



# Digital Transformation in Dredging Operations

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Transforming the Way the World Works

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## 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)

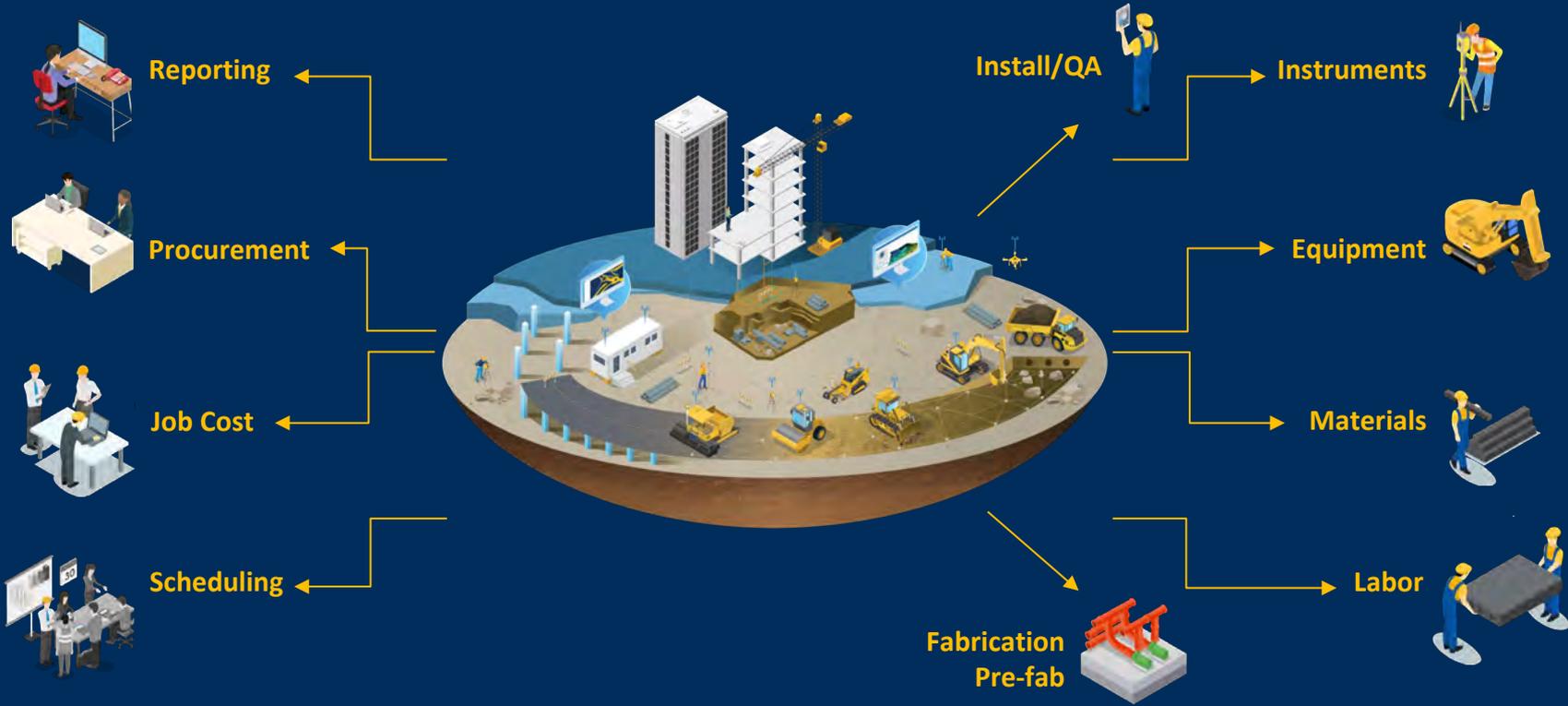
**WSJ's Management Top 250**



# Connected Construction: System-Wide Productivity

In the Office

In the Field



Fabricatable Design & Detailing



Project Docs & Contracts



Prod Schedule, Work Order Mgmt



Financial: AR, AP Management

# 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%**.



# Trimble Digital Construction

## Benefits and value added

### TRANSPARENC



**One Single source  
of truth**

Built around a structured database federating all stakeholders inputs for each project phase, tracking design variation, physical progress and enabling the handover of a Digital Twin of the project

+

### VISIBILITY



**Graphical display of  
Comprehensive data**

Reducing the overall lifecycle costs, the amount of deviation between design and construction, empowering the decision making through a data driven process

