Pain Points in the Use of Big Data Analytics for Transportation Project Delivery

Transportation Research Board Webinar
Sub-Committee on Information Systems in Construction Management

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Michigan Tech University

Panelists
Ron Perkins,
President, Jobsite Tech Group
Kelley Severns,
Bridge Engineering Research Lead,
WSP | Parsons Brinckerhoff is now WSP
Ches Maier,
Principal Consultant, Fair Cape Consulting
Pei Tang and Umesh Jois
Project Controls Manager, JCMS Inc.
Background & Objectives

• Significant progress in the area of transportation digital project delivery

• How can we critically analyze current methods to:
  • Identify unresolved pain points
  • Significantly add value to future projects.

• The speakers will analyze project experiences through the lens of big data analytics,
  • Identify opportunities presented by better organizing and analyzing digital project delivery data,
  • Developing intelligence that can improve decision-support for complex projects
INNOVATIONS FOR CONSTRUCTION

SUPPORTING INFORMATION MOBILITY | IoT | BIM

RON PERKINS
PRESIDENT | JOBSITE TECH GROUP

SPONSORED BY:
Ron Perkins
President | Jobsite Tech Group

BUSINESS
- JOBSITE TECH GROUP, LLC
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- CONSULTANT FOR:
  - HP
  - SYNNEX
  - DROPBOX
  - SMARTVID.IO
  - SAMSUNG
  - SHARP

SPEAKER
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- ENR CONSTRUCTION FUTURETECH
- AGC IT FORUM
- AGC BIM FORUM
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EDITORIAL | RESEARCH
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- BUILDING DESIGN AND CONSTRUCTION
- ENR
- CONSTRUCTION EXECUTIVE
- COMMERCIAL CONSTRUCTION RENOVATION
- AEC CAFÉ'
- DIXIE CONTRACTOR
- CALIFORNIA BUILDER & ENGINEER
- NEW ENGLAND CONSTRUCTION
- CONSTRUCTION NEWS
DESIGNS ARE CHANGING
PRE-FAB IS AFFECTING SUPPLY
TECHNOLOGY IS BEING DEPLOYED
BIM & VDC IS BECOMING A STANDARD
DRIVERS OF CHANGE

PROJECTS TAKING 20% LONGER TO COMPLETE
BUDGETS ARE EXCEEDED 80% OF THE TIME
R&D SPENDING LAGS BEHIND < 1%
TECHNOLOGY IS THE TOOL
Q4 2018
COMMERCIAL CONSTRUCTION INDEX

CURRENT USE OF ADVANCED TECHNOLOGIES BY CONTRACTORS

This quarter, contractors were asked about the use of advanced technologies in their construction projects. Over half (54%) of contractors report that they have used at least one of these technologies on their jobsites, with drones selected as the most widely used technology in this survey. Nearly three-quarters (74%) of contractors expect to adopt one or more of these technologies in the next three years.

Contractors indicated which technologies their companies were most likely to adopt in the next three years. Notably, all of the technologies included in the survey are expected to grow in use. Respondents expect drones, equipment tagging, wearable technologies and RFID tagging to be most widely adopted, with the use of wearables expected to increase by the greatest amount. These findings suggest that the commercial construction industry is beginning to embrace many of the emerging technologies available in the marketplace.

Current and Expected Future Use of Advanced Technologies Onsite by Contractors

- Drones: 34% Current, 39% Expected
- Equipment Tagging: 16% Current, 30% Expected
- Wearable Technology: 8% Current, 23% Expected
- RFID Tagging: 8% Current, 21% Expected
- Augmented and/or Virtual Reality: 6% Current, 17% Expected
- Reality Capture: 5% Current, 16% Expected
- Automated Equipment or Robotics: 5% Current, 14% Expected
- None: 26%
2019 Commercial Real Estate Outlook

Agility is key to winning in the digital era
VR market will generate $110 billion dollars compared to TV's $99 billion in 10 years.  
Source: Goldman Sachs Global Investment Research, IDC

Virtual Design and Construction (VDC) processes deliver...
- 50% time-savings in the design document phase
- 80% reduction in time to complete cost-estimate
- 60% fewer Requests-for-Information (RFIs)
- 7% schedule savings
- 600 total days direct schedule reductions
- Productivity increases of 25% or more
- 2.95% average direct cost reductions

