



Expedite Project Completion with Digital Project Delivery

Transforming the Way the World Works

Trevor Clark, PE
Director - Ports & Waterways

Agenda

- 01** Introduction to Trimble
- 02** Case Studies
- 03** Digital Project Delivery
- 04** Mechanics of Connected Construction
- 05** Benefits and Value Added







Innovation



Founded in 1978 currently in
S&P 500: TRMB

\$3.15B revenue

40+ years of technology innovation with
11,000+ employees in 40 countries

Market Leaders



Trimble solutions manage
>\$1T in **construction**

>70% of top 100 **geospatial** companies
use Trimble

>2M **transportation** assets managed
with Trimble Solutions

Overseeing 155M
acres of **agriculture**

ESG



Trimble solutions deliver millions of
metric tons of **avoided greenhouse gas
emissions** annually

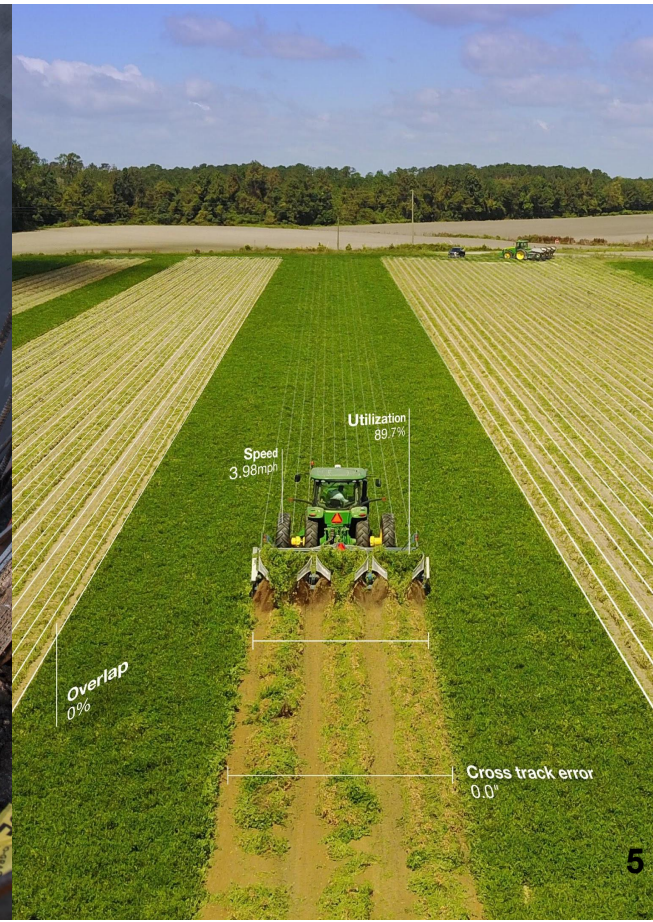
Top **10 of companies for diversity and
gender** scores (Comparably)

WSJ's Management Top 250



Our Mission

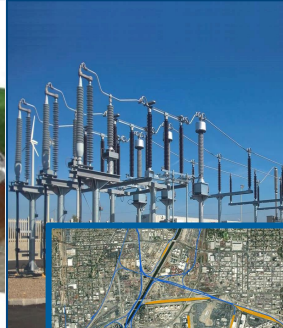
Transforming the Way the World Works



Connecting the physical world with the right digital tools



Public Works and Utilities

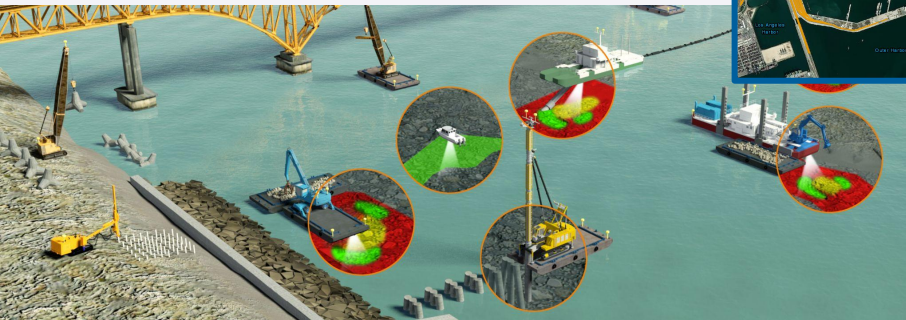


Road and Rail



Structures and Buildings

Marine Construction and Dredging



Port Industry Challenges



Greater operational complexity due to bigger ships



Quick ship turnaround /
Construction project completion



Doing more with constrained resources (port space, channels etc)



Health, Safety and Environmental compliance



Aging/retiring workforce/ staff retention/ recruitment



Intermodal competition



Port Construction Challenges 2021



Tougher bid competition



Faster project completion



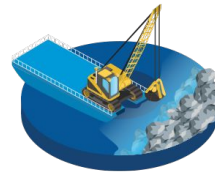
Doing more with constrained resources (higher productivity per machine hour)



