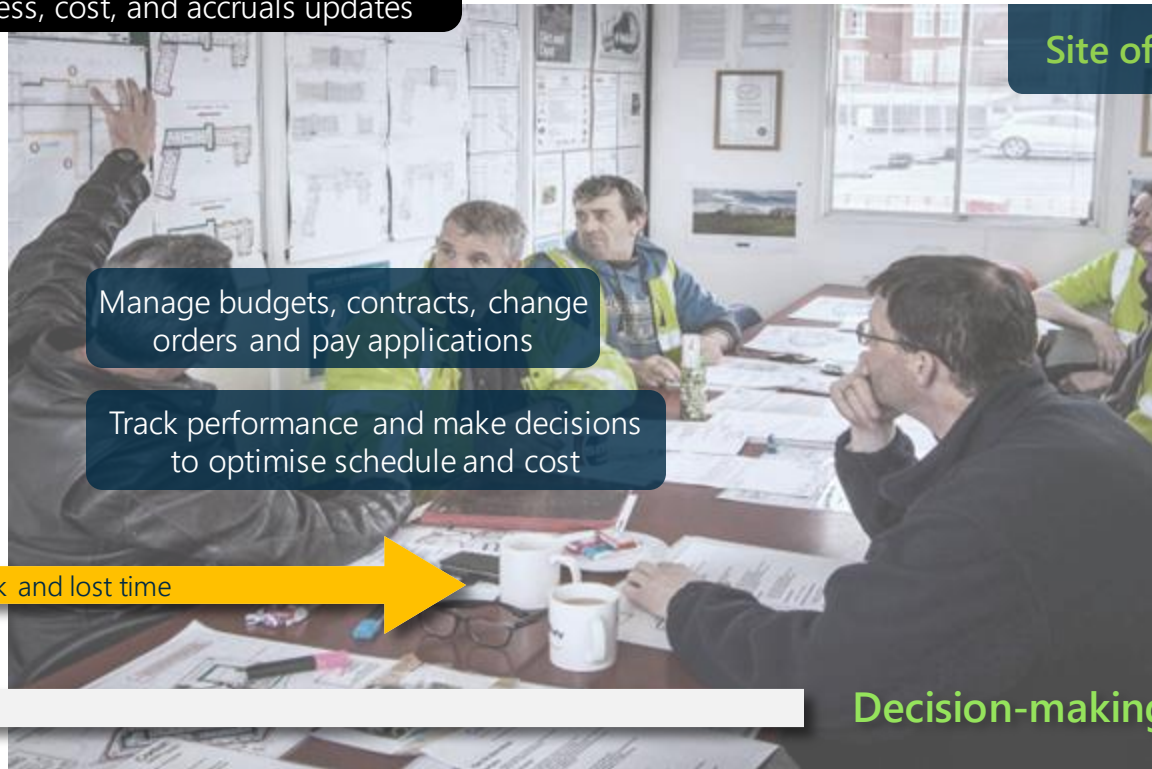


- Monitor safety
- Direct work
- Collect field data



Work happens

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

Decision-making



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)