Source: Top 5 Emerging Technologies for 2016 in Engineering & Construction by Red Vector

...VR and AR promise to transform AEC, but for many firms it’s still out of reach

Technology, including BIM, virtual and augmented reality, gaming, and 3D printing provide a wide range of opportunities to improve productivity throughout the project lifecycle, as well as attract new talent to the industry. http://facilityexecutive.com/wp-content/uploads/2016/01/TacklingProductivity.jpg

"momentum will continue to mount around cloud-based enterprise applications in 2016, according to a new survey of CIOs and other tech leaders."

"...virtual reality, human-to-machine collaboration, and wearable technologies will integrate into the building industry."

As an industry of professionals specializing in the design and construction and operations of a physical, spatial environment, we are uniquely suited to master this new virtual, spatial environment. If you haven’t begun to embrace these tools and embed them in your operations, what are you waiting for?
In the future, not only will IoT devices be used on the construction site, but they’ll be used throughout the building operations to give us continued insights on how that building is performing. There’s so much opportunity for IoT to support construction safety, quality, efficiency, productivity, and sustainability.

“The vision of the AR cloud will come to fruition in the next five to seven years,” says Adamek. “A virtual copy of everything on earth, including buildings, will be scanned and converted into 3D. All of this 3D will make up an entire, new virtual world that will be available for billions of users to step into via their persistent mobile connections.”

While there may be some attrition in the future, the most likely scenario is that robots will be used alongside human workers to augment their work, keep them safer and boost productivity. The current capabilities of existing robot combined with a growing labor shortage will probably lead to robots handling some of the more menial repetitive tasks, leaving the human worker to focus on other aspects of their job.

Drone use is skyrocketing in construction work, at a rate even higher than agriculture and manufacturing, data shows. Construction drone usage has skyrocketed by 239 percent year over year.

Drones are leveraging artificial intelligence and machine learning to find a stronger foothold in construction and other enterprise markets.
CHALLENGES IN AEC

COMMUNICATION
COLLABORATION
COORDINATION
INTEROPERABILITY
**Owner**
- On time
- On/under budget
- Efficient
- Sustainable
- Low maintenance
- Comprehensive As-Builds

**Architect**
- Capture client vision
- Design details
- Specify products
- Meet codes
- Collaboration
- Flexibly enforce standards

**Engineers**
- Building integrity
- Code compliance
- Coordinated systems
- Energy efficient
- NEW technologies (IoT)

**General Contractor**
- Achieve Scope of Project
- Control Budget & Schedule
- Manage Subs & Safety
- Minimize Change Orders
- Deliver project on time
- Comprehensive project handover

**Subcontractors**
- Stay on schedule & budget
- Order building products
- Coordinate with GC and others
- Adopt BIM practices if needed
- Use NEW tech-tools & services
- Install NEW technologies

**Supplier | Reseller**
- Support sales process
- Handle - PO, Invoice & Delivery
- Provide install or training on specialized products
- Stay current on AEC tech – BIM, IPD, Pre-Fab, UAV, Scanning

**Distributor**
- Pricing and Promotions
- Support VAR channel
- Training on new products and services
- Provide sales tools
- Logistics

**Manufacturer**
- Innovative products
- Sustainable designs
- Proper Go-To-Market
- Support BIM and other tech
- Educate Owners / Developers
- Pre-Fab R & D

**PROJECT TEAM**
COMMUNICATION | COLLABORATION | COORDINATION | INTEROPERABILITY
INNOVATION
HP DesignJet MFP solutions solve some of the toughest challenges in the construction industry. Stay up-to-date and focused on building with the complete portfolio of products from HP. Designed to fit your unique requirements, printing, scanning solutions and accessories, like the HP DesignJet Rugged Case make it easy to transport and protect your MFP from onsite damage.

“The HP DesignJet T830 printer enables us to scan and print virtually anywhere we choose, which frees up a lot of resources and helps us work more efficiently. It is currently sitting in a dusty trailer but that less than ideal environment hasn’t affected its performance. Compared to some of the plotting devices we have used in the past, which needed serious effort to move, it’s night and day. This machine is truly portable.”