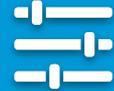
### PREDICTABILITY



**Integrated database  
crossing parametric  
design, embedded  
planning and budget  
information**

Enabling to anticipate upcoming events

### CONTROL



**A confident delivery  
process empowered by  
Trimble solutions**



# Connecting the physical world with the right digital tools



Public Works and Utilities

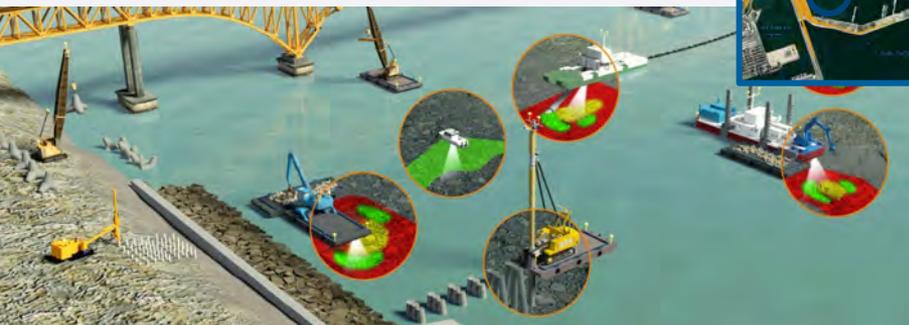


Road and Rail



Marine Construction and Dredging

Structures and Buildings



# 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*



# Trimble Marine Construction

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**Domain  
Depth and  
Breadth**



**Multi-tier  
Solutions**



**History of  
Innovation**



**OEM Partnerships  
& Mixed Fleet**



**Global Reach &  
Local Support**



**Integrated  
Solutions**

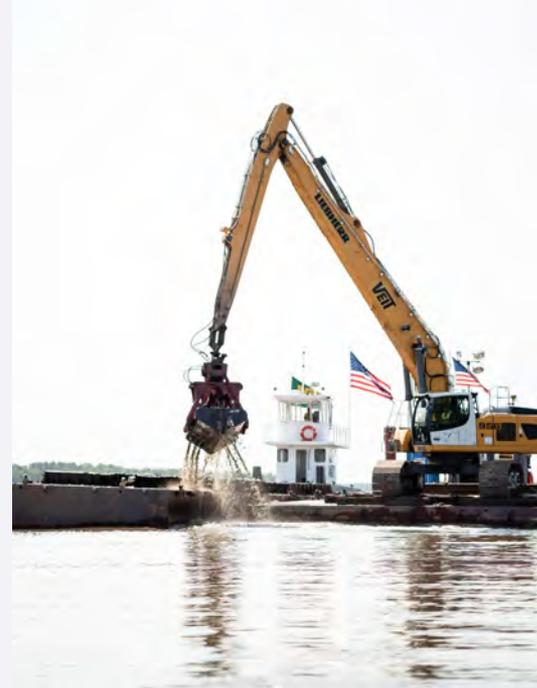


Image credit: Veit Construction, Kingsbury Bay – Grassy Point Habitat, MN



# Questions to ask ourselves

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## Dredge efficiency and safety

- Where can we build **competitive advantage** ?
- Are we achieving **maximum efficiency** ?
- Are we at **maximum uptime** ?
- Can we **reduce re-work** ?
- Where can we **improve site safety** ?
- Where are the areas to **improve our profitability** ?



# Dredging Challenges

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- Sub-surface **visibility** / **Working in the blind**
- **Monitoring project progress**
- High processing and **dump costs** for contaminated material
- **Limited safe working hours** by daylight
- **Challenging safety** environment e.g. divers
- Guesswork > **multiple passes to collect objects**
- **Rework** of missed high spots/ slumping
- **Mistakes can be costly**
- **Overwork** > inefficiency
- **Work interruptions** for new survey verification



Image credit: [WEDA](#)

Technology can significantly reduce these challenges, using visualization



# Paid or unpaid overdepth

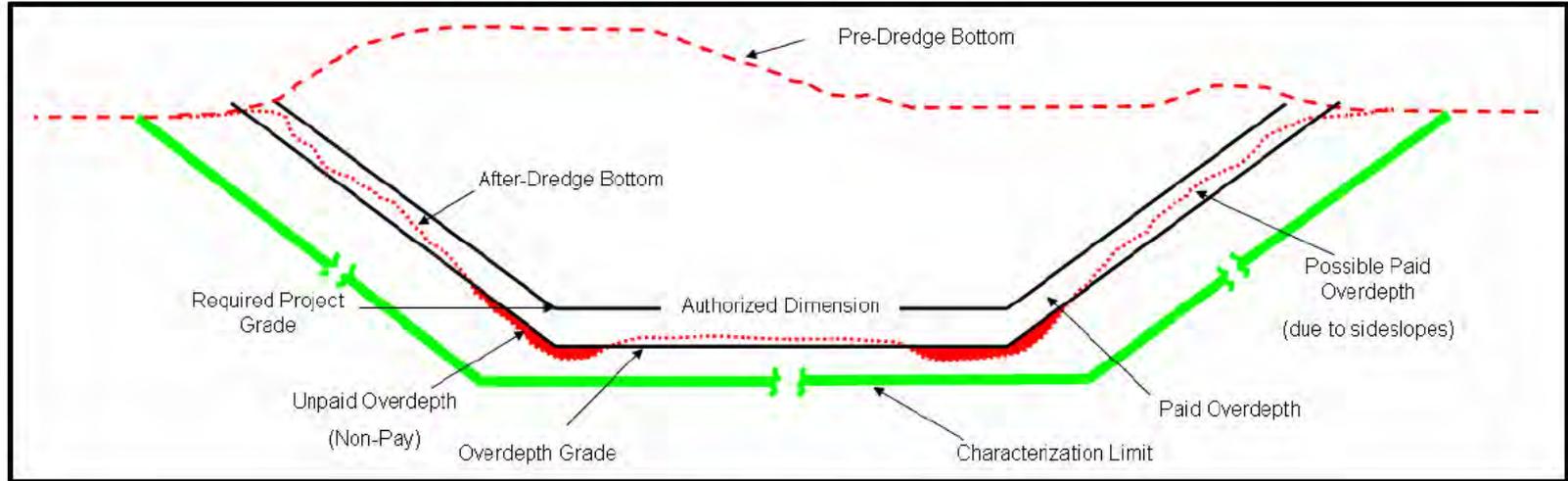


Figure 1. Various dredging prism dimensions and zones.