Health, Safety and Environmental compliance



Aging workforce/ staff retention/
staff recruitment



Machine shortages

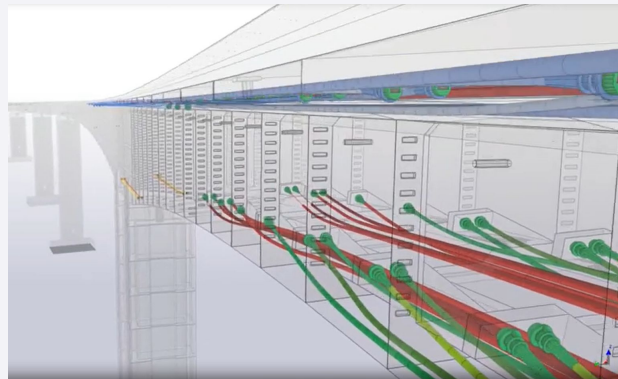


Mega Projects without drawings!

634-meter cantilever concrete bridge

Design team located in four different countries

Using structural BIM software, model sharing and collaboration software, and augmented reality



95% of all information is transferred to the contractor with IFC files

Parametric design was used to model about 70% of all the objects

The BIM model contains over 200,000 rebar and 250 post-tensioning cables



Why Owners, Designers and Contractors are Adopting Digital Delivery

Risk Reduction, Improved Profits and Shared Savings

Digital Delivery

On July 30th last year, this Norwegian P3 project opened a 17 mile long national road after 26 months of construction.

Utilized digital and connected construction technologies including Quadri.

Total cost of \$657M, **\$167M in shared savings**. 25% cost savings.

The road opened **three months ahead of schedule**. 10% time savings.



Industry Norms

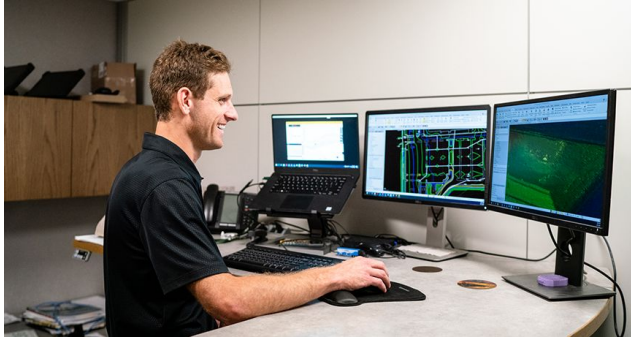
Large projects across asset classes typically take 20% longer to finish than scheduled and are up to 80% over budget

On average, change orders represent 19% of total construction cost

With BIM **change orders are reduced to 7.5%**.



Connected Construction at



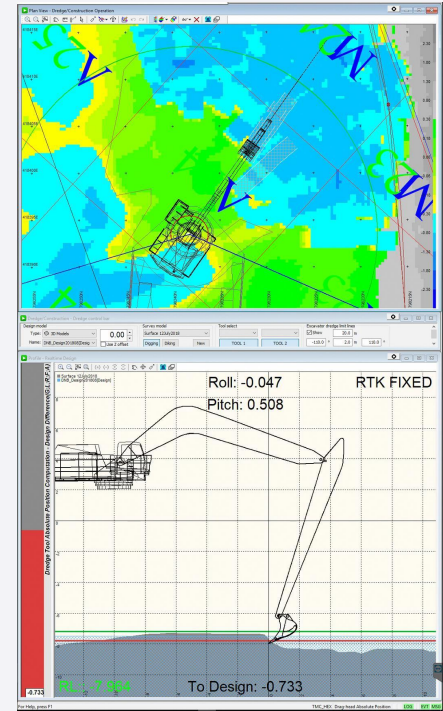
85% of the company's earthwork projects rely on machine control, rovers, total stations and base stations

“We have never had production data per machine, but now we see the quantity moved per day and can compare load counts and production quantities”

Port of Kalama

Underwater Visibility Leads to Above Ground Productivity

- Location: 30 miles NW of Portland, Oregon
- Project: Marina dredging (8,800 yds³), 550-foot-long guest dock, including utilities and new access gangways
- Contractor: Advanced American Construction
- Results:
 - **15-20% dredging savings** than conventional methods (over \$100,000)
 - Improved **pile driving accuracy** (~2 inches)
 - More **collaborative communication** with port owner
 - **Efficient daily burn rate**



Trimble | Rail

PLANNING

- Alignment planning
- Linear scheduling
- Aerial Solutions
- Project Support
- Project Coordination



CONSTRUCTION

- Machine control
- Slab track construction
- Deformation monitoring
- As-built & clearance scanning

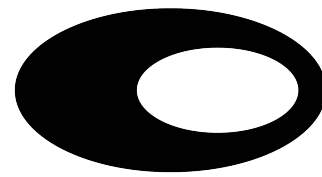


OPERATIONS & MAINTENANCE

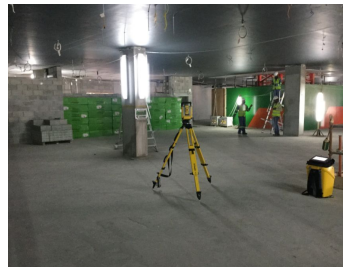
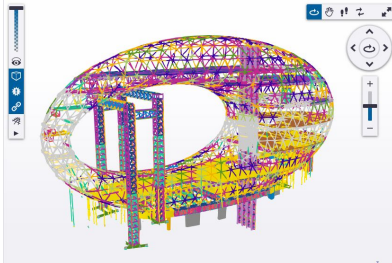
- Tamping
- Track survey & scanning
- 3D point cloud solutions
- GPS based Positive Train Control (PTC) data collection
- Rail asset lifecycle solutions
- Vision-based wayside detectors



