**Improving Safety Through Technology:
A Tactical Guide to the Best Investments**

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Dodge Data & Analytics
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Research

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Spent last 18 years leading research into significant global trends

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Newmetrix
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20-year construction industry veteran

Spent the last 6 years focused on data and predictive analytics

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Earn CEUs For This Session

Participants must:

1. Sign in using attendance sheet in the back of the room.

2. Attend at least 95% of the session.

3. Complete the session and post-program evaluation.

4. Complete a brief assessment with a score of 75% or greater.

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Additional instructions will be emailed to attendees requesting CEU credits. For questions, please email: **jo-anne.torres@agc.org,** or call (703) 837-5360.

Earn CE hours for this Session

1.0 AIC CPD Credit | AGC of America has been approved to offer Continuing Professional Development (CPD) credits for qualifying programs by the American Institute of Constructors (AIC).

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AIA continuing education credit has been reviewed and approved by AIA CES. Learners must complete the entire learning program to receive continuing education credit. AIA continuing education Learning Units (LUs) earned upon completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for non-AIA members are available upon request.

Speaker Disclosure

AGC event speakers may have proprietary interests, including but not limited to, exposure to the industry, increased consultation services, book sales and/or receipt of financial compensation/speaking fees.

Learning Objectives

By the end of this session, participants will be able to:

1. Discuss which technologies are used most widely currently and benchmark your company's use against industry levels of adoption.

2. Identify the technologies that contractors believe have the most potential to improve safety in the future.

3. Review best practices for site technology adoption, both from contractors with experience and from industry experts engaged with multiple firms seeking to adopt technology.

4. Describe commonly experienced challenges that impede the effective use of technology onsite and ways to address those issues.

Dodge Research on Safety
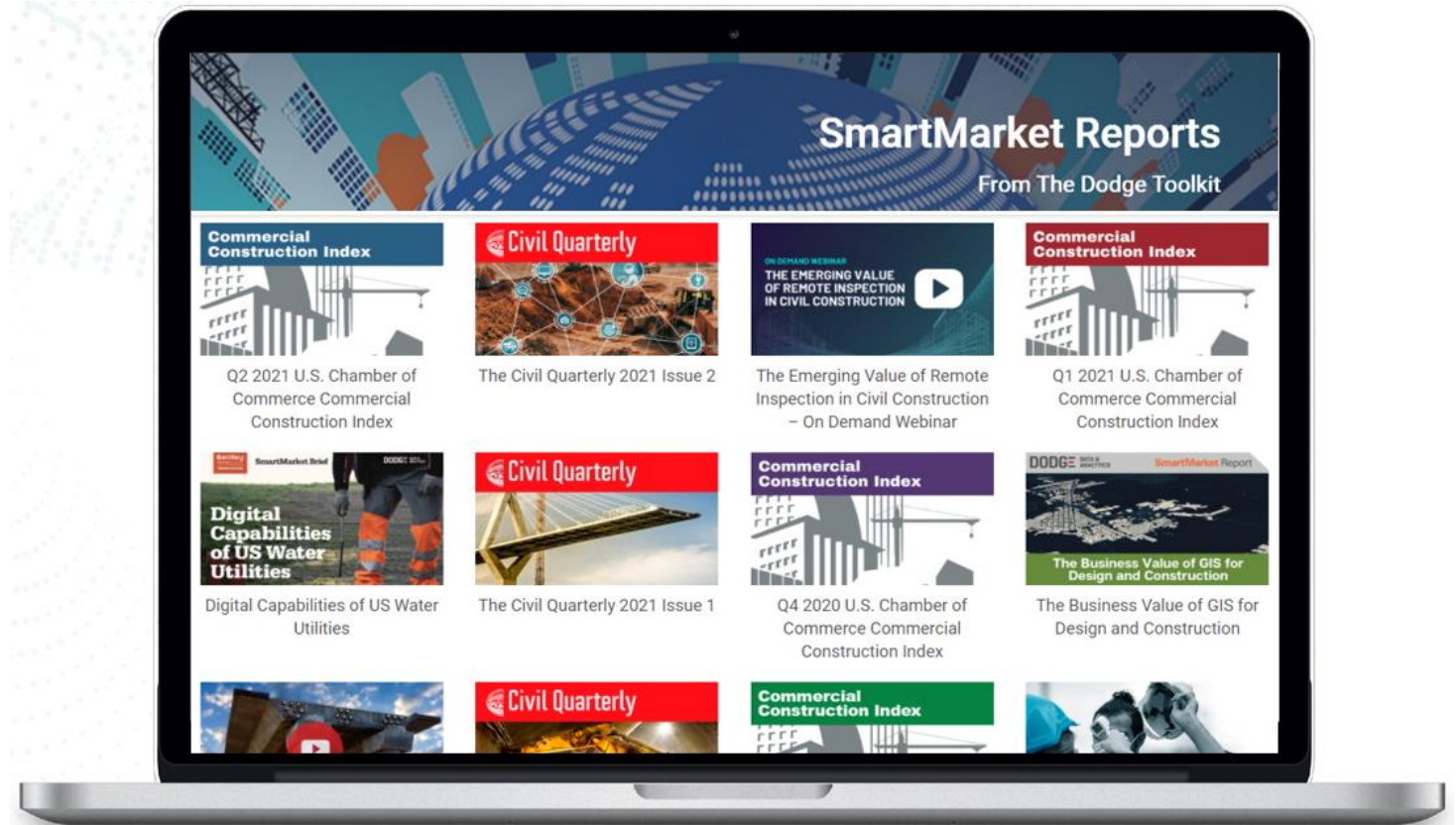
Additional Text Goes Here If Needed

Dodge Industry Insights Research

Safety is a frequent topic of Dodge research

- *Processes*
- *Technologies*
- *Performance data*
- *Culture*

FREE: www.construction.com/toolkit/reports

The Business Case for Lean

Survey of Trade and General Contractors

- *AGC and Lean Construction Institute*

- *Presenting:*
  - Wednesday, September 22, 9:00 – 9:45 Canary 3

"Why Some Projects Excel"

- Compared "best project" from last 5 years with a "typical" (<u>not worst</u>) project

- Determined performance on each (cost, schedule, safety, quality, etc.)

- Determined use of "lean practices" vs. industry standard practices on each (from team formation to close-out)
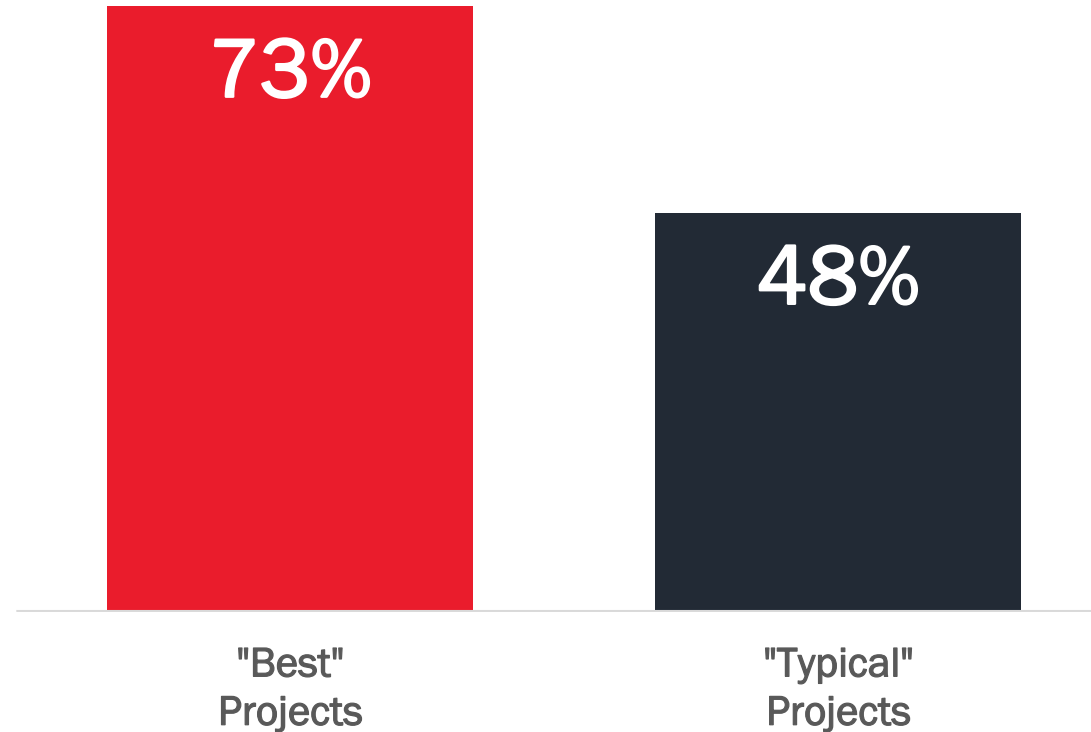
- Correlated practices with outcomes

The Business Case for Lean

Safety varies a lot between best and typical

Top Level of Safety Performance:
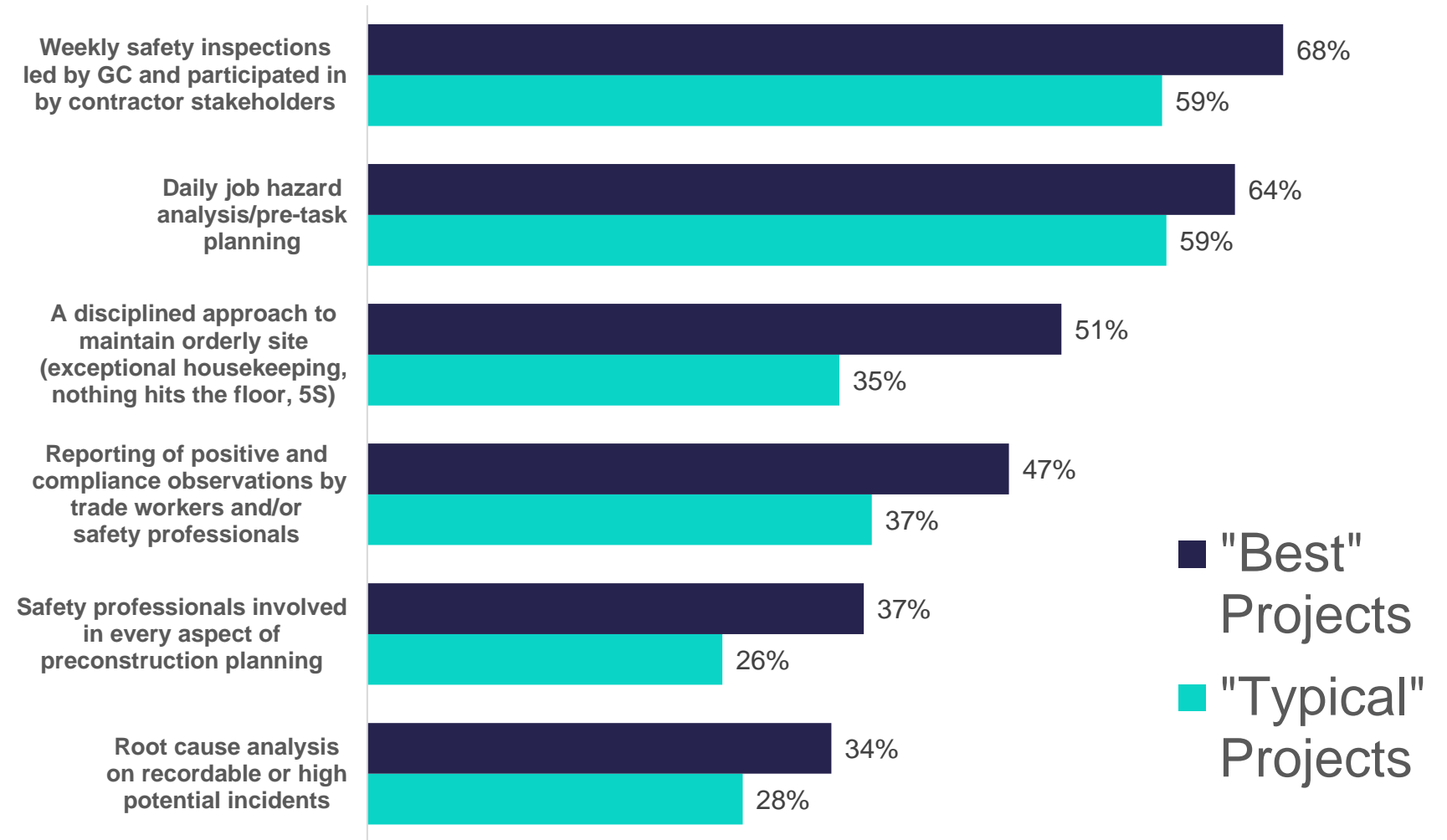- No lost time.
- No recordable incidents.
- No harm to the public.
- Good safety culture shared by all companies onsite.