Dredge tolerance imprecision can represent the profit for a project



# Calibration / Tolerances

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FINAL ACHIEVED ACCURACY:  $f$  {OPERATOR, SENSOR QUALITY, LEVER ARMS, ENVIRONMENTALS, MATERIAL TYPE, ETC.}

## ERROR BUDGET INPUTS

GNSS Horizontal: +/- ~0.03'/0.01m (RTK)

GNSS Vertical: +/- ~0.06'/0.02m (RTK)

GNSS Heading: +/- ~0.10° (2m baseline)

Inclinometer: +/- 0.01° - 0.50°

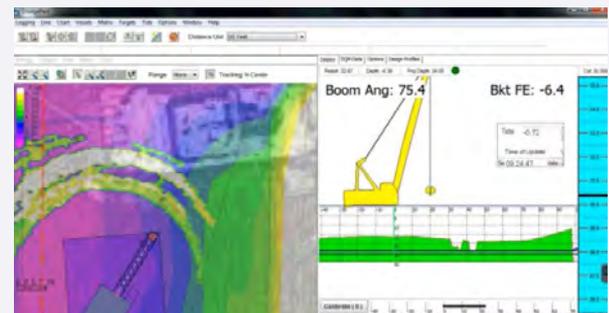
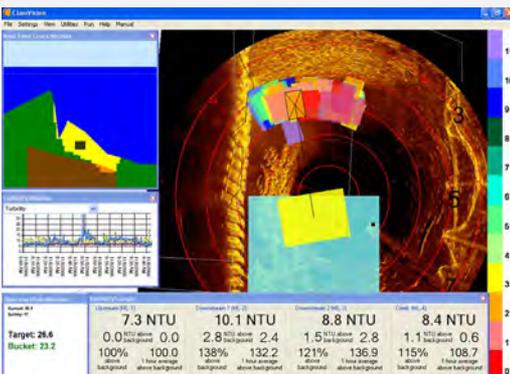
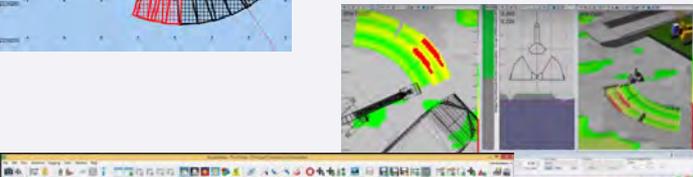
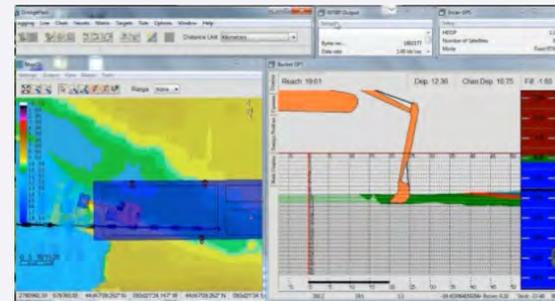
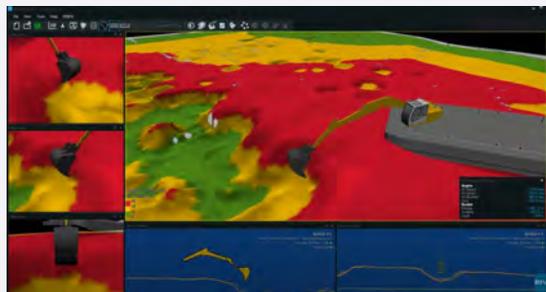
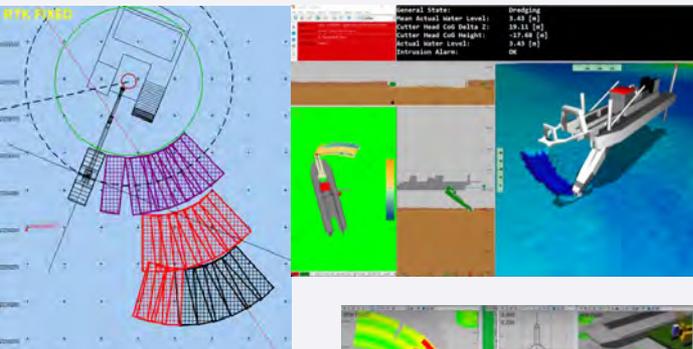
Attitude: +/- 0.01° - 0.50°