Museum of the Future



متحف المستقبل
MUSEUM OF THE FUTURE



One of the world's most complex construction projects

65% reduction in rework

50% improvement in productivity

25% reduction in total energy

Building a Smarter Technology Ecosystem

1

**CENTRALIZE DATA BETWEEN
STAKEHOLDERS, ACROSS PHASES**

COMMON DATA ENVIRONMENT

2

**BRIDGE THE GAP BETWEEN DESIGN
AND CONSTRUCTION**

CONNECTING THE OFFICE AND THE FIELD

3

**CAPTURE DIGITAL ASSETS FOR
FUTURE USE**

DIGITAL TWINS AND DIGITAL DELIVERABLES



Connected Construction: System-Wide Productivity

In the Office



Reporting



Procurement



Job Cost



Scheduling



Install/QA



Instruments



Equipment



Materials



Fabrication
Pre-fab



Labor



In the Field



Fabricatable Design & Detailing



Project Docs & Contracts



Prod Schedule, Work Order Mgmt



Financial: AR, AP Management



Connecting the Office & Field

BRIDGE THE GAP BETWEEN DESIGN & CONSTRUCTION

- Reduce redundancy & maximize deliverables
- Allow for input by downstream trades during design (design-assist, design/build, CM/GC, CMR, etc.)
- Create purpose built models for smart construction systems
- Eliminate design interpretation and retain quality
- Use field technology that provides productivity gains, safety and quality control



How we see the BIM ladder

LEVEL 0 2D DRAWINGS

Project Centric
Plot/PDF
Single disciplined
2D CAD Files
Geometry on Layers

ISOLATED



LEVEL 1 3D MODELS

Project Centric
Some 3D model files
Single disciplined
2D/3D CAD Files to viewers
Geometry on Layers

COLLABORATIVE



LEVEL 2 3D COLLABORATION

Project Centric
3D model files
Multi-disciplined
3D CAD Files to viewers
Geometry on Layers
Some disciplines with objects

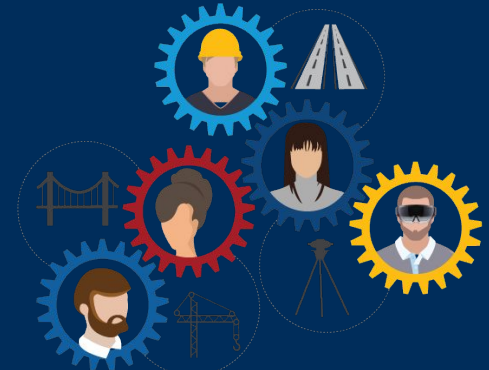
INTEGRATED



LEVEL 3 A SOURCE OF TRUTH

Project Centric
Shared Central Model, with API
Multi-disciplined
Lean | Faster Cycles
Workflow support
Objects with Properties