Maurice Clarke
Virtual Design and Construction Manager

Versatile Jobsite Plotter Has More Than 253 Shades of Gray
Source: ENR Magazine
December 21, 2015
“A lot of our markups that we will do in Bluebeam for example it is very helpful to have that in color….comments from the architect in green, you’ve got comments from the contractor in red, you got comments in blue from the engineer...to be able to print in color is very helpful... Its very important to have that ability to print be able right there onsite, it really helps minimize the time it takes to get an updated submittal...”

Jason Jones, Technology Director
O’Neal, Inc.

“The majority of the subs still build off of their shop drawings at the end of the day which is produced from the model but its paper drawings that they are producing from the model that they’re building off of.”

Jason Waddell, Director of Construction Technology Development
Batson-Cook

“There was a definite benefit of being able to get one sheet, one pertinent bit of information, whether it was a plan or a detail or a section whatever the case may be. Being able to print that on the spot the most up to data from our Bluebeam PDF session. That was a very good benefit to have and it was received very well...”

Maurice Clarke, Virtual Design and Construction Manager
Hensel Phelps Construction Co.

“There are times where there are particularly tough areas where its easier just to print out that view or a couple of views there and get around the group and they can easily mark it up.”

Benjamin Crosby, Director of BIM / VDC
W.G.Yates & Sons Construction
• Printing BIM models for better collaboration
• Scanning marked up models to send to BIM Manager for Revit® modifications
• Printing in color supports LEAN and reduces latency on the jobsite!
• INSTANT PRINT AND THE TARGETED PRINTING SUPPORTS THE BIM PROCESS AND KEEPS US INTO IT
1. Print on demand is the new normal
2. HP and others are embracing the digital workflow in product design
3. Print/Scan incorporated into digital workflow shortens RFI roundtrip
3D Scanning Technology permits precision measurement, imaging and comparison for production and quality assurance in the design, building and restoration industries. Inspections, planning or documenting structures in 3D, laser measurement technology allows companies to maximize efficiencies and improve processes.

“A lot of this wouldn’t happen at all without scanning and 3D models. True, it’s exactly what surveyors have been doing for a long time, gathering 3D coordinates, but what we have now is a system and method that can collect all these 3D data points incredibly quickly. We’re solving the same problems—defining shapes and surfaces—but we’re doing it a heck of a lot quicker, and in a way that is perceived as exciting.”

Simon Barnes, RICS, CEO of Plowman Craven
Hand Tape: multiple personnel, 100s of points per day

Total Station: 1 or 2 personnel, 500+ points per day

GPS: 1 or more personnel, 1000+ points per day

Laser Scanning: 1 personnel, 1,000,000+ points per second
VERSATILE

• Rapid, simple and complete recording of the current status of buildings and building sites.

• Millimeter-accurate measurement of large environments and objects in only a few minutes

PORTABLE

• Immediate processing of the data in all commonly used CAD programs.

ACCURATE

• Simple variance comparison in the construction process and in the case of final building inspections.

USER-FRIENDLY

• Greater transparency, greater legal certainty in claim management.

• Data is available for the entire building lifecycle.
SCANNING | AS-BUILT | VERIFICATION | ARCHIVE
According to Intel, the aerial survey made the survey far quicker and less expensive. The Stone Arch inspection saw a cost savings of approximately 40 percent, and across both projects, the drone inspection reduced overall workhours by 28 percent. (Read More)
SCANNING | DISRUPTION
VR has captured the imagination of architects seeking the ultimate experience for design and creation. Likewise, AR has captivated contractors, seeking the “ultimate stud-finder” to assist in layout and inspections.

Unlike VR, which fully immerses participants in an artificial environment, AR enhances the experience of the real world by incorporating contextual information when and where it is needed. AR will be more integrated into our everyday lives than VR, and a much larger market opportunity in construction and facilities maintenance. The sweet spot for AR lies at the intersection and overlay of domains of information.
VIRTUAL REALITY (VR) | AUGMENTED REALITY (AR)

PHYSICAL MOCK-UP
12 WEEKS

VIRTUAL MOCK-UP
2 WEEKS
“Manipulating large and complex Revit® files to convey critical information pertaining to a high profile, mega project can be a daunting task. Utilizing visualization tools such as Samsung Gear VR, VIMAec™, and Unity enabled our project team to communicate more effectively, collaborate in a virtual environment, and minimize project delays - therefore minimizing cost impacts.”