Rotational Encoders: +/- 0.01° - 0.20°

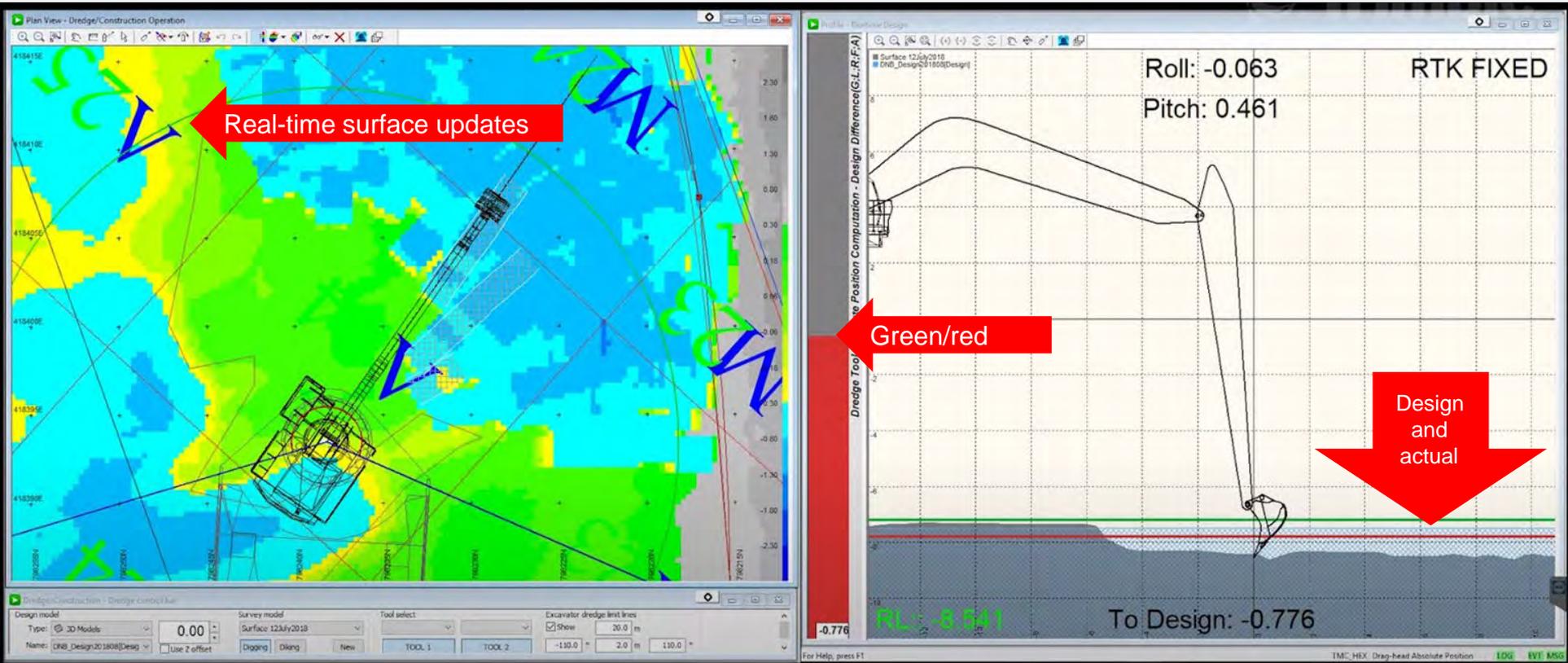


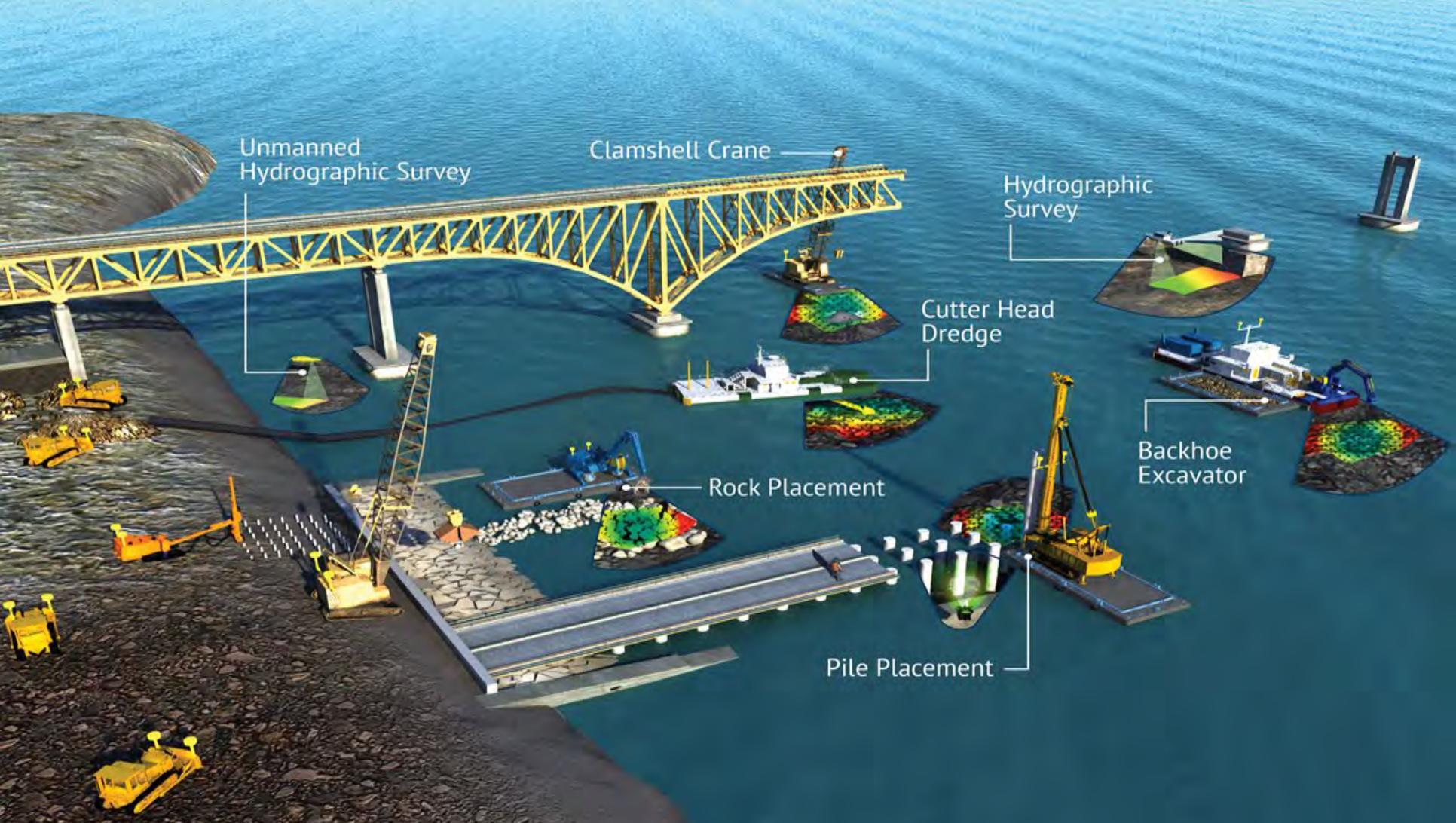
# The Visualization Advantage

Multiple options



# The Visualization Advantage





Unmanned Hydrographic Survey