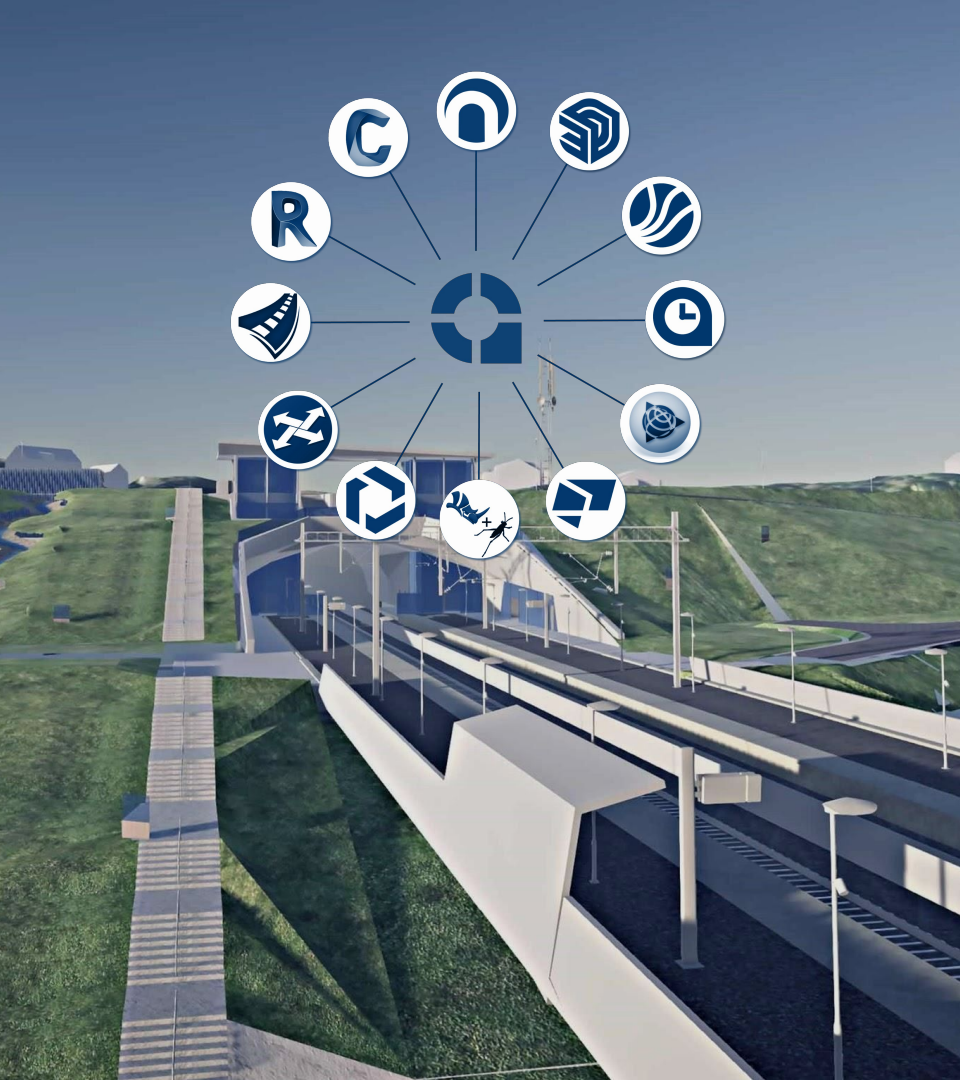
INSTANT UPDATED



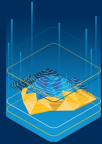
LEVEL 4 ENTERPRISE BIM

Owner's Business Centric
Shared Central Multi-project
Data, with API
Multi-disciplined
Lean | Faster Cycles
Workflow support
Objects with Properties
Assets along network





A Common Data Environment



CENTRALIZED DATA SET BETWEEN
STAKEHOLDERS, ACROSS PHASES

Centralize

Create models used for intelligent construction technology

Feed information to business intelligence tools for reporting including Project Management, Financial and ERP Systems.

Streamline

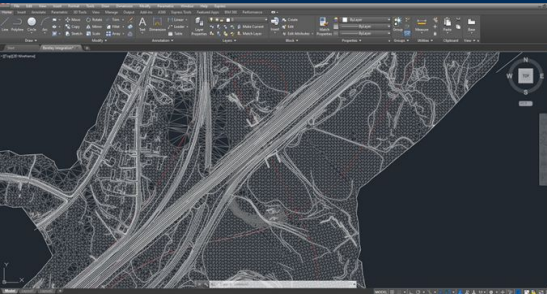
Better communication between the hand-off from design and construction where most breakdowns occur