73%
48%

"Best" Projects
"Typical" Projects

Improving Safety Through Technology: A Tactical Guide to the Best Investments

The Business Case for Lean

"Lean" safety practices correlate to best projects

Weekly safety inspections led by GC and participated in by contractor stakeholders
- "Best" Projects: 68%
- "Typical" Projects: 59%

Daily job hazard analysis/pre-task planning
- "Best" Projects: 64%
- "Typical" Projects: 59%

A disciplined approach to maintain orderly site (exceptional housekeeping, nothing hits the floor, 5S)
- "Best" Projects: 51%
- "Typical" Projects: 35%

Reporting of positive and compliance observations by trade workers and/or safety professionals
- "Best" Projects: 47%
- "Typical" Projects: 37%

Safety professionals involved in every aspect of preconstruction planning
- "Best" Projects: 37%
- "Typical" Projects: 26%

Root cause analysis on recordable or high potential incidents
- "Best" Projects: 34%
- "Typical" Projects: 28%

■ "Best" Projects

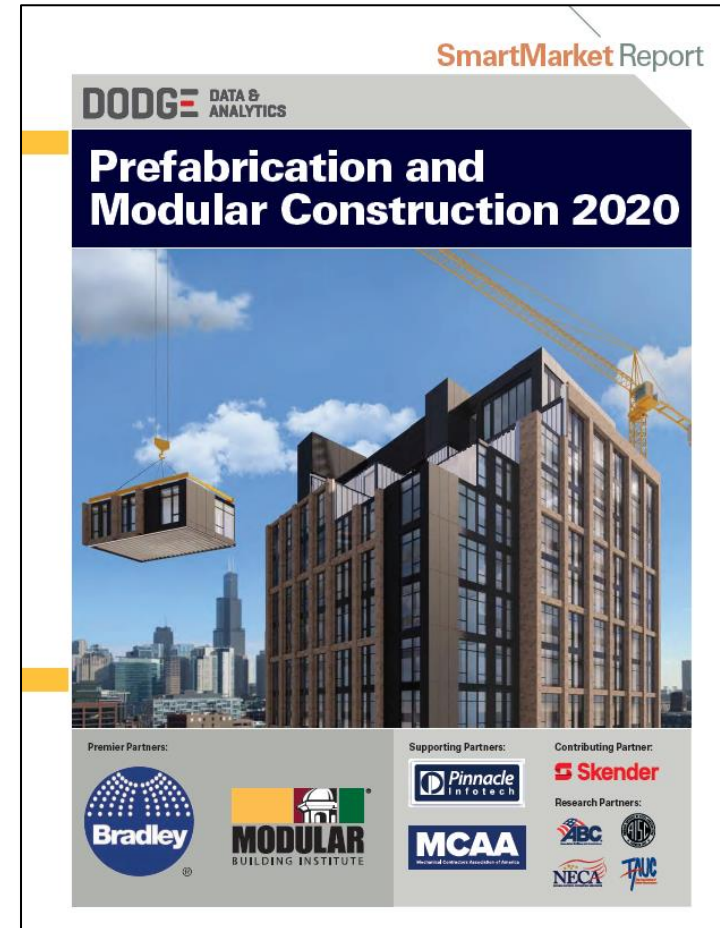■ "Typical" Projects

Prefabrication & Modular

Survey of Contractors, Architects, Prefab Manufacturers

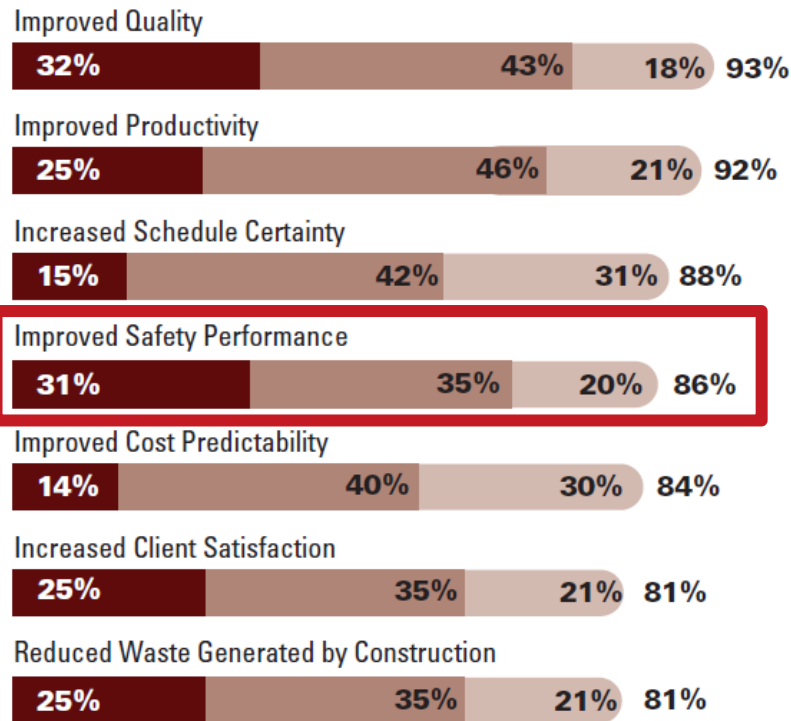FREE: www.construction.com/toolkit/reports

Prefabrication

Prefabrication:

Improved safety performance is among top benefits for trade and general contractors

Trade Contractors: Impact of Prefabrication on Seven Key Performance Factors (Percentages Reporting Medium, High or Very High Contribution for Each Factor)

Dodge Data & Analytics, 2020

■ Very High ■ High ■ Medium

Improved Quality
| 32% | 43% | 18% | 93% |

Improved Productivity
| 25% | 46% | 21% | 92% |

Increased Schedule Certainty
| 15% | 42% | 31% | 88% |

Improved Safety Performance
| 31% | 35% | 20% | 86% |

Improved Cost Predictability
| 14% | 40% | 30% | 84% |

Increased Client Satisfaction
| 25% | 35% | 21% | 81% |

Reduced Waste Generated by Construction
| 25% | 35% | 21% | 81% |

GCs/CMs: Impact of Prefabrication on Seven Key Performance Factors (Percentages Reporting Medium, High or Very High Contribution for Each Factor)
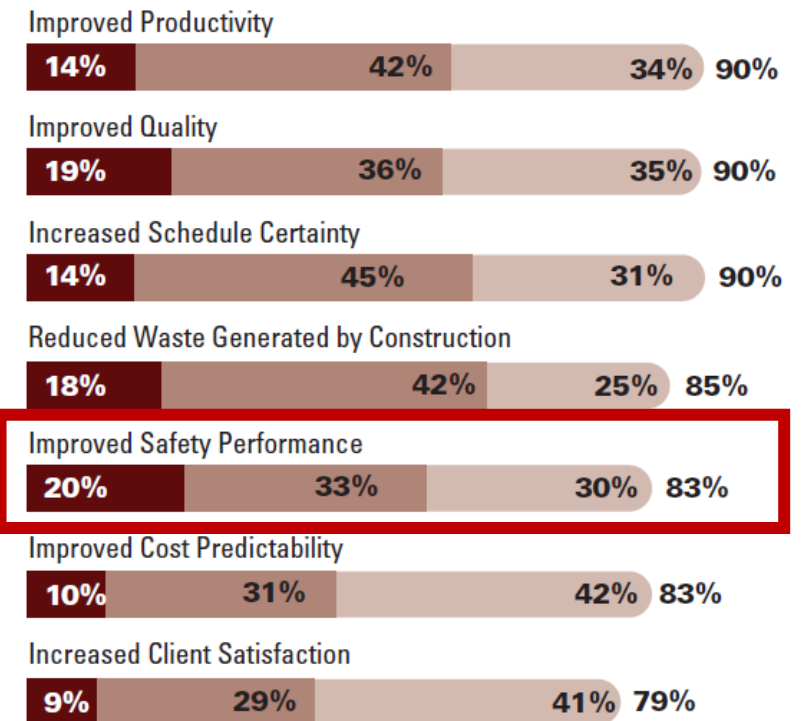
Dodge Data & Analytics, 2020