Clamshell Crane

Hydrographic Survey

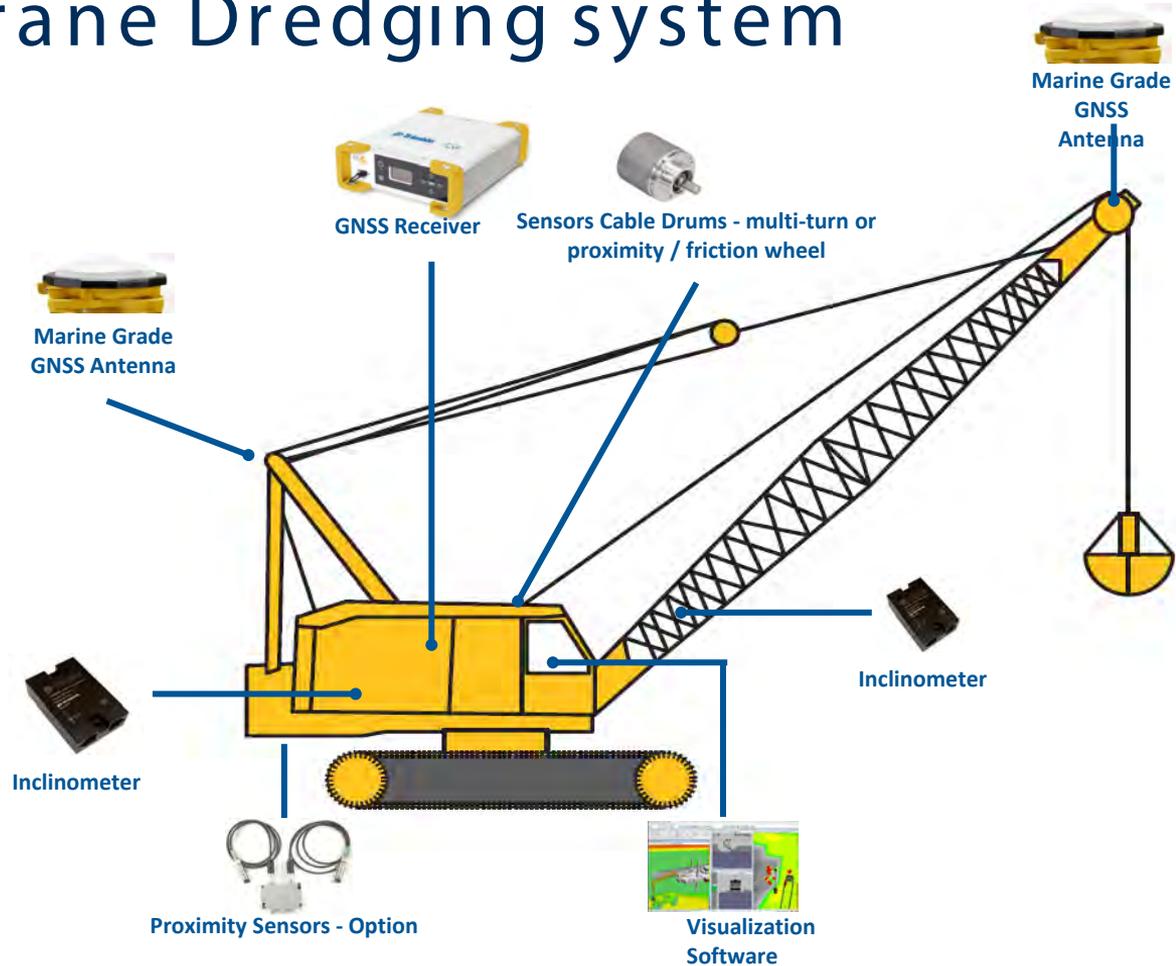
Cutter Head Dredge

Backhoe Excavator

Rock Placement

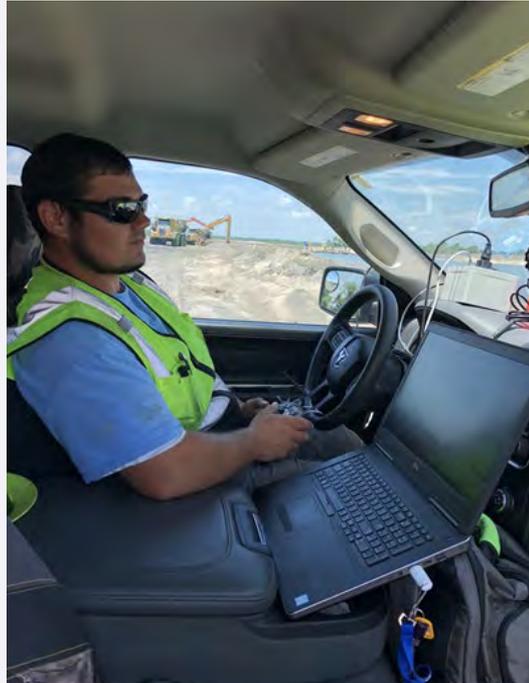
Pile Placement