Build automated tasks for faster communication

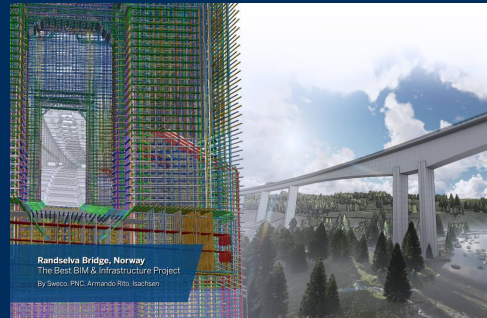


Connectors

Flexible software agnostic design options



Design



Structure



Architect



Quadri

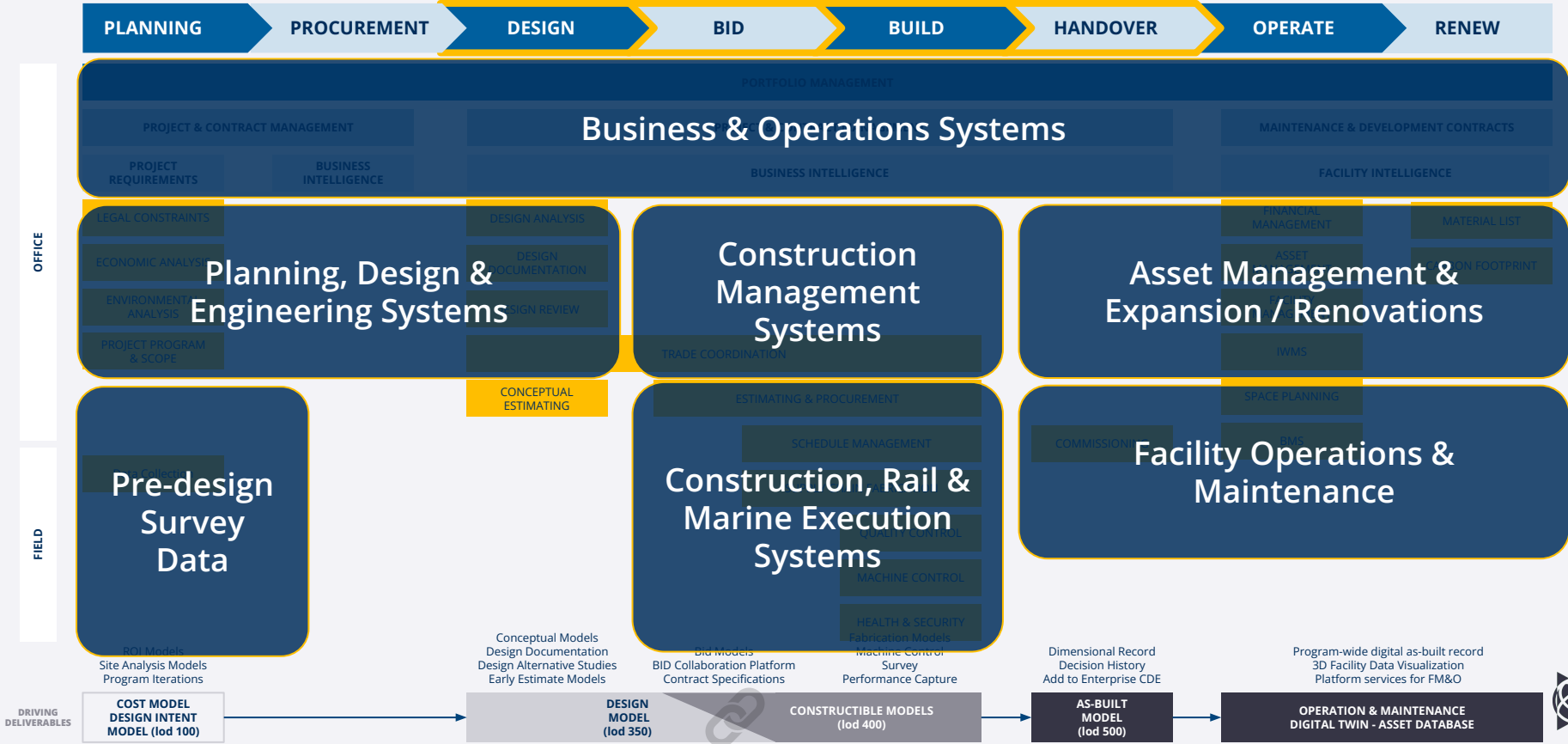


Data Aggregation for a Digital As-Built



Technology Ecosystem

Hand-off between design and construction is where most breakdowns occur.



Field Visualization

Pre-construction identification of project errors saves time!

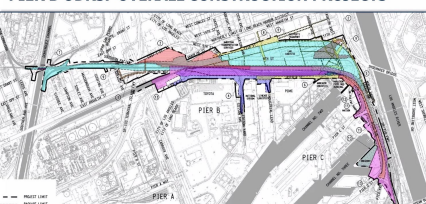


Field Productivity Monitoring

Mass Haul Tracking <ul style="list-style-type: none">• Completion %• Volume moved vs target• m³ per hour• Delay details	Grading Operations <p>Progress</p> <ul style="list-style-type: none">• m³ variance to target grade <p>Productivity</p> <ul style="list-style-type: none">• m³ per hour of operation <p>Quality</p> <ul style="list-style-type: none">• m² coverage at grade vs off-grade	Asset Utilisation <ul style="list-style-type: none">• Running hours vs Target• Working hours• Idle hours• Working / Idle % efficiency	Carbon Emissions <ul style="list-style-type: none">• Run time• Trip distance• Fuel consumption• CO₂ emissions
Load & Haul Productivity <ul style="list-style-type: none">• Total Payload• Tonnes per hour• Cycle Time• Cycle Segmentation (Load, Haul, Wait, Return, Wait)• Cycle Count• Load Time• Loader Passes• Payload Compliance• Cycle Distance• Source and Destination locations• Material Type• Tonnes Per Litre• Stopped time by location	Compaction Operations <p>Progress</p> <ul style="list-style-type: none">• m² variance to target specification <p>Productivity</p> <ul style="list-style-type: none">• m² per hour of operation <p>Quality</p> <ul style="list-style-type: none">• m² coverage at target specification / method• NDT measurement results.	Fleet Availability <ul style="list-style-type: none">• Planned downtime• Unplanned downtime• Availability % by asset	Safety <ul style="list-style-type: none">• Operator induced events• Event time and location• Event severity• Avoidance zone breach• Time and duration
		Fuel Management <ul style="list-style-type: none">• Run time• Total fuel by asset• Litres per hour• Trip distance• Tonnes per litre	