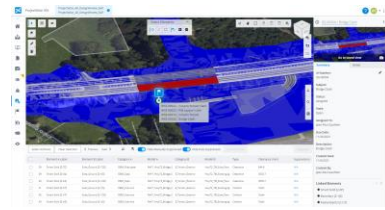
AVEVA Diagrams



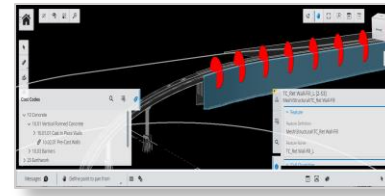
Intergraph Smart 3D



Others



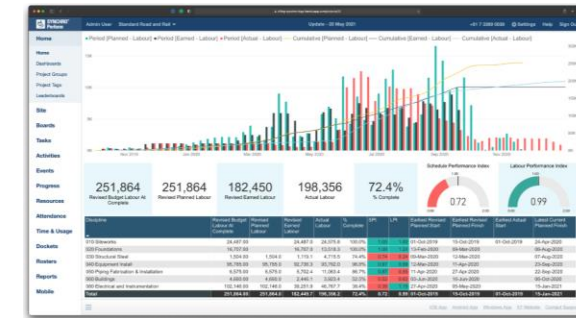
Design review validation / Clash



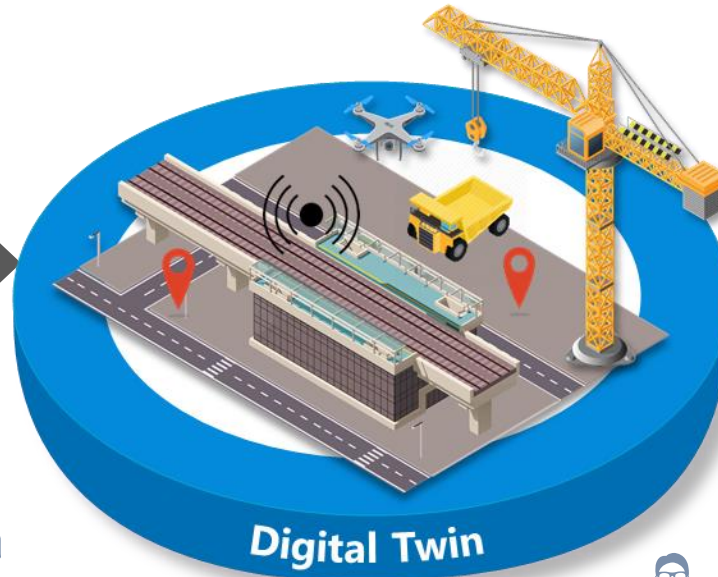
Construction model splits & 5D QTO



4D Plan Development



Performance Management



Digital Twin



Client / Owner



Project Director / Leaders



Engineer Designers



Planner Estimator



Construction



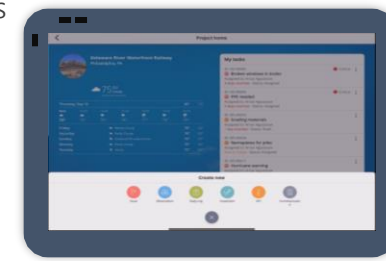
Superintendents



Project Engineers



4D Constructability review



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

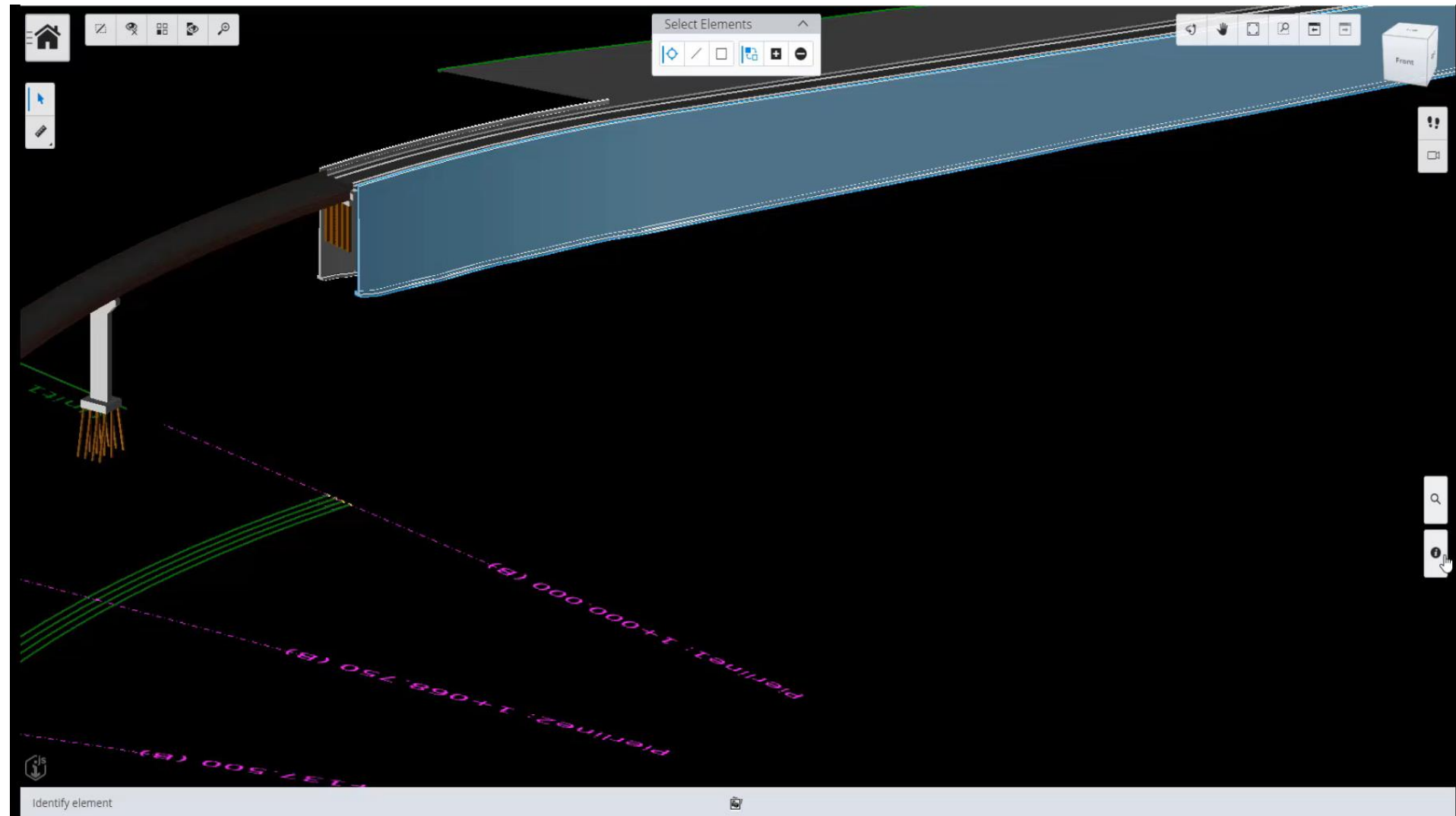
Model-based take-off

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

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.

| 4D Planning & Communication

The screenshot displays the SYNCHRO 4D Desktop software interface. The main window shows a 3D model of a construction site with various structures and equipment. A Gantt chart is visible in the upper right, showing the schedule for tasks from June 15th to July 1st, 2017. The interface includes a menu bar, a toolbar, and a task list on the left. A legend in the bottom left corner identifies construction activities: Excavate Cap (orange), Install Rebar (purple), Metal Decking (red), Pour concrete (blue), Steel detailing (green), and Waterproof (light blue). The status bar at the bottom indicates 'Enough memory', '5:37 PM 6/28/2017', and 'Transactions: 3499'.

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

The screenshot displays the SYNCHRO Control software interface for a project named 'CTRL-PROD-002 Sandy Crossing Projects'. The main view shows a 3D model of a road or track with several colored markers (red, blue, green) indicating specific tasks or issues. A tooltip for a 'Bad Pavement' issue is visible, showing its ID (SIO-00027), priority, status (Review), due date (Sep 28, 2021), and assigned person (Rich Humphrey). Below the model is a timeline slider showing the current time as 2/25/2020 9:00:00 AM. At the bottom, a table lists tasks with columns for Task, ID, Subject, State, Status, Created By, Assigned to, Due date, and Priority.