Alexa Malusky
Virtual Design and Construction Engineer.
"We use VR to communicate with our project staff and the owner on how we are building the job. The value of augmented reality is being able to take the model in the field. "You can see the work that is real and virtual overlaid on top of each other. We can identify scheduling, coordination and production impacts."

Brian Krause
Director of Virtual Design and Construction
Clark Construction

"It’s powerful and adds another dimension to the way in which we can de-risk the project, "Pixels are cheaper than bricks."

Chris Mayer
Chief Innovation Officer
Suffolk

"Some benefits accrue to the client, because they have a better sense of the structure they will have when it’s done, but other benefits accrue to the contractors and engineers,"

Jim Dray
Chief Information Officer
Thornton Tomasetti

"Our biggest clients are requesting to have VR on their future projects – proof enough that it’s been a great success. It not only benefits our clients but also benefits our own project teams and estimators."

Wade Martin
Virtual Design and Construction Coordinator
Brasfield & Gorrie

AR enables Pepper Construction to understand scale, check placement of mechanical, electric and plumbing or other equipment as a way of assuring quality control and will inspect a site before a concrete pour to check sleeves and imbeds are in place and in the right spot.

Jennifer Suerth
Vice President of Technical Services
Pepper Construction Co.
VIRTUAL REALITY (VR) | AUGMENTED REALITY (AR)

BENEFITS

• Immersive experience
• Realistic presentations
• Free roam walk-throughs
• Easy to Use
• Improves collaboration
• Retains all BIM data
• No need for Revit® to view
• Cloud based
• No file size limits
VIRTUAL REALITY (VR) | AUGMENTED REALITY (AR)
VIRTUAL REALITY (VR) | AUGMENTED REALITY (AR)
BIM is used both for the design of a structure and is very much driving the innovation in the field of construction. The “I” in BIM stands for Information. This information is used downstream throughout the project’s lifecycle for planning, designing, analysis, fabrication, construction and ownership.

GCs and CMs have known this for years: the value of a BIM model to them is if they can positively impact downstream processes like coordination, scheduling, estimating, and field layout.

What good is a model if it can’t tell the story of project cost, time, and quality?
The Smart Jobsite: BIM in the Field at Turner Construction Company

Before the Field
Turner Construction Company uses Building Information Modeling (BIM) throughout the life of a project. Starting early in the design phase, Turner works with designers, trade subcontractors, and owners to identify the risks ahead on the job and leverage the use of BIM to control that risk. This includes applications such as 3D virtual trade coordination, estimating, scheduling, constructability reviews, and logistics planning. Early planning is integral to the implementation of BIM throughout the rest of the project process.

Eliminating Surprises:
Laser Scanning to Capture Existing Conditions
Turner uses laser scanning to capture detailed geometric information about existing conditions and has used the scanning process on 85% of all BIM projects to rapidly and accurately produce a model-based representation of existing conditions for the project team. This process often uncovers information about existing conditions, identifying variances from as-built documentation and deficiencies in surfaces not being level or plumb due to settlement or improper placement. This information can be critical for alterations or additions.

Scientific Management of Work:
Visual Production Control™
Turner captures jobsite material information in several ways, using tools such as Radio Frequency Identification (RFID) tags and barcodes, and can represent that information visually in digital models for a user-friendly, rapid project status updates. Reviewing the ideal and curtainwall tracking images below, it is easy for the project team and the owner to quickly understand which materials are on site, in place, or not yet installed. This accurate and up to date record keeping can be used to identify issues with supply lines or rapidly adjust the project schedule.

Building in Quality:
Model-Based Layout with Robotic Total Stations
With model-based layout, Turner takes traditional survey methods further and adds precise location coordinates from the model. This helps Turner leverage detailed models built for trade coordination or other purposes and accurately lay out building systems in the field exactly as planned during the 3D model-based coordination process. Model-based layout not only increases the level of layout precision, but also takes less manpower than traditional layout methods. This confidence and productivity is based on the accuracy of the BIM model.