■ Very High ■ High ■ Medium

Improved Productivity
| 14% | 42% | 34% | 90% |

Improved Quality
| 19% | 36% | 35% | 90% |

Increased Schedule Certainty
| 14% | 45% | 31% | 90% |

Reduced Waste Generated by Construction
| 18% | 42% | 25% | 85% |

Improved Safety Performance
| 20% | 33% | 30% | 83% |

Improved Cost Predictability
| 10% | 31% | 42% | 83% |

Increased Client Satisfaction
| 9% | 29% | 41% | 79% |

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AGC 2021 CONVENTION — THE CONSTRUCTION ASSOCIATION

Prefabrication

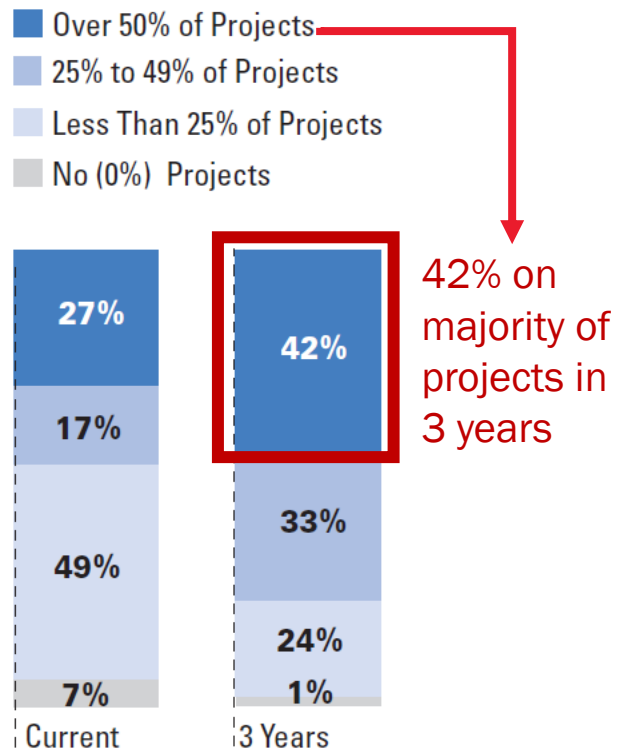**BIM:**

Driver for prefabrication

Percentage of BIM Users Engaged With Model-Driven Prefabrication
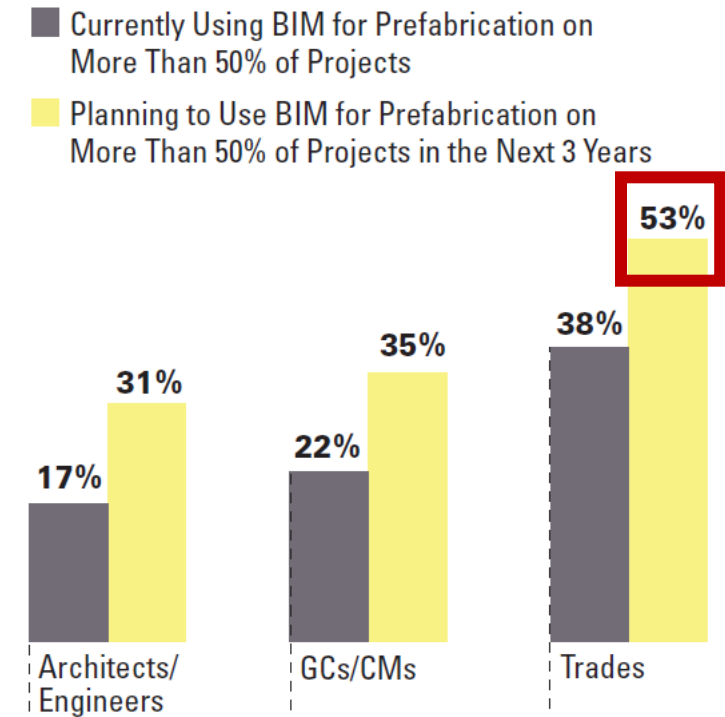(Comparing Current Implementation Levels With Predicted Levels in 3 Years)
Dodge Data & Analytics, 2020

- Over 50% of Projects
- 25% to 49% of Projects
- Less Than 25% of Projects
- No (0%) Projects

42% on majority of projects in 3 years

Current
- 27%
- 17%
- 49%
- 7%

3 Years
- 42%
- 33%
- 24%
- 1%

High-Level Implementation of BIM for Prefabrication by Company-Type
(Percentages Using BIM for Prefabrication on More Than 50% of Projects (Current and Next 3 Years)
Dodge Data & Analytics, 2020

- Currently Using BIM for Prefabrication on More Than 50% of Projects
- Planning to Use BIM for Prefabrication on More Than 50% of Projects in the Next 3 Years

Architects/Engineers
- 17%
- 31%

GCs/CMs
- 22%
- 35%

Trades
- 38%
- 53%

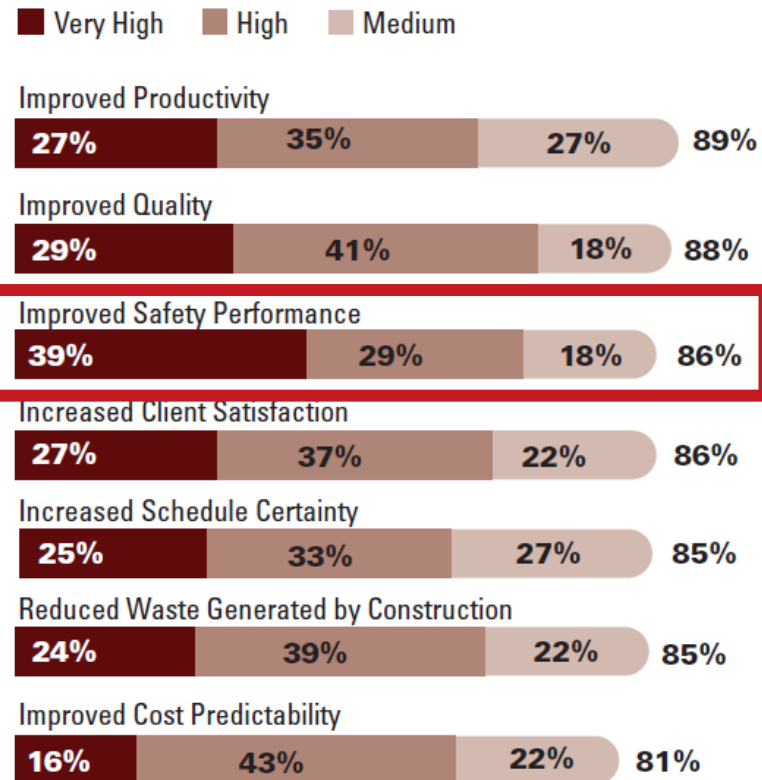Improving Safety Through Technology: A Tactical Guide to the Best Investments

Modular

Modular:

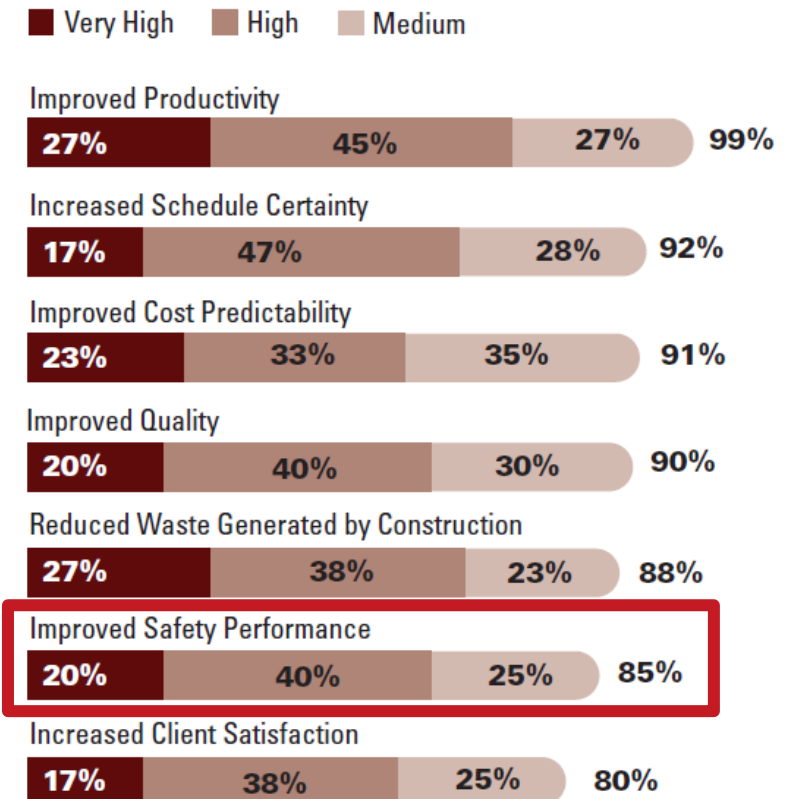Improved safety performance is among top benefits for trade and general contractors

Trade Contractors: Impact of Modular Construction on Seven Key Performance Factors (Percentages Reporting Medium, High or Very High Contribution for Each Factor)

Dodge Data & Analytics, 2020

■ Very High ■ High ▪ Medium

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| 27% | 35% | 27% | 89% |

Improved Quality
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Improved Safety Performance
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| 27% | 37% | 22% | 86% |

Increased Schedule Certainty
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Reduced Waste Generated by Construction
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Improved Cost Predictability
| 16% | 43% | 22% | 81% |

GCs/CMs: Impact of Modular Construction on Seven Key Performance Factors (Percentages Reporting Medium, High or Very High Contribution for Each Factor)

Dodge Data & Analytics, 2020

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Improved Productivity
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Increased Schedule Certainty
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Improved Quality
| 20% | 40% | 30% | 90% |

Reduced Waste Generated by Construction
| 27% | 38% | 23% | 88% |

Improved Safety Performance
| 20% | 40% | 25% | 85% |

Increased Client Satisfaction
| 17% | 38% | 25% | 80% |

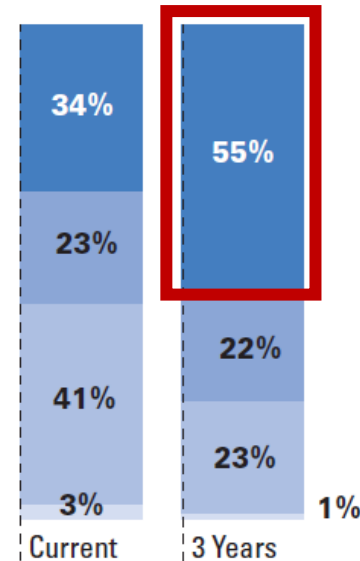Improving Safety Through Technology: A Tactical Guide to the Best Investments

Modular

BIM:

Driver for Modular

Percentage of BIM Users Engaged With Model-Driven Modular Construction
(Comparing Current Implementation Levels With Predicted Levels in 3 Years)

Dodge Data & Analytics, 2020

- Over 50% of Projects
- 25% to 50% of Projects
- Less Than 25% of Projects
- No (0%) Projects

	Current	3 Years
Over 50%	34%	55%
25% to 50%	23%	22%
Less Than 25%	41%	23%
No (0%)	3%	1%

55% on majority of projects in 3 years

Percentage of BIM Users Who Are Highly Engaged in Model-Driven Modular Construction (High/Very High Use, Current and Forecasted Over Next 3 Years)