Task	ID	Subject	State	Status	Created By	Assigned to	Due date	Priority
	SIO-00028	Test	Open	Review	Rich Humphrey	Rich Humphrey	Nov 30, 2021	
	SIO-00027	Bad Pavement	Open	Review	Rich Humphrey	Rich Humphrey	Sep 28, 2021 43 days Overdue	
	SIO-00026	Dumpster placement	Draft	Draft	TJ Feasby	Rich Humphrey	Jun 17, 2021 146 days Overdue	
	SIO-00025	Traffic concerns	Open	Review	TJ Feasby	Rich Humphrey	Jun 18, 2021 145 days Overdue	
	SIO-00024	Ok	Draft	Draft	Rich Humphrey	Rich Humphrey	Apr 17, 2021 207 days Overdue	
	SIO-00023	Demo. Qq	Draft	Draft	Kerry Newbanks	Rich Humphrey	Nov 5, 2020 389 days Overdue	
	SIO-00020	test	Draft	Draft	Kerry Newbanks	Rich Humphrey	Sep 30, 2020 406 days Overdue	

Solution

Manage documents and models

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

Media and PDF indexing

Use AI to quickly index media to better organize 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

Task	ID	Subject	State	Status	Created By	Assigned to	Due date	Priority
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	SIO-00020	test	Draft	Draft	Kerry Newbanks	Rich Humphrey	Sep 30, 2020 406 days Overdue	

Solution

Bid management

Manage latest files, PDF plan sets, models, photos and more to keep everyone on the 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

SYNCHRO Control 3/8/2021- Cost (REAL DATA ONLY)
Bainbridge Bridge Project (REAL DATA ...)

Cost

Contracts Schedule of Values Potential Change Orders Change Orders Pay Apps

+ Create contract

Contract #	Contract name	State	Original amount	CO amount	Current amount	Contractor	Contractee	Parent contract #
CON-00001	Phase 1 Bainbridge Prime Contract	Published	\$4,222,500.00	\$83,547.00	\$4,306,047.00	Bridgeport Constructors	City of Bainbridge	-
CON-00002	Phase 1 Bainbridge Sub-Contract	Published	\$180,000.00	\$0.00	\$180,000.00	Final Touch Builders	Bridgeport Constructors	CON-00001