Offsite Construction
Prefabrication of Systems and Assemblies
The use of BIM enables Turner’s subcontractors to prefabricate a wider variety of building systems than was possible in the past. Prefabrication from a coordinated model assures project team members that building elements will be fabricated and installed just as modeled. Prefabrication has other advantages as well: prefabrication work that is complete offline under controlled conditions improves safety and quality. Building systems that have been pre-assembled can be rapidly installed, requiring less time than traditional methods.
BIM in the FIELD
BIM in the FIELD

- Bringing information closer to the work area
- Save time - View Forms, RFI’s, Drawings with no travel
- Extend the Trailer – hold coordination meetings and safety briefings at the “BIM” Box

“Placing a DataVault in the work area will guarantee two hours of time savings per day. For each floor you move up you can add an additional 30 minutes of productivity”

Jason Jones | VDC Director
Miron’s Ci Hubs are essentially modified gang boxes equipped with a TV monitor, computer, printer, and file-synchronizing software. A complete synchronized system provides the construction team with the building information model and the digital drawing set right where they need it, just in time, and always current. **Crews are trained to use the unit and provide everyone on site (including subcontractors) with increased efficiency due to the ability to not only view plans, sections, and details, but print them!**
• Faster access to the data
• Increased confidence in the build and reduced mistakes
• Improved Building Information Modeling Integration
• Reduced wait times
• Improved durability, security and mobility
• Connectivity
• Productivity - Building Information Modeling (BIM) access directly at the jobsite
• Mobile Work Environment - Reach nearly every job on the construction site during any stage of construction.
• Securing Assets - KNAACK® quality steel box is built to protect against theft and resist jobsite conditions.
For builders, the case for return on investment is straightforward. Drones are cheaper to fly than manned aircraft and faster than human surveyors, and they collect data far more frequently than either, letting construction workers track a site’s progress with a degree of accuracy previously unknown in the industry. With the right computing tools, builders can turn sensor data into 3D structural models, topographical maps, and volumetric measurements (useful for monitoring stockpiles of costly resources like sand and gravel). Collectively, that intelligence allows construction companies to more efficiently deploy resources around a job site, minimize potential issues, trim costs, and limit delays.

According to a March 2016 report from Goldman Sachs, construction will be the largest use case for commercial drones in the immediate future, generating $11.2 billion of the projected $100 billion in global spending over the next five years.
Preconstruction survey, topographical measurements, project progress, and even as-Designed/as Built become concise and efficient using unmanned aviation solutions. The Yuneec H520 is designed to fly repeatable, perfect-placement flight over construction sites, providing not only measurable and demonstrable project data, but also helping to identify shrink points, at-risk areas, or security breach points.

“We’ve mapped 1,400 acres of Brasfield & Gorrie job sites. Over the next five years, we hope to use drones on most, if not all, of our 200-plus job sites. People often think of drones and reality capture as a future concept, pie-in-the-sky dream, but at Brasfield & Gorrie we’re seeing real value using UAS today.”

Hunter Cole
Virtual Design & Construction
THE TECHNOLOGY CONTINUUM IN DESIGN AND CONSTRUCTION

THE OFFICE  THE TRAILER  THE JOBSITE  THE FIELD  FACILITIES MANAGEMENT
Bain predicts that by **2020 annual revenues could exceed $470B for the IoT vendors** selling the hardware, software and comprehensive solutions.

McKinsey estimates the Internet of Things (IoT) has a potential economic impact of **$2.7-6.2 trillion USD until 2025**

General Electric predicts investment in the Industrial Internet of Things (IoT) is expected to top **$60 trillion during the next 15 years**.

IHS forecasts that the IoT market will grow from an installed base of 15.4 billion devices in 2015 to **30.7 billion devices in 2020** and **75.4 billion in 2025**.
The Internet of Things (IoT) has a potential economic impact of 2.7-6.2 trillion USD until 2025.

Who will capture this opportunity?