# Wire Crane Dredging system



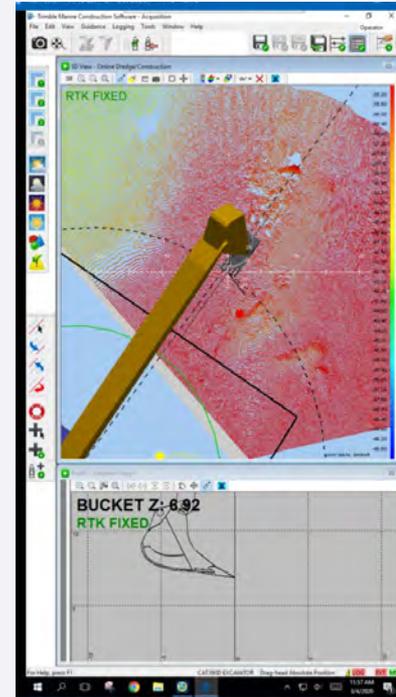
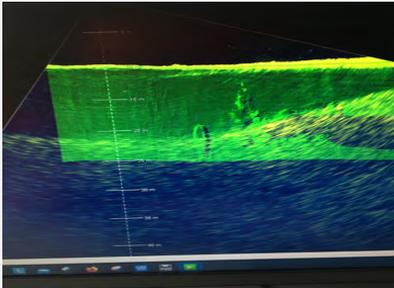
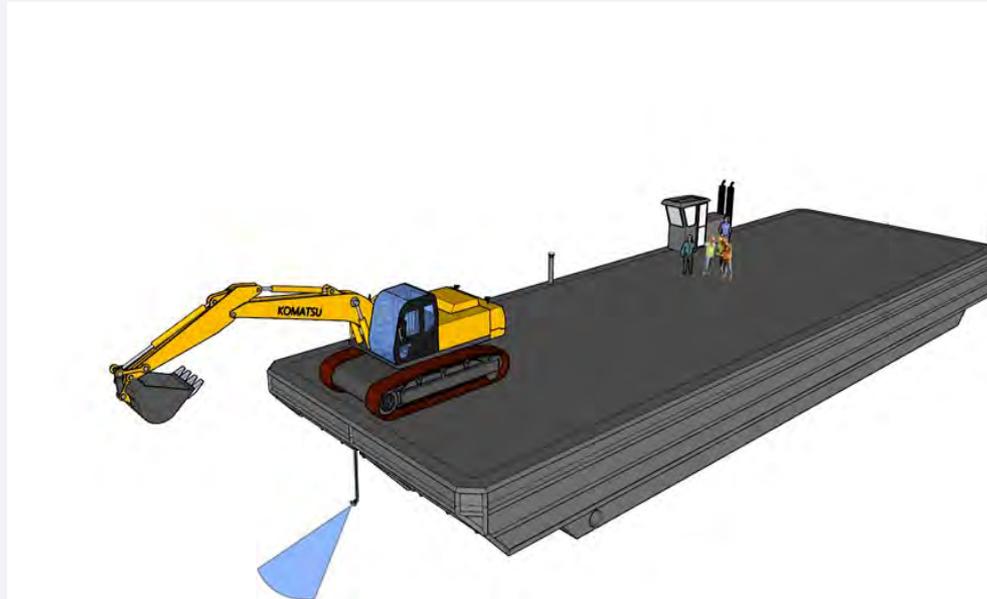
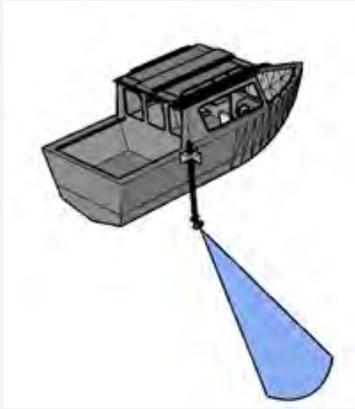
# Ad-hoc hydrographic drone survey