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

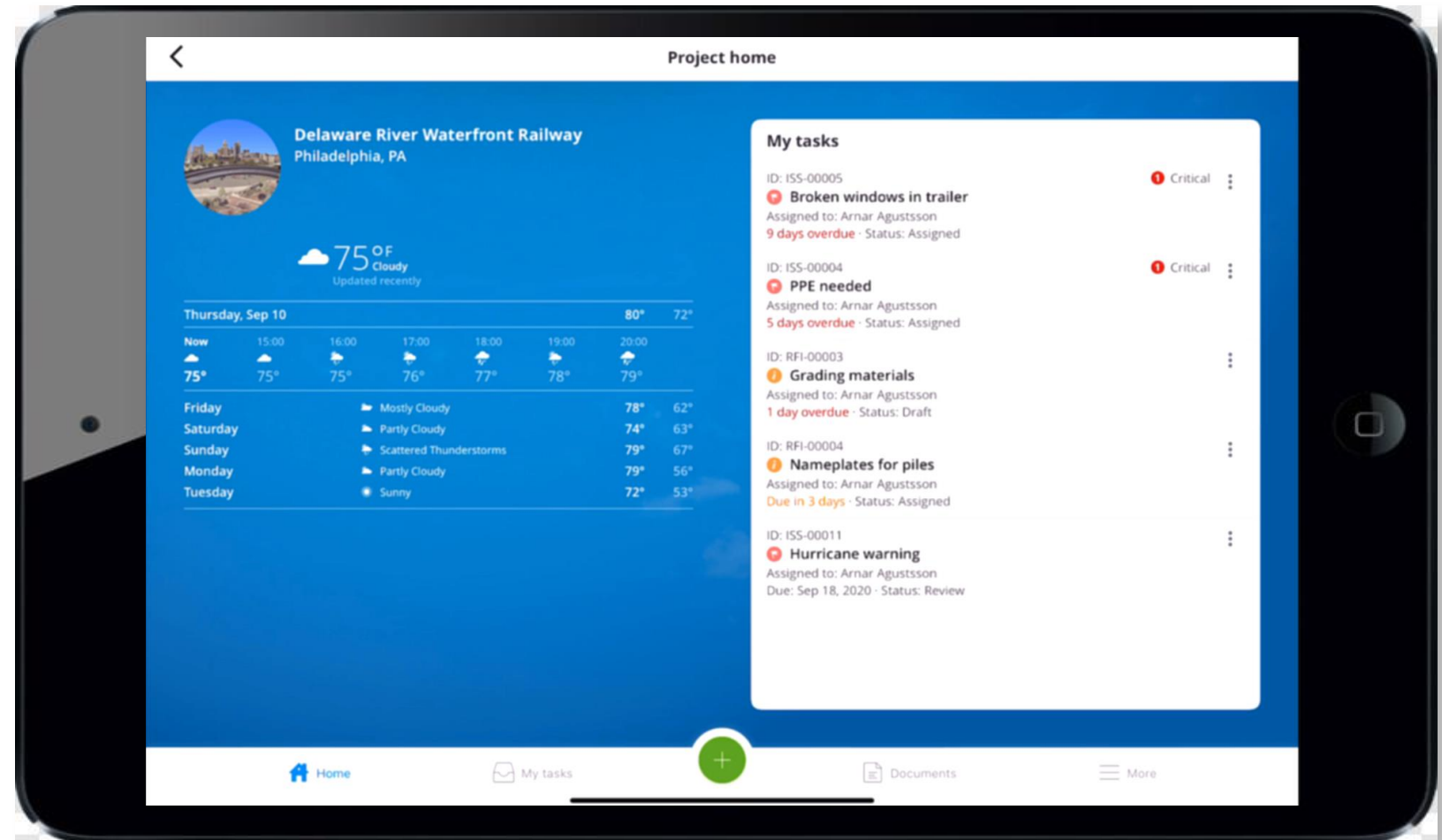
QA/QC inspections

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

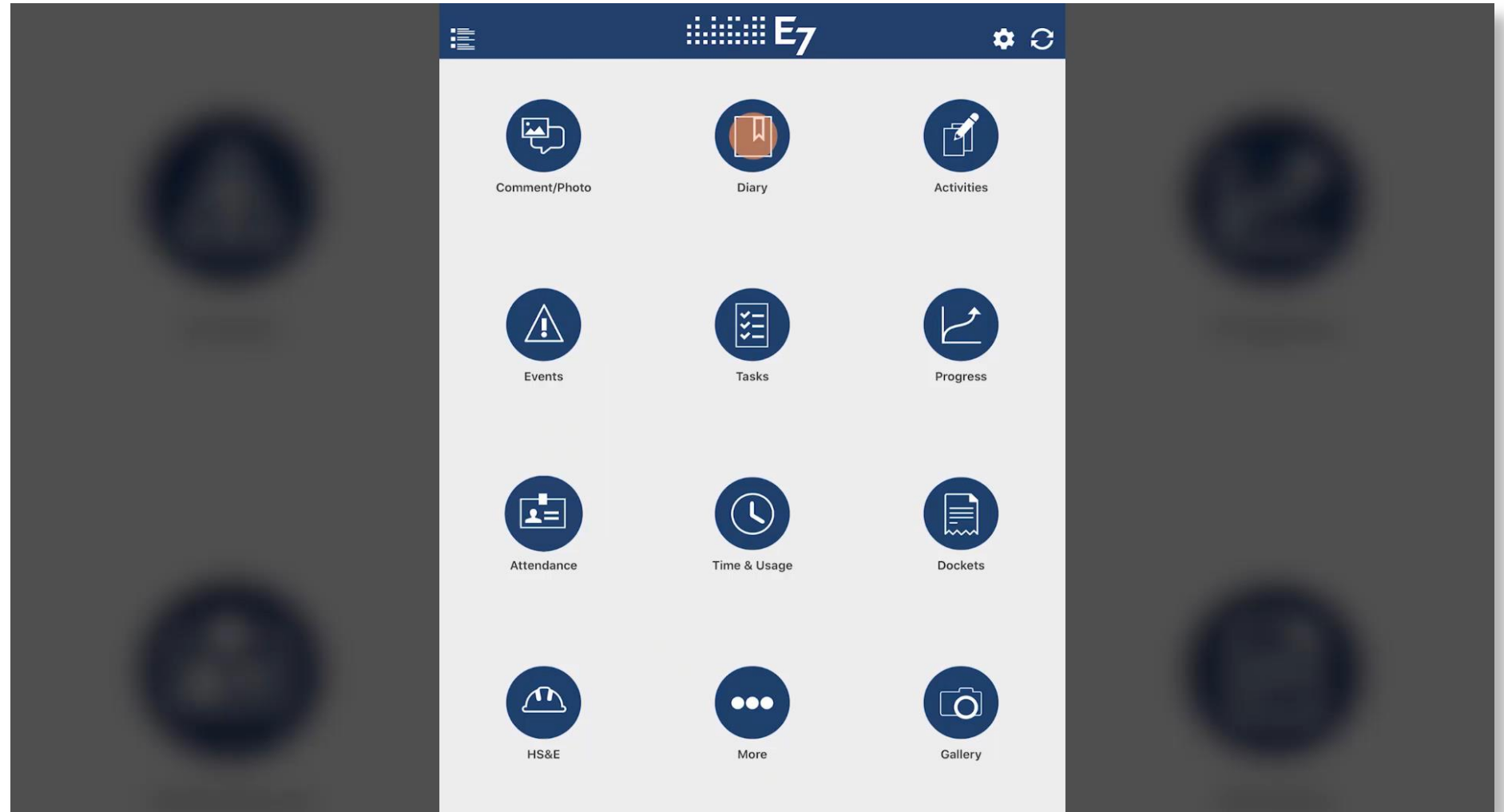
Earned value

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

The screenshot shows the SYNCHRO Perform software interface for event management. The top navigation bar includes the SYNCHRO Perform logo, a project name "_002 Standard EPCM Project - Waratah Process Facility", and an update date of "2 Aug 2022". A sidebar on the left lists various project management categories such as Organization, Project, Site, Boards, Tasks, Activities, Events, All Events, Commercial, Environmental, Safety, Notices, Bulk Assign, Progress, Resources, Attendance, Time & Usage, Dockets, Rosters, Reports, and Mobile.

The main content area is titled "Events" and features a "List" view. It includes a search bar, filters for "Event types", "Disciplines", "Search", and "Related Activities", and a "Filter" button. The events are displayed in a list format, grouped by date ranges. Each event entry includes a warning icon, a count, a title, a location, and action buttons like "On Workboard", "Stop", "Pause", "Finish", and "Start".

Date Range	Event ID	Event Title	Location	Impact	Action
Monday, 22nd August 2022 to Sunday, 28th August 2022	50	Significant rain event	RP diary_weather	Delays - Weather Event	On Workboard, Stop, Pause, Finish
Monday, 27th June 2022 to Sunday, 3rd July 2022	48	Demo monday morning	RP	Delays - Weather Event	On Workboard, Stop, Pause, Finish
Monday, 20th June 2022 to Sunday, 26th June 2022	47	YYC Event	RP	Delays - Subcontractor	On Workboard, Start
Monday, 6th June 2022 to Sunday, 12th June 2022	46	Demo event unplanned	RP diary_hse	Delays - Subcontractor	On Workboard, Start
Monday, 6th June 2022 to Sunday, 12th June 2022	45	Welder fire	RP	Delays - Subcontractor	On Workboard, Stop, Pause, Finish
Monday, 9th May 2022 to Sunday, 15th May 2022	43	Test	A	Delays - Subcontractor	On Workboard, Start
Monday, 18th April 2022 to Sunday, 24th April 2022	42	subbie failed to provide operator crew stood down	PW ABC contracting BC001 industrial piling	Delays - Subcontractor	On Workboard, Start