	Pier B On Dock Rail Phase	Demo	Excavation	Earthworks	Road/ Pavement	Rail	Walls	Concrete	Utilities	Sewer	Lighting	Fencing	Traffic	Landscape	Other
1	Anaheim Way 12" LADWP Water Relocation	x	x		x				x				x		Jack and bore
2	Shoemaker Bridge Demolition	x		x				x					x		
3	PBRY-Locomotive Facility	x		x	x	x				x	x	x		x	
4	PBRY-West Expansion and Pier B St Realignment	x		x	x	x			x	x	x	x	x	x	site improvements
5	PBRY-East Expansion	x		x		x	x			x	x	x			
6	LA-04 Pump Station		x					x		x					pump, scada, electrical
7	Dominguez Channel Bridge					x		x							Pile driving, wet environment
8	PBRY-Yard Utility Construction & Street 1	x		x	x				x	x	x		x	x	site improvements
9	PBRY-Rail Access & North Yard	x		x	x	x	x		x	x		x	x	x	Compressed air
10	Crescent Warehouse Modification	x								x				x	site improv, strx/arch mods
11	Pico West Demolition & Utilities	x		x					x				x		
12	Pico East Demolition & Utilities	x		x					x	x			x		
13	PBRY-Pico Realignment & Yard Reconstruction	x		x	x	x			x	x	x	x	x	x	compressed air, striping/signs, site improvement

PIER B ODRSF OVERALL CONSTRUCTION PROJECTS



Collaborative BIM,
Machine Control,
Earthworks

Collaborative
BIM, Rail,
Design

Collaborative
BIM, Mixed
Reality, Utilities

Collaborative BIM,
Design, Survey,
Marine



Trimble Cybersecurity Certifications:

- SOC 1, Type 2
- SOC 2, Type 1
- SOC 2, Type 2
- TrustE Privacy Shield
- Cyber Essentials +
- ISO27001:2013

Certifications and SOC Compliance

Viewpoint has proudly [earned SOC certifications](#) as part of the American Institute of Certified Public Accountants (AICPA) control platform—thus providing customers with an increased peace of mind and verifying our partners. Those certifications are listed below.



	Vista	Spectrum	Jobpac Connect	Viewpoint Team	Field View	Viewpoint For Projects
SOC 1 Type 2	✓	✓				
SOC 2 Type 1	✓	✓	✓	✓	✓	✓
SOC 2 Type 2	✓	✓	✓	✓	✓	✓
ISO 27001					✓	✓
Cyber Essentials Plus					✓	✓

CERTIFICATE OF REGISTRATION

Information Security Management System - ISO/IEC 27001:2013

The Certification Body of Schellman & Company, LLC hereby certifies that the following organization operates an Information Security Management System that conforms to the requirements of ISO/IEC 27001:2013

Trimble, Inc.

for the following scope of registration

The scope of the ISO/IEC 27001:2013 certification is limited to the information security management system (ISMS) supporting the Trimble in-scope divisions / business units and related hosted applications and services listed below, and in accordance with the statement of applicability, version 3.5, dated October 29, 2020:

Division / Business Unit	Applications / Services
Trimble Cyber Security (Cyber)	Enterprise Security Operations Provided to the In-Scope Divisions / Business Units by the Security Operations (SecOps) Team
Trimble Cloud xOps (xOps)	Operational Support, Service Desk, Development and Operations (DevOps), Developer Virtual Private Network (VPN) Service, and Service Enterprise Cloud Management
Trimble Civil Construction Software Systems (CCSS)	GeoManager / Pulse
Trimble Connect (Connect)	Connect
Trimble Transportation and Logistics – Europe (T&L-EU)	FleetWorks, FleetWorks for Carbox, FleetHours, Performance Portal (HelloDriver), MyTrimbleT&L-EU (Workflow), SOLID Web, and Absence Planner
Trimble Cloud Core Platform (TCCP)	Trimble Identity, API Cloud, Profile X, Data Ocean, Processing Framework, Search, and Internet of Things (IoT)
Project and Program Management (PPM)	ProjectSight, Proliance, and Prolog Sky
Trimble Maps and Applications for Professional Services (MAPS)	PC*MILER Web Services, PC*MILER On Prem, CoPilot Web Services, CoPilot Application, MileOn by PC*MILER Application, DR Track, and DirectRoute

which includes the following in-scope location(s) on pages 2 - 3

Certificate Number: **1650760-4**

Authorized by:

Christopher L. Schellman
CEO, Schellman & Company, LLC
4010 W. Boy Scout Blvd., Suite 600
Tampa, Florida 33607, United States
www.schellman.com



Issue Date
November 19, 2020

Original Registration Date
December 6, 2011

Expiration Date
December 4, 2023

Certificate Version
Version 4



Trimble's **digital delivery workflow** contributes to sustainability throughout the project lifecycle from **design through O&M.**

Port Sustainability Contributions

- The **3D design hub** provides existing, design, and process data, **preventing costly surprises** - environmentally and otherwise - and allowing for **evaluation of potential risks and events** through each phase of construction from the beginning
- **Rework is minimized** through the **collaborative design** environment, containing *all* design information
- **Machine control** optimizes run-time and material use, while ensuring **minimal disturbance of surrounding communities and habitats** and avoiding any **dangerous areas**
- **Digestible plans** and progress information allow for smooth **stakeholder interaction**
- **Communication** between the field and office empowers **safe and efficient** response
- A complete, accurate, and accessible **as-built** model encapsulates detailed information for repair history, preventing unnecessary work and exploration to **evaluate and solve** issues **quickly and accurately**



AAPA Urges Congress to Pass Sustained Infrastructure Investment

America's seaports are doing their part, investing \$31 billion in port-side infrastructure, but it's not enough. The U.S. needs major, long-term, infrastructure investment to keep American trade and commerce competitive and on the move.