McKinsey & Company
THE LEADERS ALL HAVE IoT STRATEGIES
Commercial buildings had 518 million connected “things” in 2016.
A building is constructed with HVAC, lighting, security & access, safety, and water management systems that contain sensors for management and tracking.

Facilities managers and owners have access to tools, applications and services that enable monitoring of devices.

Applications and tools create detailed and actionable reports.

Integrates information with company’s financial, security and accounting systems.

Facilities managers and owners can pinpoint areas of service, areas for energy improvement and benchmark facility.

Building occupants’ experience, more secure systems and more satisfaction with building environment.
Internet of Things in Construction

IoT in a Commercial Building

- Mobility & Customization
- Occupant Comfort & Environmental Control
- Energy Consumption Monitoring
- Building Functionality & Area Sensors
- Detailed & Actionable Reporting
Example
Curing the Concrete Pour

Solution
Embedded concrete sensor and real-time mobile app

Solution
inSite Monitor: Skanska’s custom IoT product for real-time environmental monitoring

SOURCE: SKANSKA
The Smart City sees an even larger adoption with the use of 1.6 billion connected things.
AECOM Hunt's Innovation Center in Indianapolis supports several Midwest U.S. projects in implementing BIM.
“Suffolk is ahead of the curve, using machine learning to analyze data, predict risk, and deliver better buildings.”

Jit Kee Chin
Executive Vice President and Chief Data Officer
“BIM is evolving very rapidly as new software and processes are developed. Some of the things Skanska is pioneering include the use of drones, virtual reality, laser scanning and leveraging gaming technology to easily navigate models.”

“We are also using cloud-based systems for quantifying and estimating, and for project collaboration.”

Mark King
VIRTUAL DESIGN & CONSTRUCTION MANAGER
SKANSKA USA

Innovation

Our innovation services continue to evolve alongside technology’s exponential growth. As pioneers in construction and project development we are not bystanders to the future of our industry – we are its builders. We are actively pushing our people, our projects and our industry forward with today’s most exciting emerging technologies to deliver on the needs of our clients.

Mark King
VIRTUAL DESIGN & CONSTRUCTION MANAGER
SKANSKA USA
Remote operation
Remote Support
Supply replenishment
Tool tracking
Equipment tracking
Vehicle tracking
Personnel tracking
Remote usage monitoring
Augmented Reality (AR)
Building Information Modeling (BIM)
Power and fuel savings
Security and Remote Monitoring

VALUE PROPOSITION

THE INTERNET OF THINGS
NEW WORKFORCE?
What is your BIM strategy?

What is your VDC strategy?

What is your IoT strategy?
RON PERKINS
RPERKINS@JOBSITETECHGROUP.COM
In 5D Integrated Project Controls

Dr. Pei Tang, Umesh Jois
JCMS, Inc.
January 25, 2019
Project Controls Support Decision Making
Challenges in Project Controls
(Data Collection, Modeling, and Analysis)

Garbage In, Garbage Out

YOUR ANALYSIS IS ONLY AS GOOD AS YOUR DATA

\[ f(\text{garbage}) = \text{garbage} \]
Poor Communication/Coordination Affects Data Collection
BIM Visualization & Sole Data Source
Improve Project Controls
Existing 4D Practice - Animation

1. Create Schedule
2. BIM Model

Linking
Few Successful 5D Cases
Limited Usage for Project Controls
Is Animation the Purpose for 4D?

FAKE VS REAL
Learn from 2D Planning and Scheduling

- Contractors’ Involvement
- Procedure and Results
- Animation is not the only result;
Proposed 4D Practice

**Results:** Animation & CPM Schedule

**Process:** Improved Communication & Coordination
Other Challenges in 4D for Project Controls

- Who Should Build 4D
- Level of Details
- Dynamic Updates
We drive BIM,
Not BIM drives us!
Pain Points of Creating Contract Language for BIM for Bridges

Kelley C. Severns, PE, PMP
Bridge Engineering Research Lead - WSP USA
BIM - Bridge Industry