Dodge Data & Analytics, 2020

- Currently Using BIM for Modular Construction at High or Very High Level
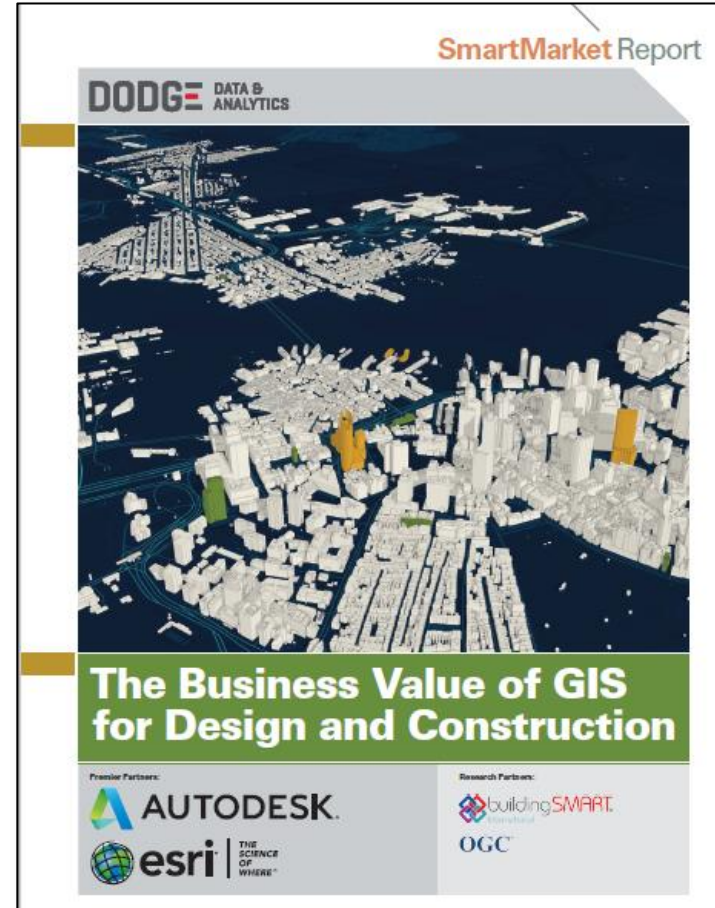- Planning to Use BIM for Modular Construction at High or Very High Level in the Next 3 Years

	Architects/Engineers	GCs/CMs	Trades
Currently Using	29%	38%	33%
Planning to Use	50%	53%	59%
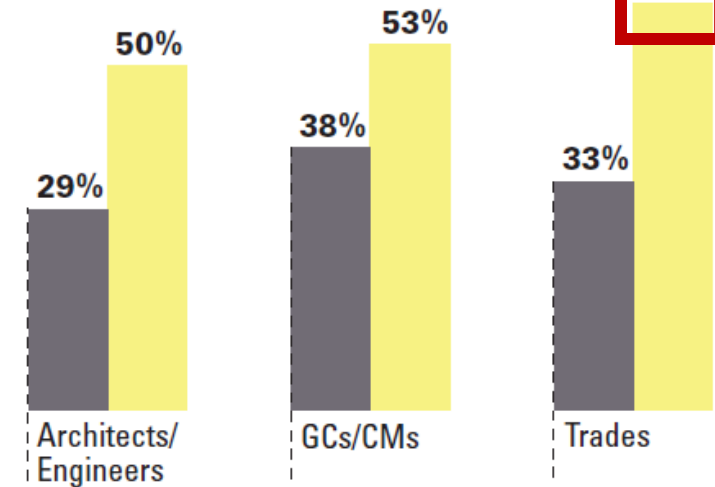
Especially trades

GIS for Design & Construction

Survey of Contractors, Architects, Engineers

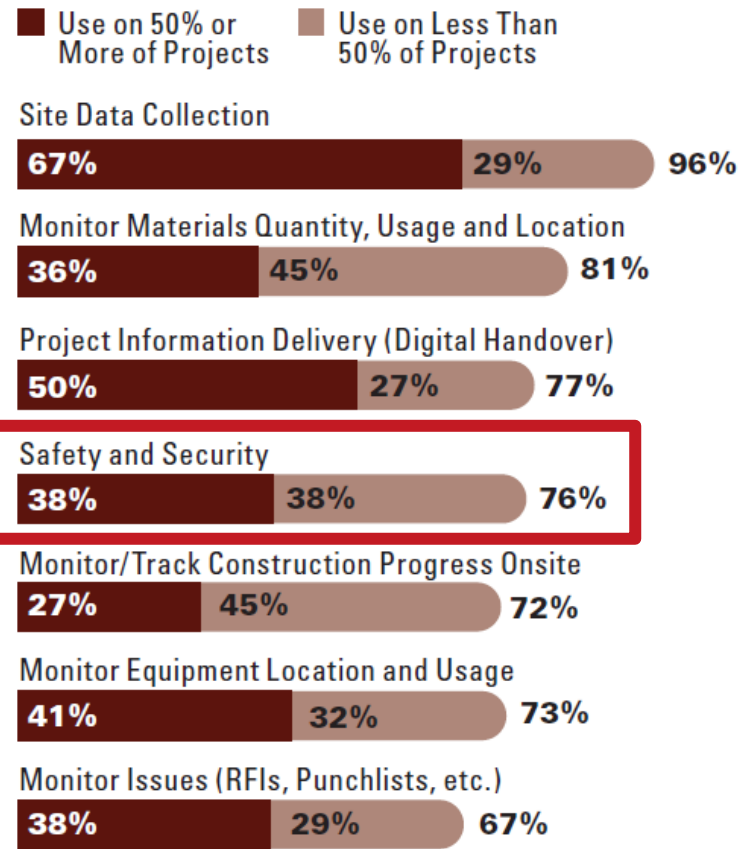FREE: www.construction.com/toolkit/reports

GIS for Design & Construction

Over 75% of GCs and Trades report use of GIS for safety and security

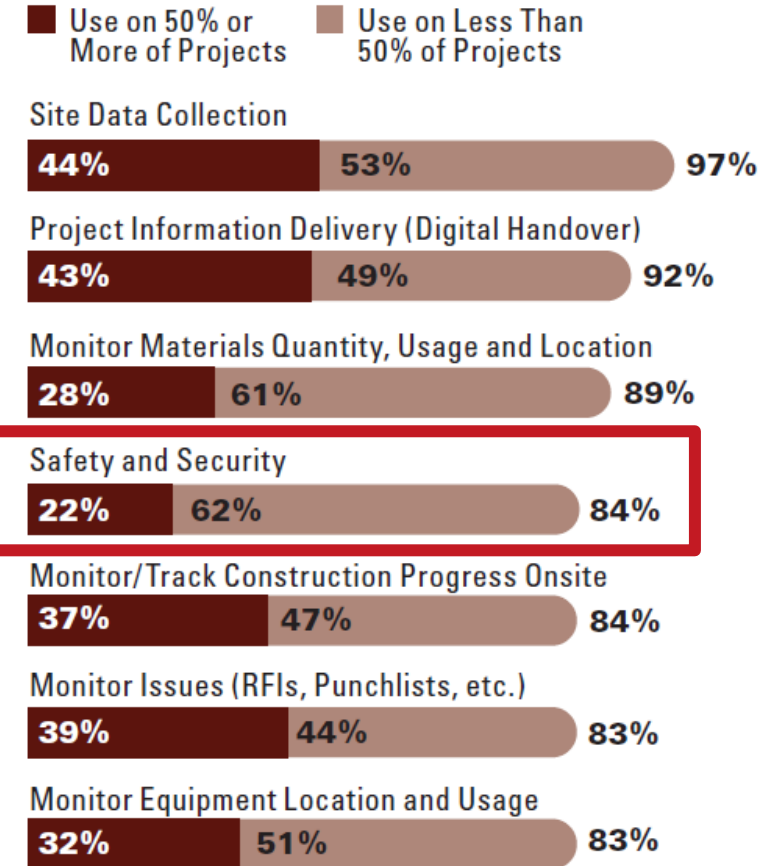- *38% of trades use on majority of their projects*

Frequency of GIS Activities by Specialty Trade Contractors

Dodge Data & Analytics, 2020

■ Use on 50% or More of Projects   ■ Use on Less Than 50% of Projects

Site Data Collection
| 67% | 29% | 96% |

Monitor Materials Quantity, Usage and Location
| 36% | 45% | 81% |

Project Information Delivery (Digital Handover)
| 50% | 27% | 77% |

Safety and Security
| 38% | 38% | 76% |

Monitor/Track Construction Progress Onsite
| 27% | 45% | 72% |

Monitor Equipment Location and Usage
| 41% | 32% | 73% |

Monitor Issues (RFIs, Punchlists, etc.)
| 38% | 29% | 67% |

Frequency of GIS Activities by GCs

Dodge Data & Analytics, 2020

■ Use on 50% or More of Projects   ■ Use on Less Than 50% of Projects

Site Data Collection
| 44% | 53% | 97% |

Project Information Delivery (Digital Handover)
| 43% | 49% | 92% |

Monitor Materials Quantity, Usage and Location
| 28% | 61% | 89% |

Safety and Security
| 22% | 62% | 84% |

Monitor/Track Construction Progress Onsite
| 37% | 47% | 84% |

Monitor Issues (RFIs, Punchlists, etc.)
| 39% | 44% | 83% |

Monitor Equipment Location and Usage
| 32% | 51% | 83% |

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Civil Contractors' Tech Investments

Civil Quarterly — DODGE DATA & ANALYTICS — 2020 No. 1

- Business Conditions in the Midst of the Pandemic
- Top Technologies in Use Onsite and Factors Impacting Wider Adoption
- Top Means of Improving Safety Onsite
- Owner Perspective: e-Ticketing is the Key to Improving Site Safety