FY21

FY22

NORMAL APPROPRIATION + IJA SUPPLEMENT PER YEAR FY22-26

Funding from the Infrastructure Investment & Jobs Act boosts critical investment every year, for 5 years.

\$230 million

\$300 million

\$450 million

Port Infrastructure Development Program (PIDP) - \$2.25B TOTAL
Port equipment and facilities improvements.

\$3.75 billion

\$2.75 billion

\$540 million

Army Corps of Engineers Coastal Navigation Program - \$2.7B TOTAL
Dredge and maintain federal coastal navigation channels.

\$2 billion

\$2.2 billion

\$3.14 billion

Rebuilding American Infrastructure with Sustainability and Equity (RAISE) & Infrastructure for Rebuilding America (INFRA) - \$15.7B TOTAL
Nationally significant transportation projects including roads, bridges and rail.

\$375 million

\$500 million

\$1 billion

Consolidated Rail Infrastructure and Safety Improvements (CRISI) - \$5B TOTAL
Rail-focused infrastructure and intermodal port projects.

\$10.5 million

\$14.8 million

\$5 million

America's Marine Highways - \$25M TOTAL
Promote sea freight transportation.

NEWLY FUNDED FOR 2022!

\$50 million

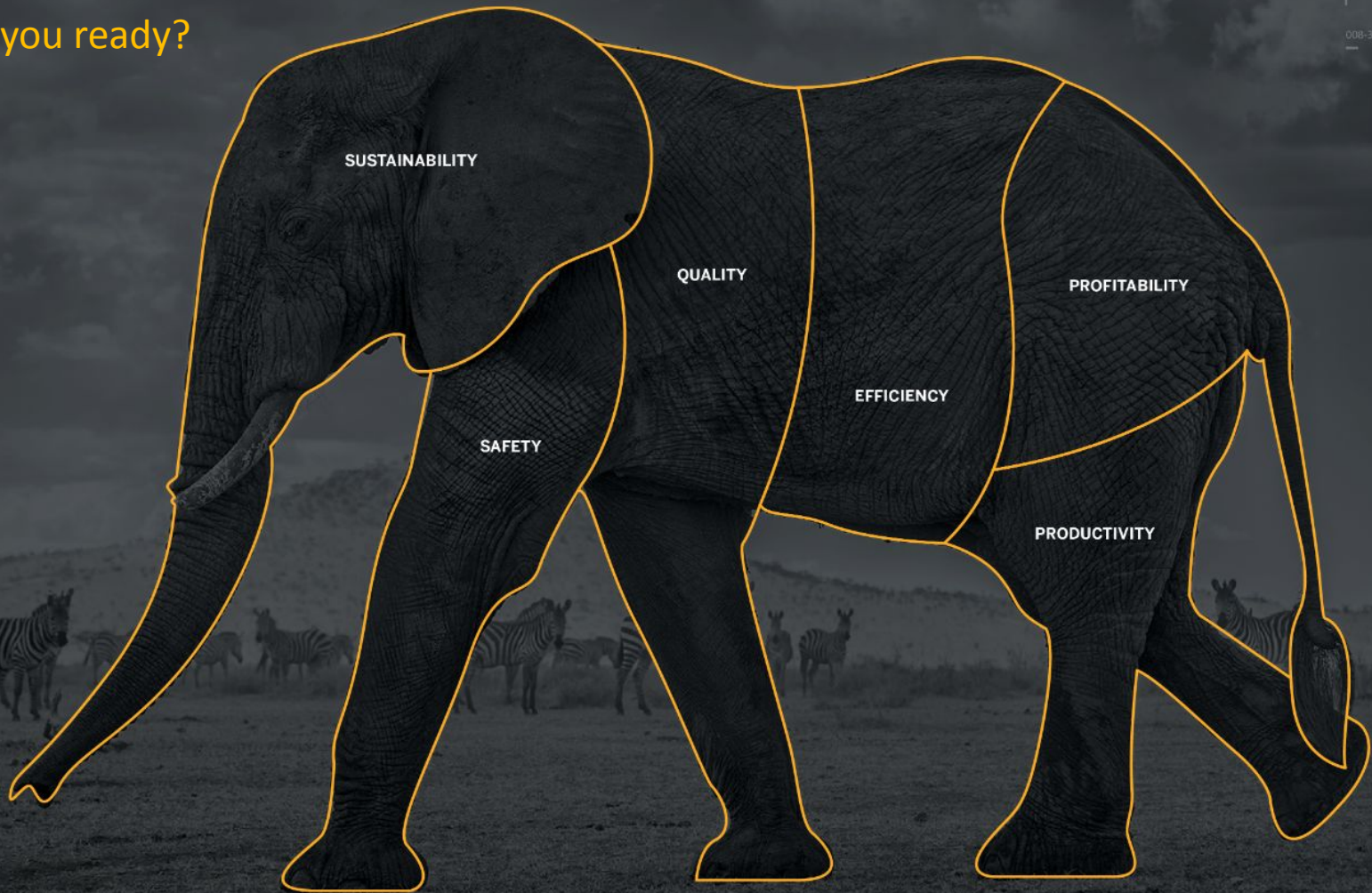
Port Truck Idling Program - \$250M TOTAL
Reduce truck emissions at ports.