Unmanned Autonomous or Remote Operated Survey Vessels



# Real-Time Verification with Sonar

As-building



# Customer Success: Tappan Zee

Document  
Project Progress

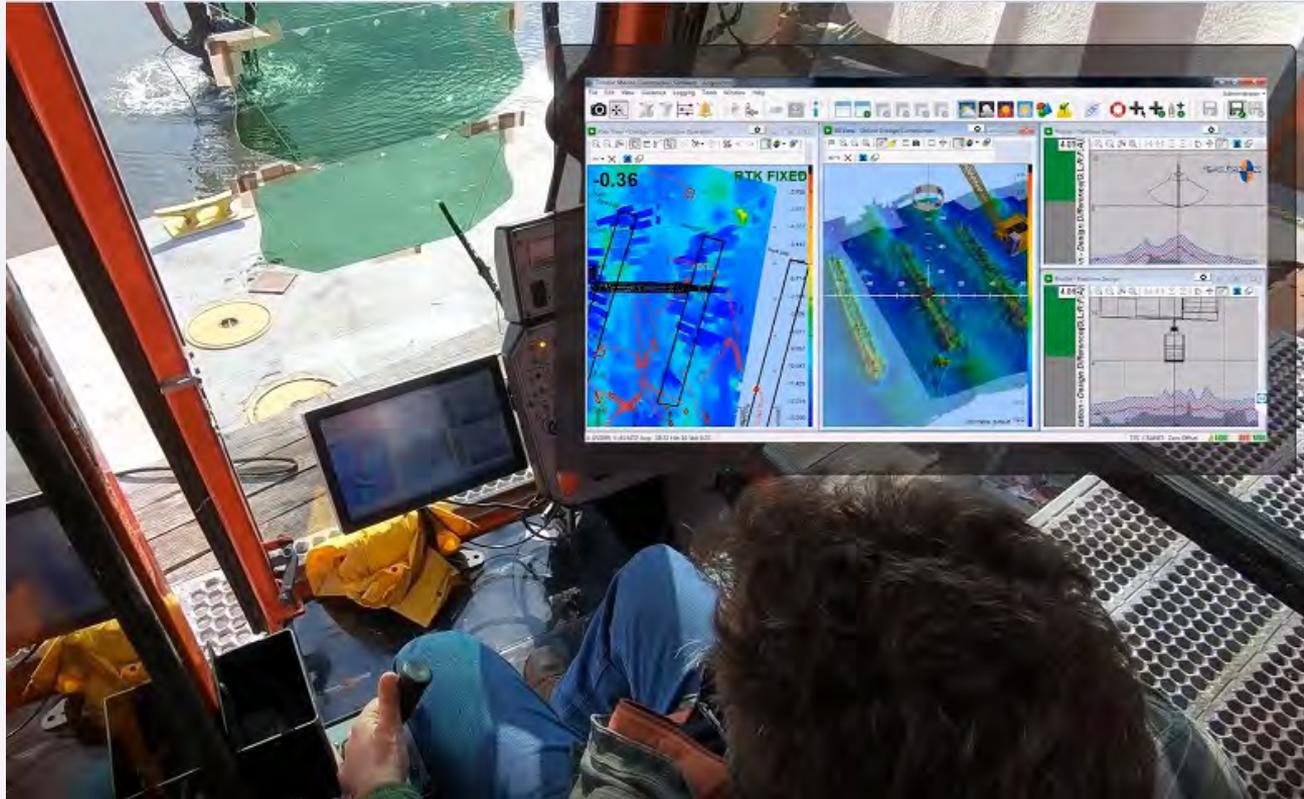


Image credit:  
Measutronics Corp.



# Customer Success: Port of Kalama

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- Project: Dredging, build a new 550 -foot-long guest dock, including utilities and new access gangways, on the east side of the Port of Kalama Marina.
- “Everything underwater is a challenge—and there was a penalty for overdredging past a certain point. We also needed to quantify the dredging totals, which required **eyes under water** .”
- Results:
  - **15-20% faster dredging** than conventional methods
  - **More collaborative communication** with owner
  - **Efficient daily burn rate**