FREE: www.construction.com/toolkit/reports

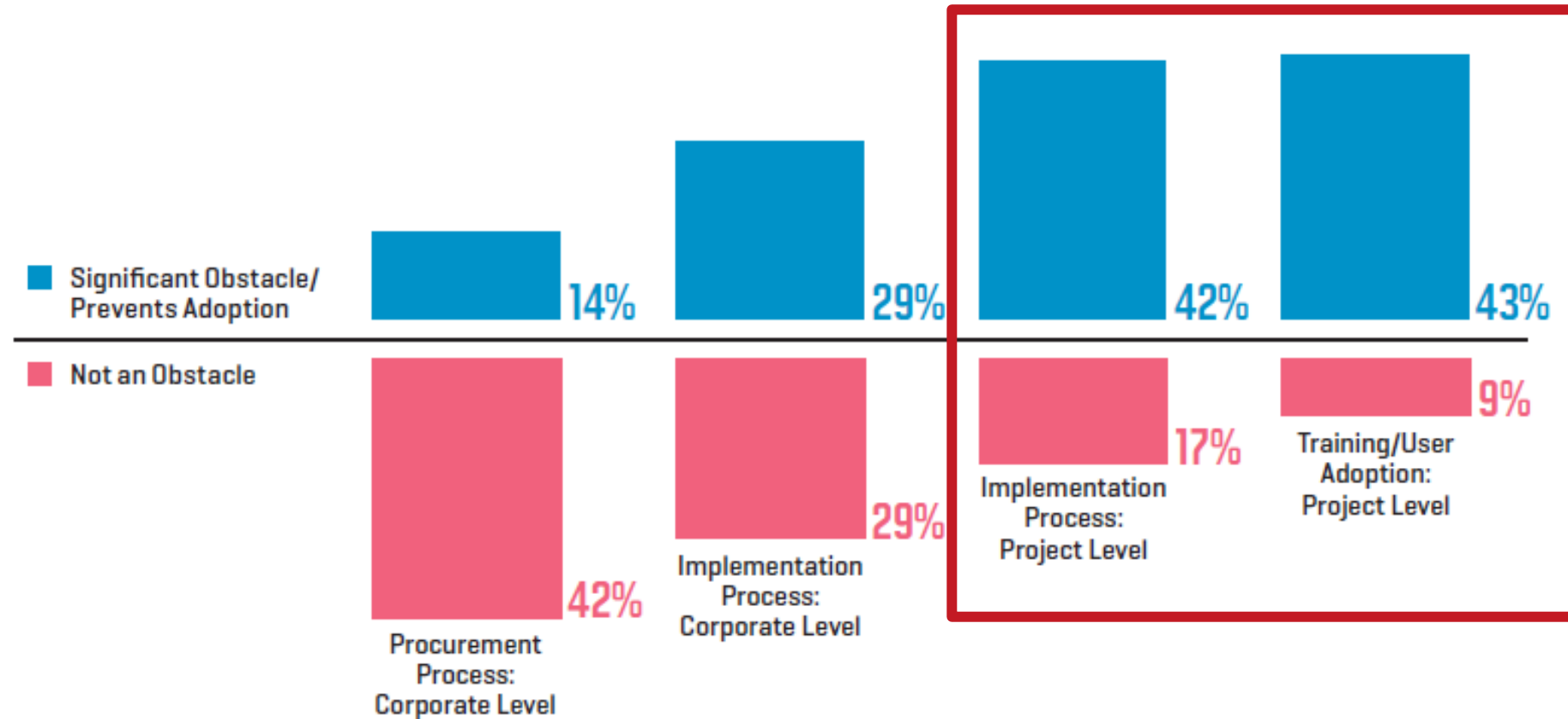## Most Important Benefits Expected From New Technologies (Selected in the Top 3)

Benefit	Percent
Increased Productivity	57%
Better Ability to Manage Project Budget	41%
Improved Safety Performance	40%
Improved Ability to Gather Data on Projects for Analysis	32%
Better Ability to Manage Project Schedule	30%
Improved Ability to Win Projects	28%
Improved Ability to Manage Workforce Onsite	26%
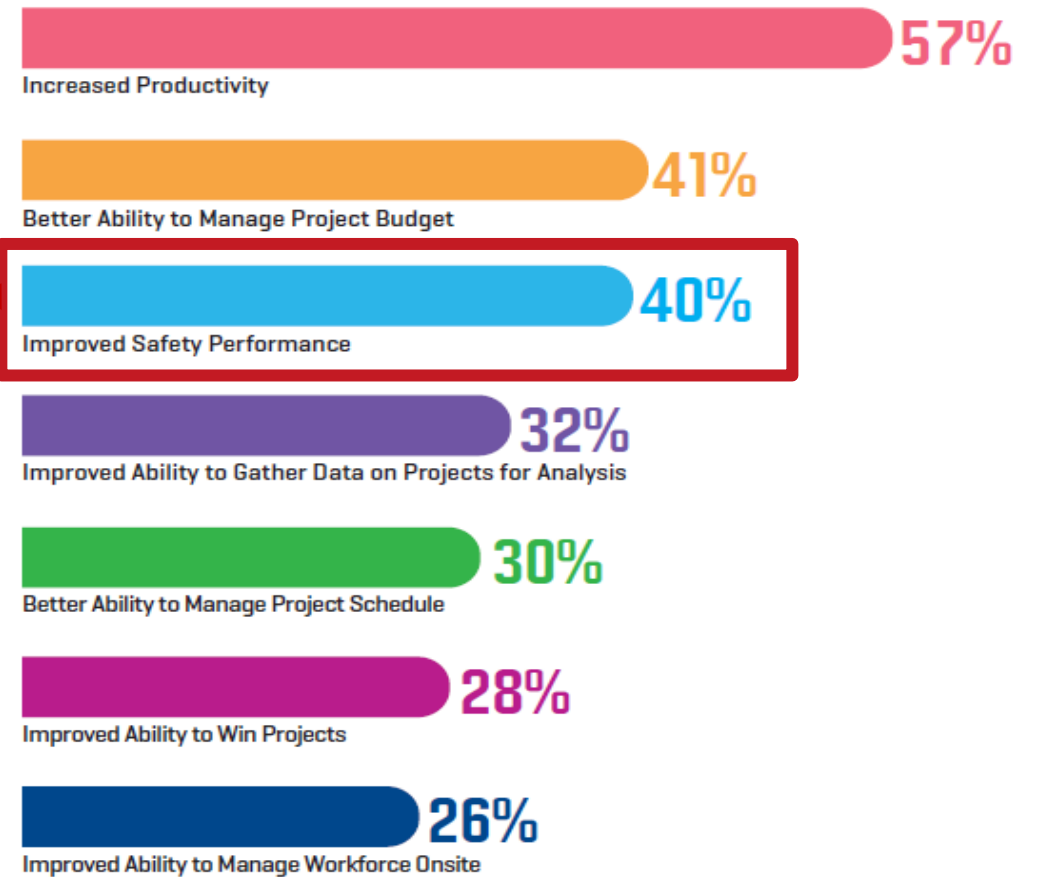
Civil Contractors' Tech Investments

Top obstacle to technology adoption:

- *Implementing at the project level*

Degree of Obstacles to Adoption of New Technologies

■ Significant Obstacle/Prevents Adoption

■ Not an Obstacle

| | 14% | 29% | 42% | 43% |

Procurement Process: Corporate Level — 42%

Implementation Process: Corporate Level — 29%

Implementation Process: Project Level — 17%

Training/User Adoption: Project Level — 9%

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BIM for Design & Construction

Survey of Contractors, Architects, Engineers, Owners

- *13 countries*
- *Released Sept 19*

FREE: www.construction.com/toolkit/reports

BIM for Design & Construction

Good response from contractors about health & safety-related benefits of BIM

- *Over 50% report all benefits studied*

Health & Safety Benefits From BIM at Moderate and High/Very High Levels (According to Contractors)

Dodge Data & Analytics, 2021

Reduced Number of Man-Hours Onsite

| 31% | 39% | 70% |

Improved Safety Awareness

| 31% | 37% | 68% |

Reduced Incident Frequency Rate

| 31% | 33% | 64% |

Reduced Environmental Impact

| 24% | 36% | 60% |

Reduced Insurance Premiums

| 26% | 28% | 54% |

■ Medium ■ High/Very High

BIM for Mechanical Construction

Survey of four types of mechanical contractors

- *Sheet metal/ducting*
- *Mechanical piping*
- *Plumbing*
- *Multi-trade*
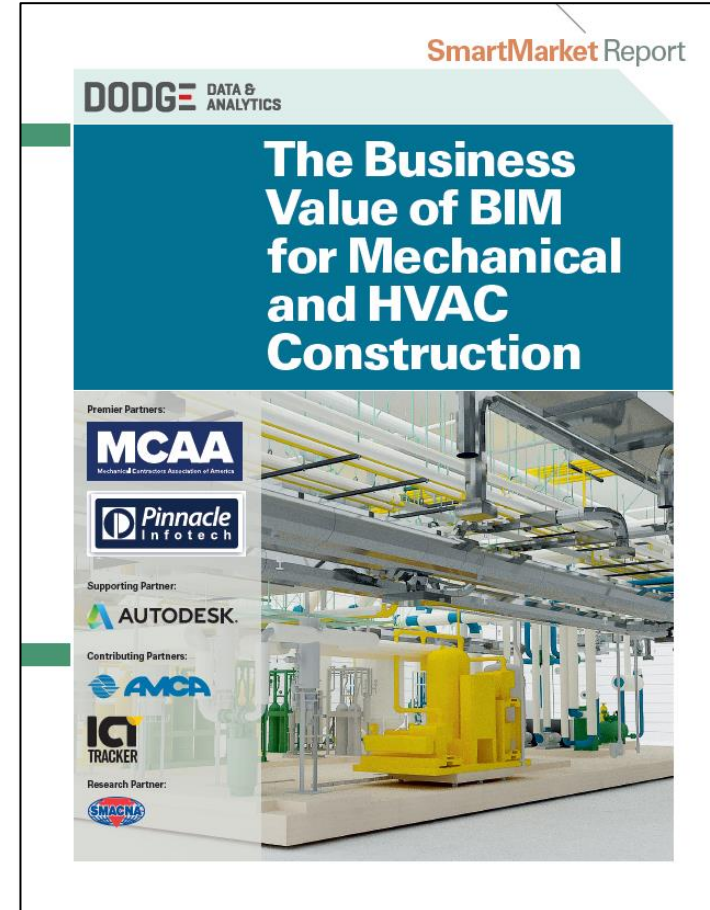
FREE: www.construction.com/toolkit/reports

BIM for Mechanical Construction

Good response from all types of mechanical contractors about impact of BIM on worker safety

- *79% report positive impact*
- *2d highest rating for "Much Better" (46%)*

Positive Impact From Using BIM to Prefabricate Versus Site Construction
(Percentage of BIM Users Reporting Improvement Compared With Site Construction)

Dodge Data & Analytics, 2020

Legend: Better (yellow) | Much Better (green)

Material Waste
42% | 48% | 90%

Labor Costs
43% | 45% | 88%

Quality of Installed Work
47% | 39% | 86%

Avoid Purchase of Extra Pipes and Fittings
45% | 40% | 85%

Schedule Performance
42% | 42% | 84%

Worker Safety
33% | 46% | 79%

Site Logistics Costs
36% | 35% | 71%

Improving Safety Through Technology: A Tactical Guide to the Best Investments

BIM for Mechanical Construction

Variations among the 79% by type of mechanical contractor

- *Most report 10% or more improvement, especially plumbing*

Positive Impact on Key Performance Metrics From Using BIM for Prefabrication Compared With Site Construction
(Percentages of Each Type of Contractor Citing Improvement)

	Sheet Metal/Ducting	Mechanical Piping	Plumbing	Multi-Trade
Worker Safety	67%	83%	73%	82%

Degree of Positive Impact on Worker Safety
(Percentage Reporting Each Degree of Improvement)
Dodge Data & Analytics, 2020