\$10 million

Electric or Low-Emitting Ferry Program - \$50M TOTAL
Purchase of electric or near-zero emissions passenger ferries

Are you ready?

008-32 EL_11GH



SUSTAINABILITY

QUALITY

PROFITABILITY

EFFICIENCY

SAFETY

PRODUCTIVITY

1 Identify Your Objectives

What's possible
with **digitization**?

- UP TO A **50% INCREASE** IN FIELD PRODUCTIVITY
- **80% REDUCTION** IN REWORK
- **10% COMPRESSION** OF SCHEDULES
- **IMPROVED** PROJECT PREDICTABILITY

- Expedite project completion
- Create a digital as-built for O&M
- Increase efficiency and sustainability
- Improve worker and jobsite safety
- Gain a competitive advantage



2 Ready the Organization

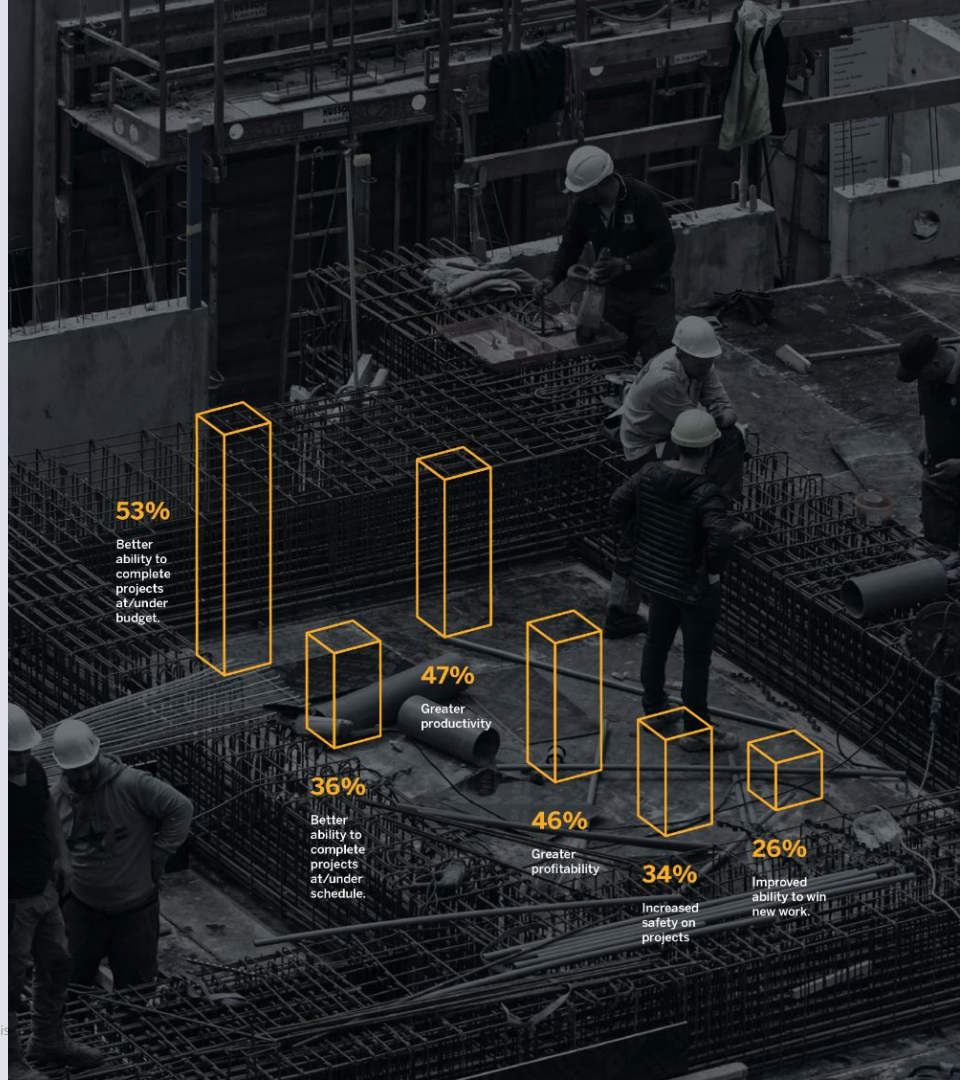
Are you prepared for the digital transformation?

- Is the initiative strategically important?
- Is it financially supported?
- Is it organizationally support?
- Is it adoptable?



3 Capitalize on Data

- What questions do you want to answer?
- What standard KPIs will you use?
- Where will the data come from?
- How can you ensure data quality?
- How can you create a data driven culture?
- How can you benchmark your data?



Thank You

For Questions or Feedback please contact:
Trevor_L_Clark@trimble.com



THANK YOU TAKK merci

GRAZIE VINAKA ERIMA KASIH

감사합니다

謝謝

ありがとう