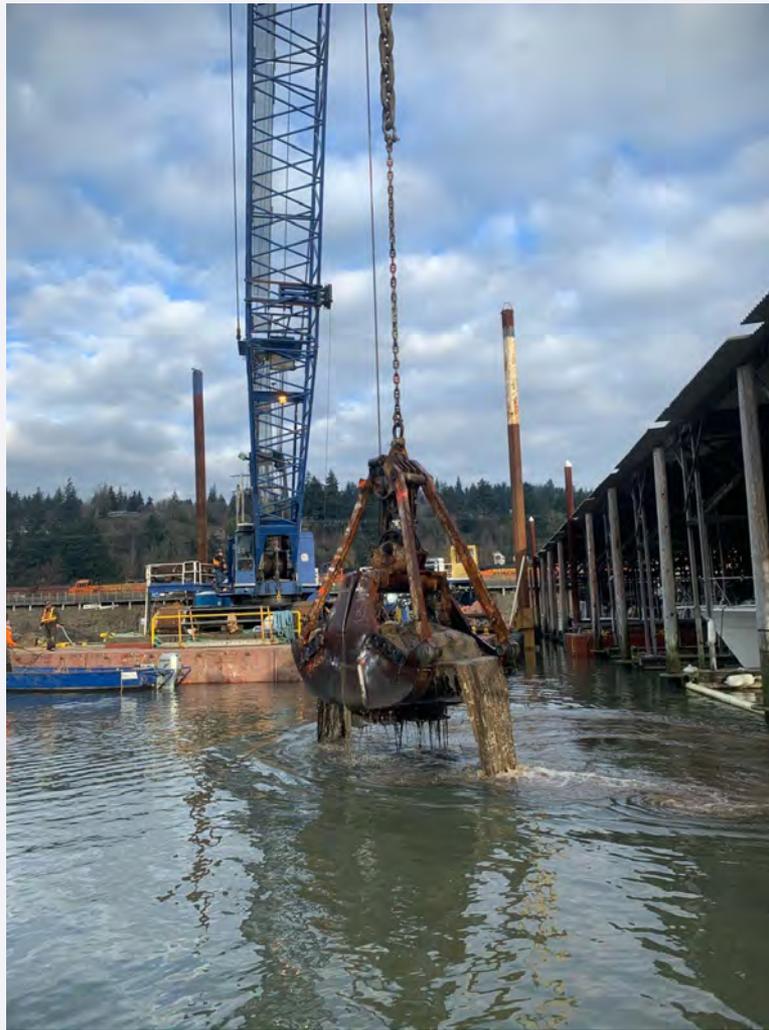


“We realized before we bid the project that tracking in-progress dredge productions would be critical to the success of the project. We engaged Trimble Marine Dealer Measutronics to help us combine the best equipment, technology and workflow for success.”

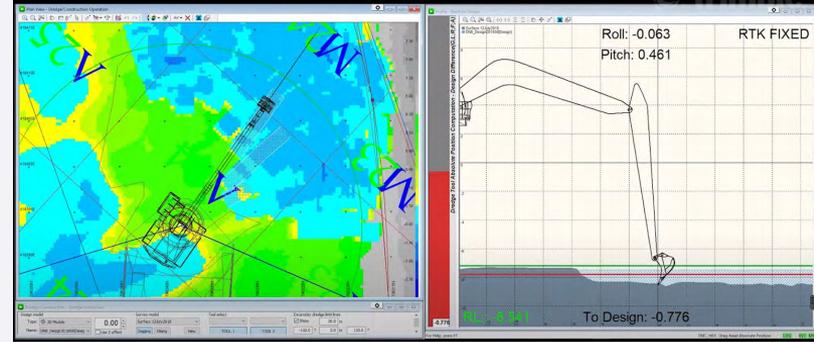
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*Evan Clemson, Vice President of Operations at AAC*





# Why digitize?



- Accuracy: **Higher precision** relative to design
- Productivity: Operator experience is not essential. New operators can be trained quickly and become **productive faster**.
- Consistency: **Reliable, repeatable results**
- **Safer**: Traditional methods may involve assistance from personnel outside the safety of the machine cabin
- Flexibility: Machine Guidance systems can allow **24-hour operation**, day or night
- Auditable: For insurance or billing disputes, keep a **digital record/trail**
- **Lower costs**: Reduce the need for frequent third party surveys
- **Confidence**: Know that the work has been completed before moving.
- Win bids: **bid accurately** and **protect bid margins**



# Solving Challenges

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- **High -definition** sub-surface visibility
- Real-time project **progress visibility**
- **Clear identification** of foreign objects
- **Eliminate excess** material dredged
- **More predictable** machine payload
- **No daylight limitations**
- **Situational awareness** in horizontal and vertical space
- **Reduced need for divers**
- **Single pass** to identify and collect foreign objects
- **Reduce or eliminate rework** / **no high spots**
- **Real-time seafloor visibility** (with sonar)
- Reduced potential for human error
- **Target zero overwork**



# Buyers Checklist

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- Easy to use
- Integrated system (hardware, software)
- Rugged and reliable solution (limited downtime)
- Trusted technology partner
- Compatible across multiple machine-types
- Installation, training, support from one provider
- Local support
- Return on investment



# Next steps

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- Request the Overdredging whitepaper
- Research new workflows (videos, datasheets, [case studies](#), free 'Marine construction productivity')
- Talk to Trimble, [marine@trimble.com](mailto:marine@trimble.com) or [jonathan\\_white@trimble.com](mailto:jonathan_white@trimble.com)
- Discuss 10~15% improvement with your estimating team
- Embed tech cost in project bids