3% to 4%	5% to 9%	10% or More

Sheet Metal/Ducting
13% | 13% | 50%

Mechanical Piping
6% | 27% | 55%

Plumbing
91%

Multi-Trade
11% | 19% | 52%

Improving Performance With Project Data

Survey of contractors

- *Capturing data*

- *Using data for better decision-making*
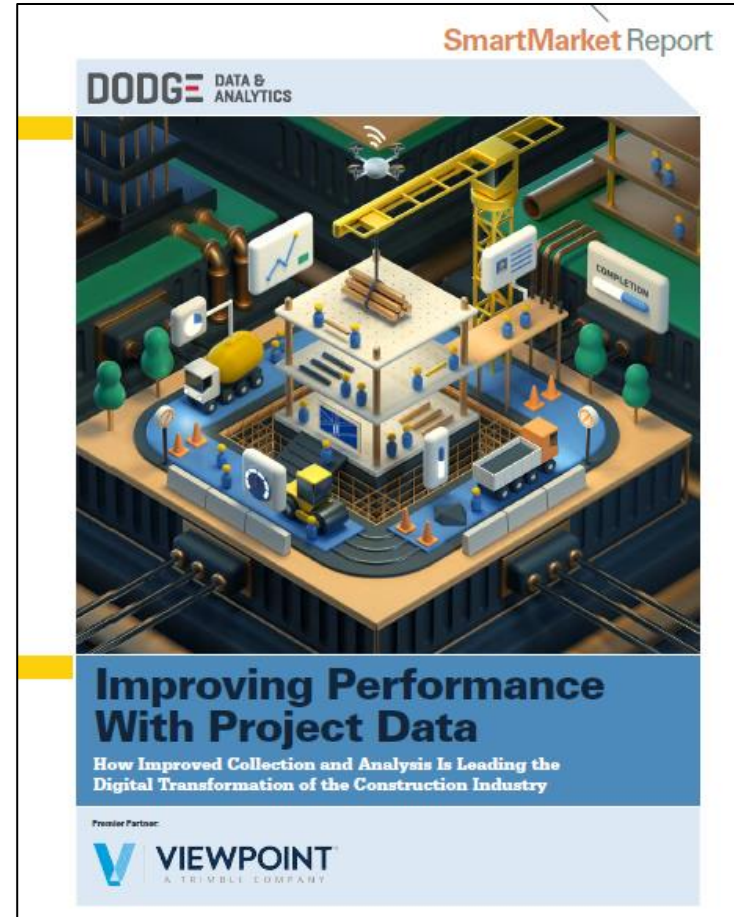
FREE: www.construction.com/toolkit/reports

Improving Performance With Project Data

Safety data:

- *Paper forms, spreadsheets were 73%*

- *Will be 21%*

- *Technology was 27%*

- *Will be 79%*

Means of Tracking Safety Performance Data
(Past, Current and Future)

Legend: Three Years Ago | Current Method | Three Years From Now

Safety Data

Category	Three Years Ago	Current Method	Three Years From Now
Paper Forms	34%	25%	6%
Speadsheets	39%	34%	15%
Custom-Designed Software	11%	20%	35%
Commercial Software	16%	28%	44%

Improving Safety Through Technology: A Tactical Guide to the Best Investments
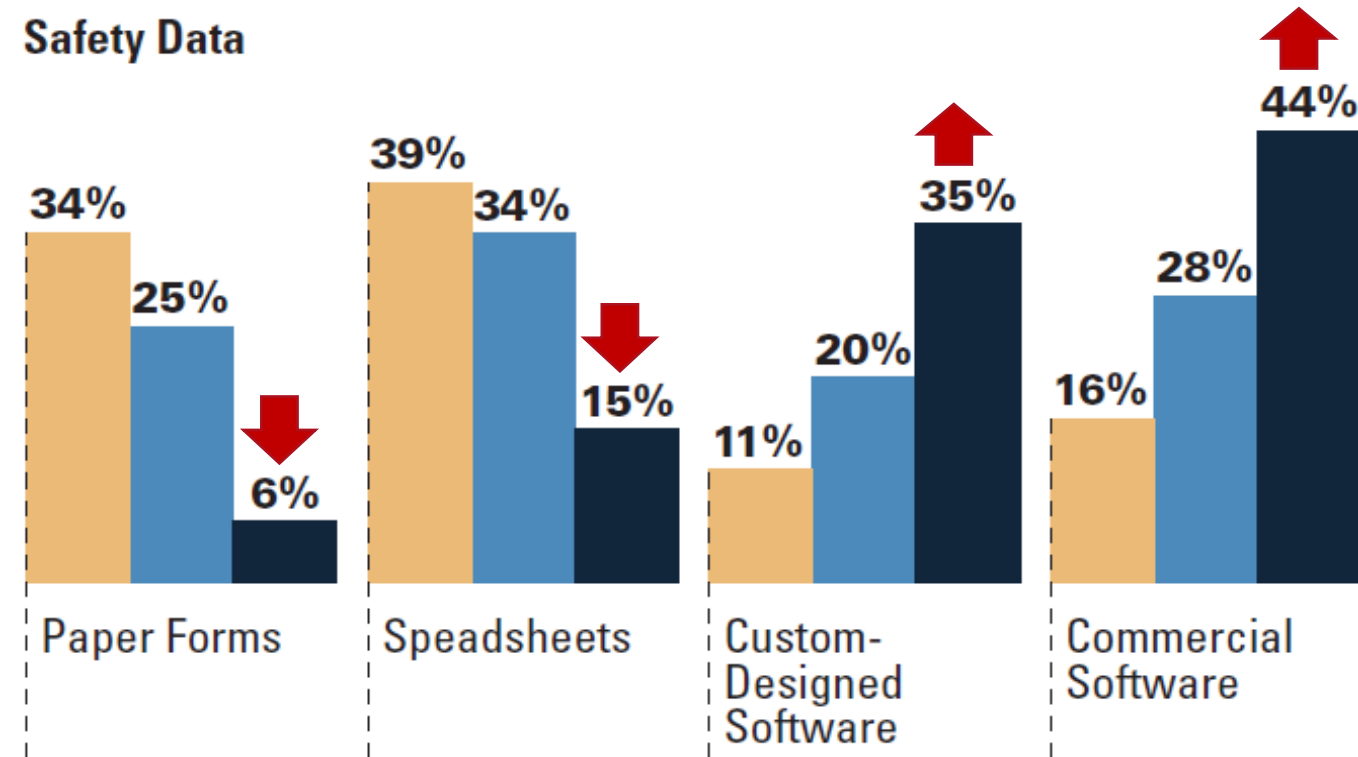
Improving Performance With Project Data

Safety performance improved when data capabilities improved

- *34% report improved safety*
- *48% of the larger contractors*
- *Half of the trade contractors gave it First Place ranking*

Project Benefits of Improved Capabilities
(According to Contractors Whose Data Gathering, Reporting and Analysis Capabilities Improved in the Last 3 Years)
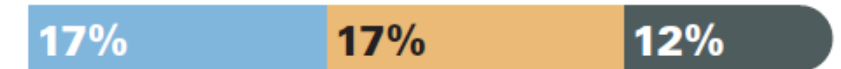
Dodge Data & Analytics, 2019

■ First   ■ Second   ■ Third

Better Ability to Complete Projects at/Under Budget

| 26% | 13% | 14% |

Greater Productivity

| 18% | 14% | 15% |
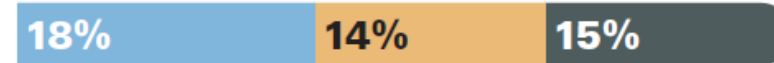
Greater Profitability

| 17% | 17% | 12% |

Better Ability to Complete Projects at/Under Schedule

| 8% | 20% | 8% |

Increased Safety on Projects

| 12% | 8% | 14% | **34%** |

(48% of large contractors)

Improving Performance With Project Data
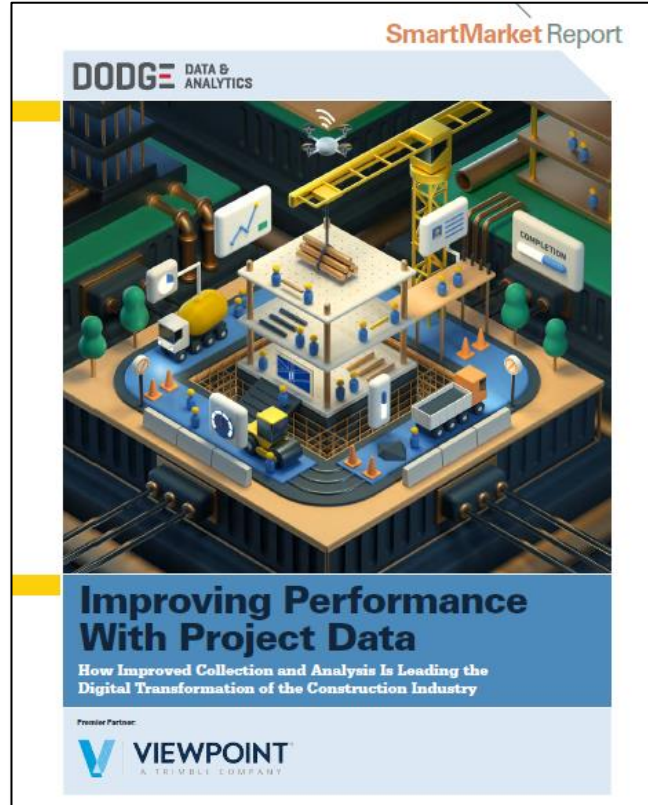
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Wearable Sensors and Safety (3pp)

Image Recognition Data for Safety Analysis

Safety Management 2021 (series)

Survey of contractors

- *Newest in a series for CPWR*
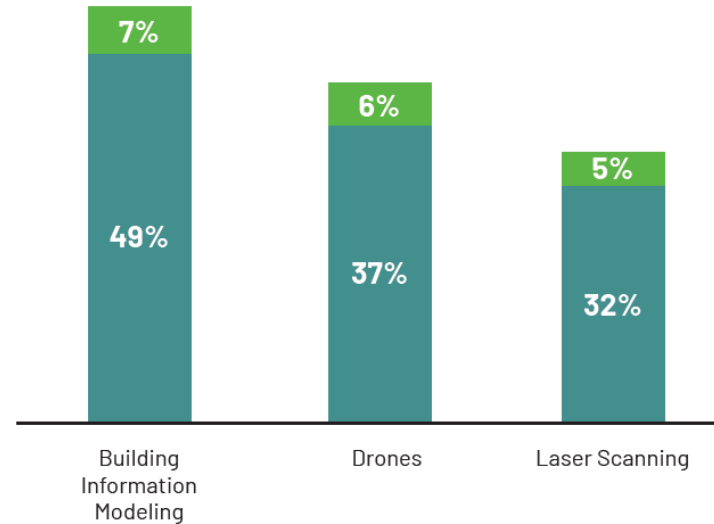- *Specific focus on data-driven safety*

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Safety Management 2021 (series)