Solution

Generate reports

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

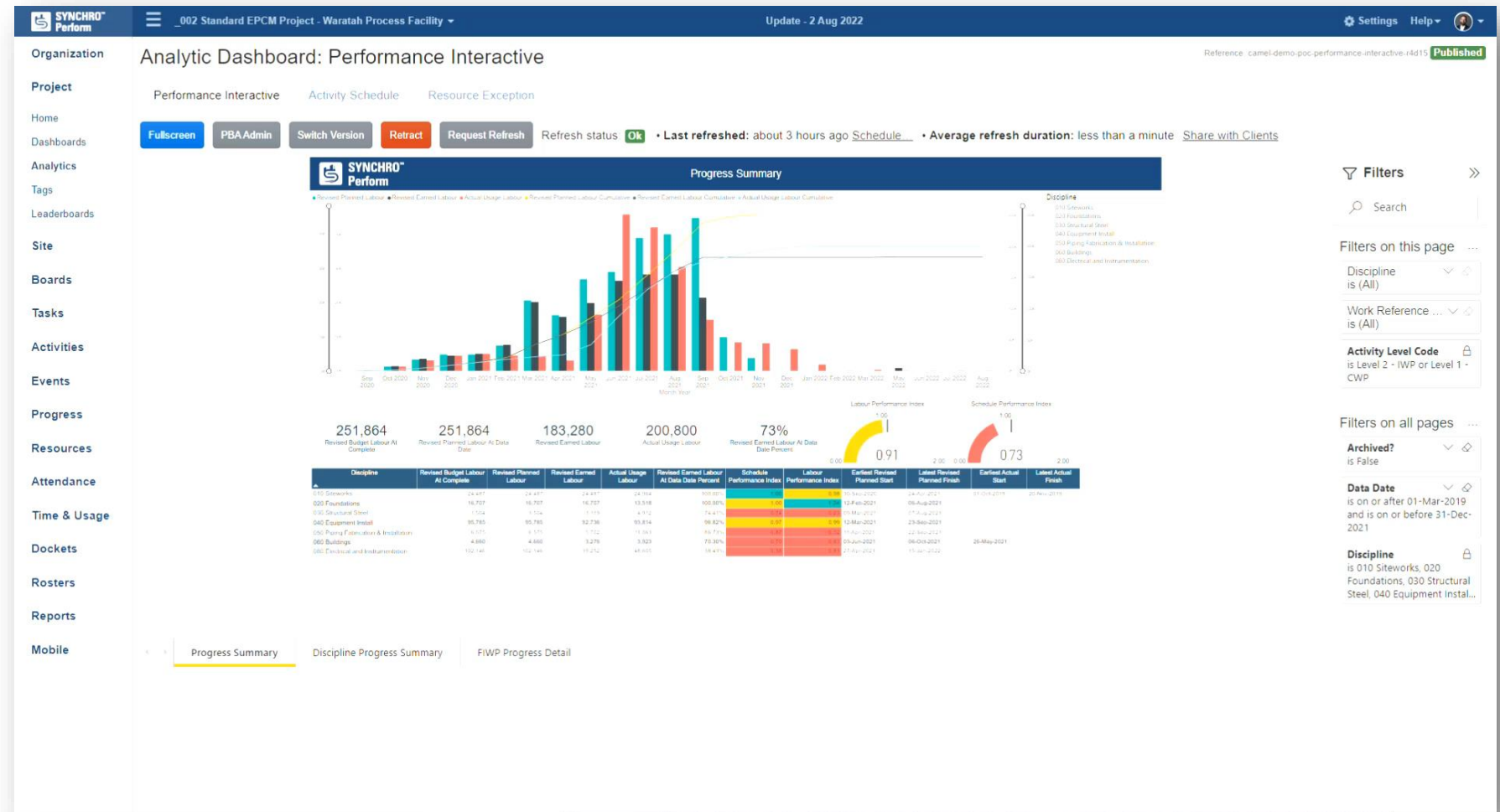
Analytics

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



THANK YOU