EXCHANGE - Bridge Design Plans - Bid - Fabrication to Construction

1. Exchange Requirements
   IFC Bridge Design Information Exchange US have been developed.

2. Industry Outreach
   Workshop hosted by FHWA for the bridge design industry was held in August 2015.

3. Standards Roadmap
   NCHRP study to develop a roadmap and workshop to share with industry was held in May 2016.

4. Implement IFC-Bridge
   The next step is to implement IFC within the bridge community to exchange bridge information.

5. Deploy for Construction
   The final step is to update contracting frameworks for design and construction.

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Gaining Momentum

- Establish standards, guidelines, or manuals to facilitate the wide use of IFC as an exchange standard.
- Develop the national standard MVD, data definitions, and data requirements for the model life cycle for all data exchanges.
- Collaborate with stakeholders to provide timely update of IFC data dictionary for common bridge elements.
- Collaborate with buildingSMART and software vendors to design and offer suitable training.
- Establish a forum/expert hub for practitioners in the bridge industry to promote the common modeling formats and share experiences.
- Develop a template of BIM for Bridges and Structures-specific contractual provisions for managing risks associated with IFC-BIM for bridges and structures.
Contact

Kelley C. Severns, PE, PMP
Kelley.Severns@wsp.com
Pain Points of Creating Contract Language for BIM for Bridges

Francesca Maier, PE
Principal - Fair Cape Consulting
Bigger Issues

Sustainable Program

Fewer Claims

- Confidence and Mutual Trust
- Repeatable Data
- Transparency
- Real-Time Feedback
- Digital prototyping

Staff Retention

- Fewer Issues
- Improved Safety
- Less Exposure to Equipment
- Defensive Body Position
- Job Satisfaction
- Less Manual Data Entry
- Collaboration

February 2019
BIM Timeline

- **Graphical Design**: Database 3D Models
- **Database Design**: Graphical 3D CADD Models
- **STEP published as ISO Standard**: Work starts on IFC
- **Ad Hoc Use**: IFC 2x published as ISO Standard
- **Standardization**: Construction Automation
- **Rapid standardization for Buildings**: Rapid adoption for Buildings
- **Urgency for standardization for Bridges**: Technology Firehose

- **1990**: Transportation Research Board Webinar
- **2000**: February 2019
- **2010**:
A New Framework

- Interoperable Data Standards
- Deliverable Standards
- Review Criteria
- Training
- Contract Language
- Level of Development

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## Level of Development

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**LOD 200**

**LOD 400**

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Deliverables

- Discipline Models
- Organized Metadata
- Document Management
- Planned Data Exchanges
- BIM Goals and Objectives
- Federated Model
- Delineated Responsibility
- Production Manual
- LOD Definitions
- Interoperable Data
Contracting Issues

- Limits of Liability
- Joint Authorship
- Mutual Reliance
- Consistency Across Contracts
- Allocate New Liabilities

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Contact

Francesca Maier, PE
ches@consultfaircape.com

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Fundamental pain point: Communication

- Communication, Collaboration, Coordination
  - Improve communication between GC and Sub on BIM projects
  - Differences in priority of stakeholders often proves to be a major hindrance to communication
  - Need to develop channels for effective communication to field creating the “Digital roundtrip”

- Interoperability
  - Multiple data sources are capturing large datasets from many different sources – particularly IoT technologies
  - Integration and sense making of this data remains a challenge.
Communicating with BIM

• BIM a language for communication:
  • Between stakeholders
  • Across different processes, from design to bidding, to construction and commissioning,

• A need for development of
  • Standards, governance, and specific contractual provisions in and around BIM.
  • Exchange formats and data models at the appropriate level of development and granularity
  • Stakeholders held accountable: reflected in contract documents.

• Practice caution in adopting standards from buildings to transportation.
• Need for interoperable data standards
BIM in Project Controls

- Underlying 4D models should reflect project and schedule realities
- Use of project controls methods using BIM only as successful as the correctness of the underlying models and information developed
- Uniform interpretation: how do model elements represent change orders, and perceived associated risks by each involved stakeholder.
- Involve contractors and sub-contractors in tying 3D and 4D models to schedule that can be used for project control.
Path Forward

Questions to be considered:

• What are the short-term, immediately resolvable challenges – low hanging fruit?

• What are the long-term challenges that require further knowledge development?

• What resources are necessary to address the short-term, and long-term challenges? This could include synthesis, problem statement ideas, or research directions