Technologies being used for safety

- *Established*
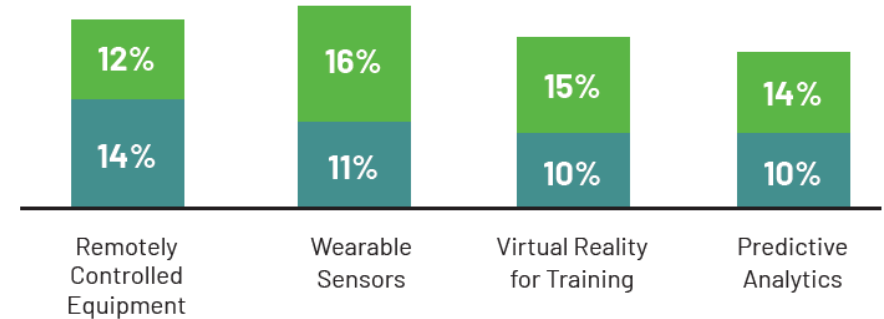- *Maturing*
- *Emerging*

Established Technologies
Dodge Data & Analytics, 2021

Building Information Modeling	Drones	Laser Scanning
7% / 49%	6% / 37%	5% / 32%

■ Expect to Use on Projects in 3 Years
■ Used on Projects

Maturing Technologies
Dodge Data & Analytics, 2021

Remotely Controlled Equipment	Wearable Sensors	Virtual Reality for Training	Predictive Analytics
12% / 14%	16% / 11%	15% / 10%	14% / 10%

Emerging Technologies
Dodge Data & Analytics, 2021

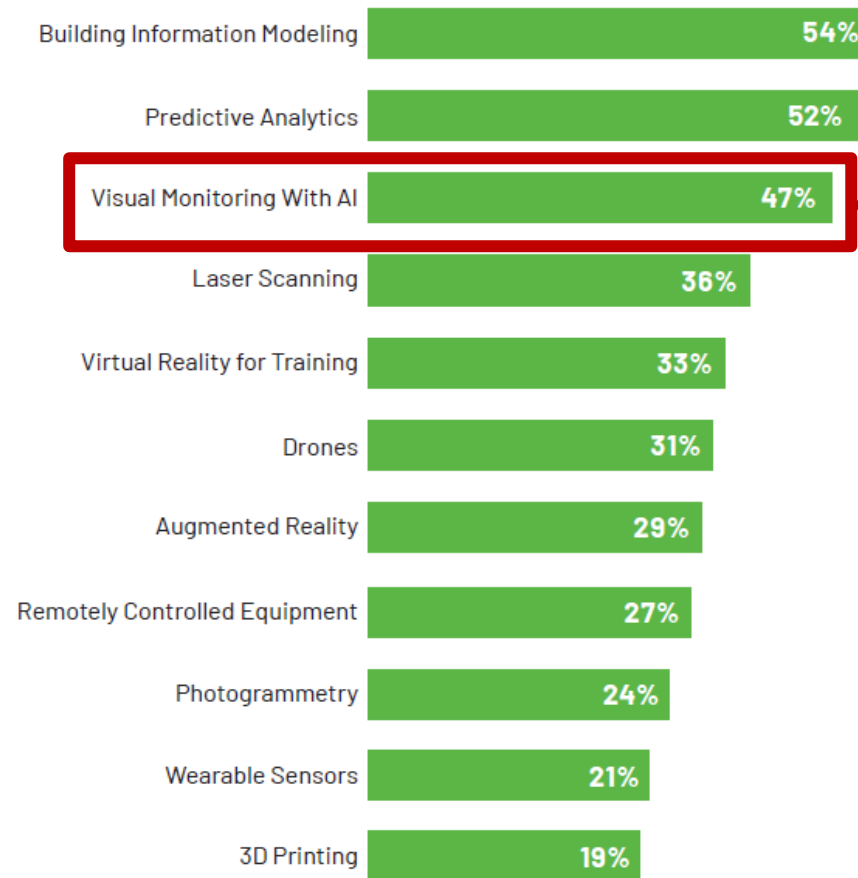| 3D Printing	Photogrammetry	Visual Monitoring With AI	Augmented Reality
3% / 8%	3% / 7%	9% / 5%	3% / 5%

Safety Management 2021 (series)

Visual monitoring with AI is "Poised for Growth"

- *Low percentage overall users*
- *High percentage of those are using it frequently*

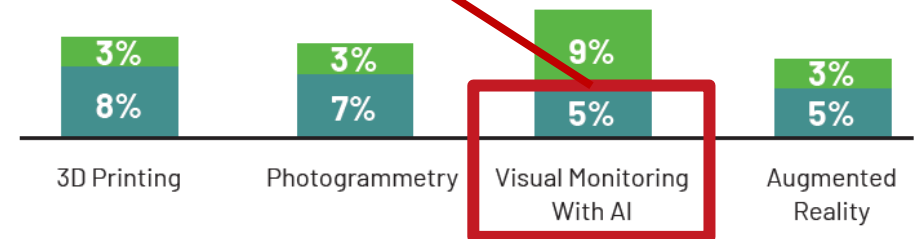**Share of Users Who Report Using Technologies Frequently/Very Frequently**

Dodge Data & Analytics, 2021
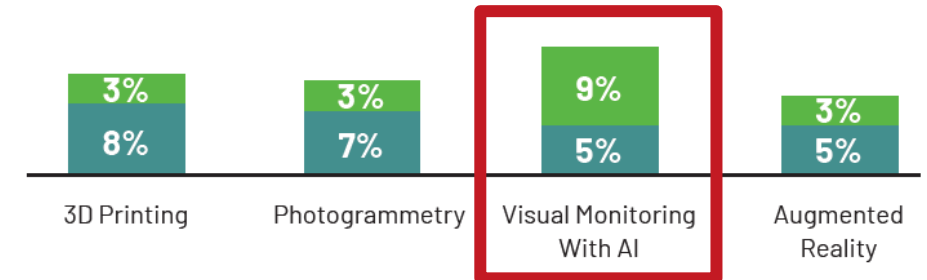
Technology	%
Building Information Modeling	54%
Predictive Analytics	52%
Visual Monitoring With AI	47%
Laser Scanning	36%
Virtual Reality for Training	33%
Drones	31%
Augmented Reality	29%
Remotely Controlled Equipment	27%
Photogrammetry	24%
Wearable Sensors	21%
3D Printing	19%

POISED FOR GROWTH
Although percentage using is small (5%), almost half of those (47%) do so frequently/very frequently

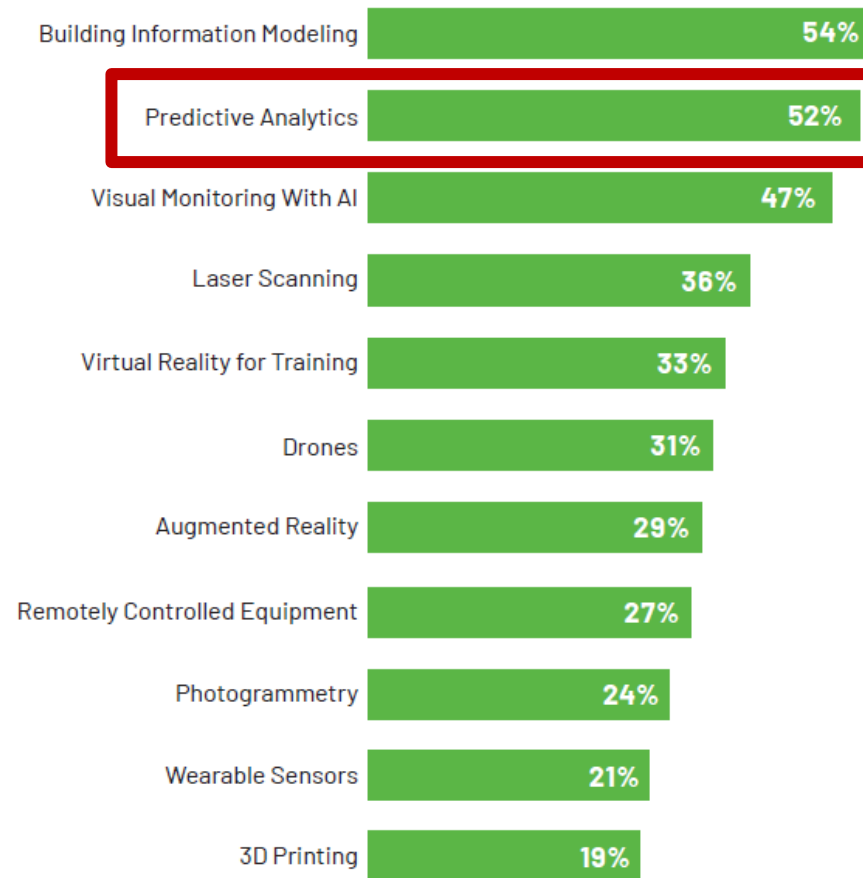**Emerging Technologies**

Dodge Data & Analytics, 2021

	3D Printing	Photogrammetry	Visual Monitoring With AI	Augmented Reality
(top)	3%	3%	9%	3%
(bottom)	8%	7%	5%	5%

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Safety Management 2021 (series)

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Share of Users Who Report Using Technologies Frequently/Very Frequently
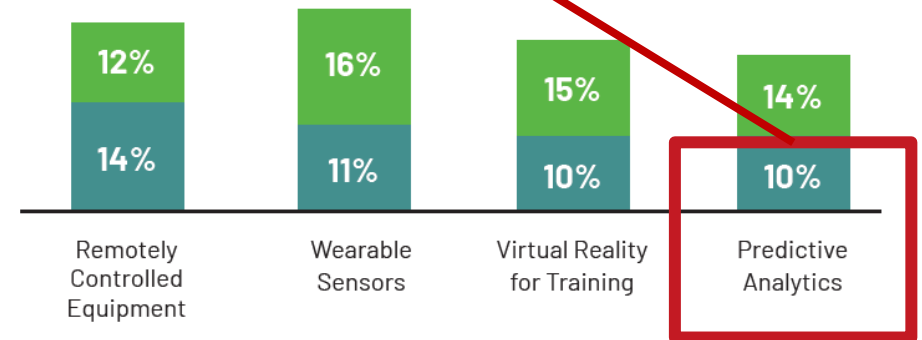Dodge Data & Analytics, 2021

Technology	Percent
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Virtual Reality for Training	33%
Drones	31%
Augmented Reality	29%
Remotely Controlled Equipment	27%
Photogrammetry	24%
Wearable Sensors	21%
3D Printing	19%

POISED FOR GROWTH
10% use but 52% of those do so frequently/very frequently

Maturing Technologies
Dodge Data & Analytics, 2021

	Remotely Controlled Equipment	Wearable Sensors	Virtual Reality for Training	Predictive Analytics
(green)	12%	16%	15%	14%
(teal)	14%	11%	10%	10%

Improving Safety Through Technology: A Tactical Guide to the Best Investments

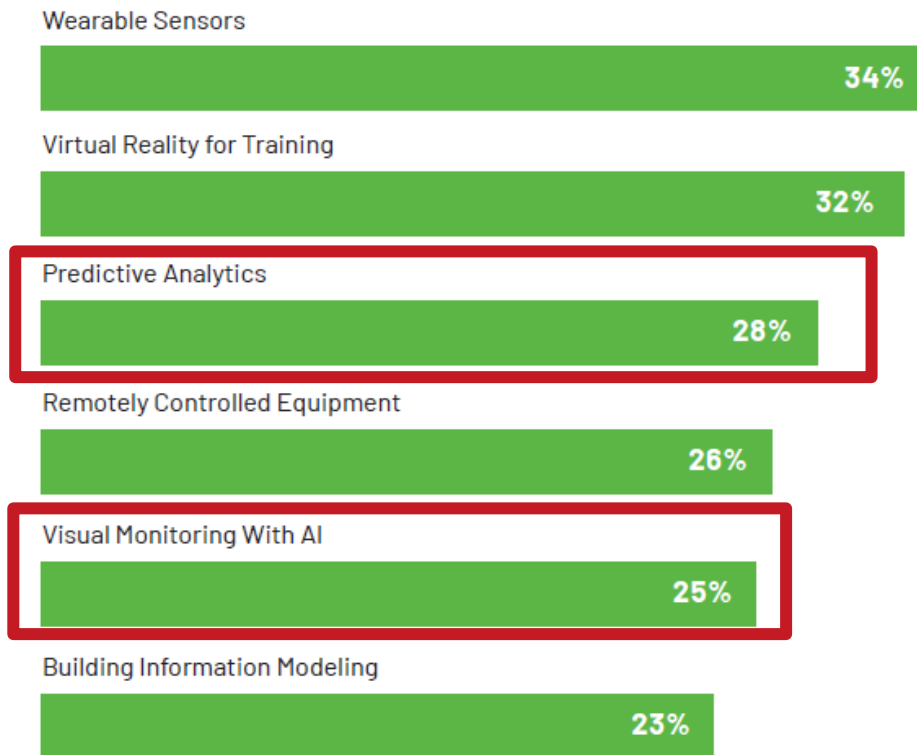AGC 2021 THE CONSTRUCTION ASSOCIATION CONVENTION

Safety Management 2021 (series)

Visual Monitoring With AI, Predictive Analytics selected among top 3 (out of 11) most likely to impact safety

Top Technologies That Contractors Believe Will Positively Impact Worker Health and Safety (selected in the top three)
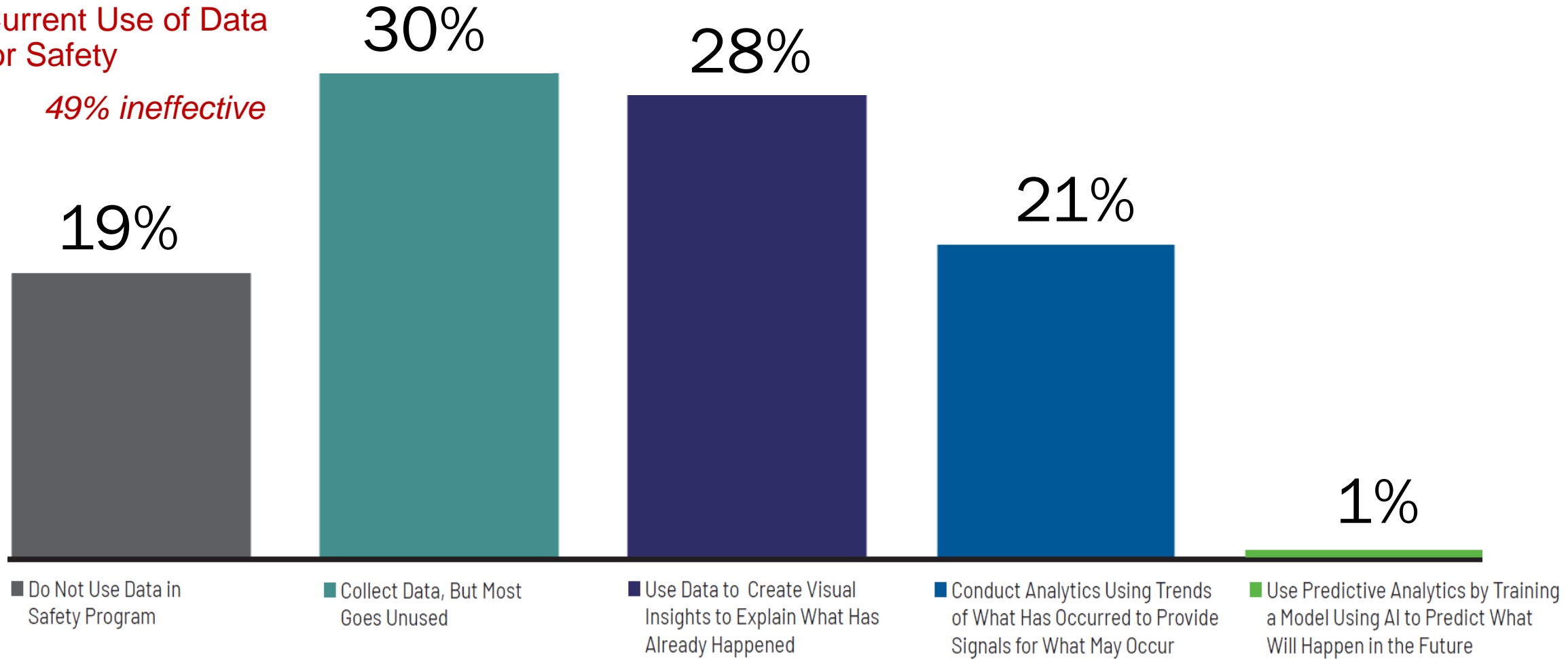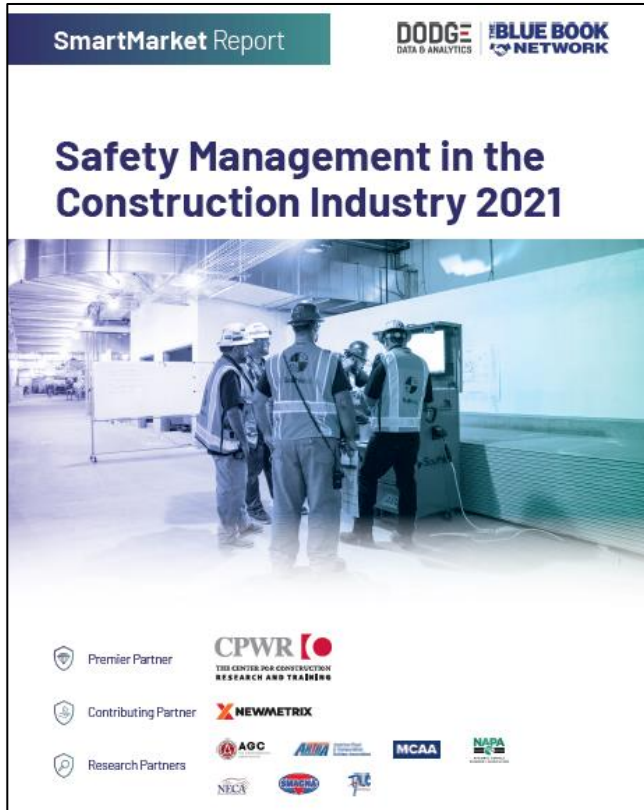
Dodge Data & Analytics, 2021

Wearable Sensors — 34%

Virtual Reality for Training — 32%

Predictive Analytics — 28%

Remotely Controlled Equipment — 26%

Visual Monitoring With AI — 25%

Building Information Modeling — 23%

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Current Use of Data for Safety

- *49% ineffective*

Bar chart values:
- 19% — Do Not Use Data in Safety Program
- 30% — Collect Data, But Most Goes Unused
- 28% — Use Data to Create Visual Insights to Explain What Has Already Happened
- 21% — Conduct Analytics Using Trends of What Has Occurred to Provide Signals for What May Occur
- 1% — Use Predictive Analytics by Training a Model Using AI to Predict What Will Happen in the Future

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Safety Management 2021 (series)

FREE:

www.construction.com/toolkit/reports

Predictive Analytics for Safety (2pp)

Safety Management 2021 (series)

FREE:

www.construction.com/toolkit/reports

Data-Driven Safety Culture

Safety Management 2021 (series)

8 Steps to Get Started

1. **Digitize inspections**

2. **Use the power of checklists**
   Inject safety into more processes, and then digitize the checklists.

3. **Focus on data availability**
   Make the data you have more available, and then look for more procedures to capture and make available.

4. **Create safety KPIs from the data**
   Communicate successes and opportunities for improvement.

5. **Create performance metrics**
   How well are the safety processes themselves being carried out and how long does it take to complete them?
   Use data to demonstrate that safety processes are not a bottleneck.

6. **Relate safety metrics to organizational performance**
   How are safety practices helping overall effectiveness?

7. **Insert instant checks**
   Places to simply and immediately record an observation—either as a stand alone (such as a hazard reporting app on everyone's phone) or as part of a larger operational checklist.

8. **Iterate and refine**
   "When you get to this point, you're not done," says Freivald. "You're always focused on safety."

Newmetrix Benchmarks

3 Metrics You Should Track But Don't

Key Metric #1 - Modified Incident Rate

Incident Types
Fatality
Lost Time
Rest. Duty / Xfer
Recordable
First Aid Injury
Property Damage
Near Miss

Actual Number of ALL Incidents *(can include subs)*

Actual Hours Worked *(can include subs)*

Hours in 100 Person-Weeks

$$\text{MIR} = \frac{\text{Incidents}}{\text{Hours}} \times 3{,}846$$

NEWMETRIX

Key Metric #1 - Modified Incident Rate

Target Value = 12.0

(Meaning 12 incidents should be reported for every 100 person-weeks worked)

Key Metric #2 - Average Incident Severity

- Each incident is assigned a Severity Value

  ○ Includes sub incidents

- The Severity Values are averaged over the reporting time period (week, month, year, etc.)

Newmetrix Std. Severity Scale	
Incident Types	Severity Value
Fatality	7
Lost Time	6
Rest. Duty / Xfer	5
Recordable	4
First Aid Injury	3
Property Damage	2
Near Miss	1

NEWMETRIX

Key Metric #2 - Average Incident Severity

Target Value = 2.3

(Meaning only a fraction of incidents reported should be recordables)

X NEWMETRIX

Key Metric #3 - Craft Observation Rate

How is the Craft Observation Rate (COR) Calculated?

Actual Craft Hours Worked

$$COR = \frac{Hours}{Observations}$$

Observations Made

NEWMETRIX

Key Metric #3 - Craft Observation Rate

Target Value = 100

(Meaning every craft worker should be engaged by

an observation every 2 ½ to 3 weeks)

NEWMETRIX

Steve Jones
Dodge Data & Analytics

Timothy Gattie, PE
Newmetrix

Thoughts, Comments, Questions?

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