Webinar Series Summary

A series of eight webinars was delivered during the period November 2013 – November 2014. This webinar series was planned to provide a cohesive and successive series of best practices. The first webinar provided an overview to the series. The second through fourth webinars covered use of 3D models in planning, design and construction. The fifth through seventh webinars addressed typical challenges and implementation strategies, while the final webinar introducegd future uses of 3D models. The list of webinar titles and live delivery dates is in Table 1.

Table 1: Webinar Titles and Live Delivery Dates

Webinar Title	Live Delivery Date
Overview of 3D Engineered Models for Construction	November 20, 2013
Creating 3D Engineered Models	January 8, 2014
Applications of 3D Models in the Construction Office	February 19, 2014
Applications of 3D Models on the Construction Site	April 2, 2014
Managing and Sharing 3D Models for Construction	May 7, 2014
Overcoming Challenges to Using 3D Engineered Models for Construction	September 10, 2014
Steps to Requiring 3D Engineered Models for Construction	October 15, 2014
The Future: Adding Time, Cost and Other Information to 3D Models	November 19, 2014

Webinar Planning

The webinar series was delivered with the volunteer support of subject matter experts from across the country. Guest speakers from nine state DOTs, one local authority, five contractors, two construction organizations, two consultants and FHWA Head Quarters provided technical presentations to fulfill a prepared lesson plan and learning objectives. Guest speakers were invited; they were recruited by a process of word-of-mouth, professional interactions, presentations at industry conferences and past participation on AASHTO committees and Technology Implementation Groups.

Audience polls were designed to maintain audience interest and participation. Long and open-ended questions were asked immediately before the webinar started to maintain interest for those who had connected early. From the second webinar onwards, standard demographic questions were used to characterize the audience. Shorter poll questions were used to break up the technical presentations. The poll responses have helped to capture a national state of the practice to contrast the best practice illustrated by the technical presentations. It is important to hold the poll results in the context of normal stated preference survey bias.

Guest speakers prepared their own presentation materials, which were then consolidated and formatted for consistency. There was a practice run one week in advance, using the consolidated slides and polls. On the day of the webinar, all speakers connected thirty minutes prior to the live run.

Marketing started the day after delivery of the previous webinar. Webinars were marketed through email distribution of the flyer and registration link, as well as through the 3D modeling website. Email distribution lists were used:

- EDC coordinators in FHWA Division offices
- Contacts at AASHTO, ARTBA and AGC distributed to their members
- The registration link was in the sidebar of the weekly EDC News email
- Registrants of the previous webinar were given a 24-hour advanced notification
- A list of all prior registrants of webinars

Webinar Delivery

Webinars were delivered through the National Highway Institute Adobe Connect classroom. This provides the visual presentation of pre-loaded PowerPoint slides and poll questions. An AT&T conference call line was used for audio. An audio bridge between the room and the conference call allowed audio to be broadcast via Voice Over IP (VOIP) in the Adobe Connect classroom.

For the first webinar, a room with a maximum of 200 connections was used. However, this webinar was over-subscribed more than a week in advance of the broadcast and for subsequent webinars a room with 500 connections was used. The second and third webinars were also over-subscribed. The webinars were consistent in achieving a peak audience to registration ratio of approximately 0.60:1. Peak attendance consistently occurred approximately 30 minutes into the webinar. From the second webinar onwards, the number of viewers per connection was tracked. The average number of viewers per connection over the whole series was approximately 2.5. Table 2 summarizes registration and attendance statistics.

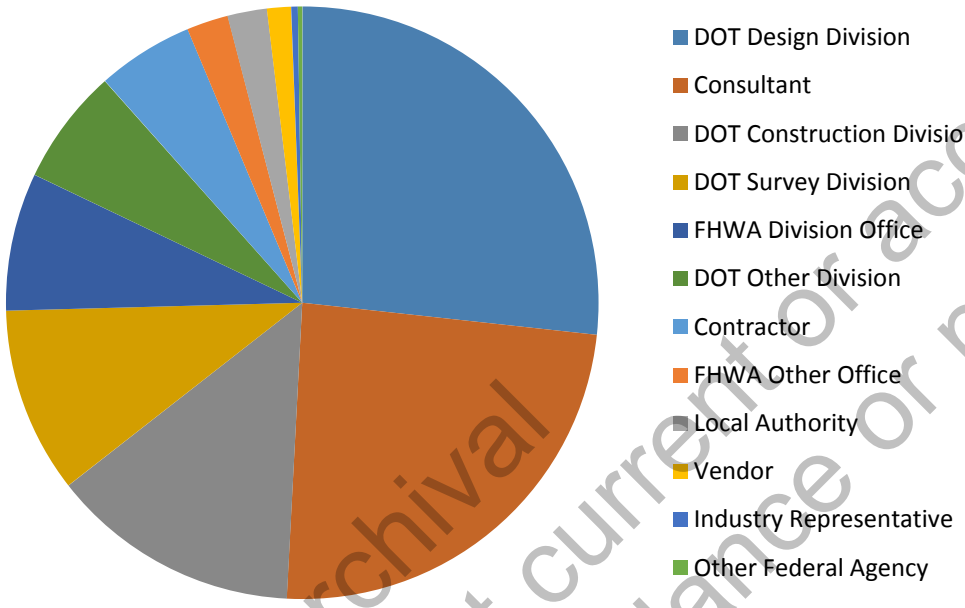
Table 2: Webinar Registration and Attendance Statistics

Webinar	Available Connections	Registration	Peak Attendance	Peak Attendance : Registration
1	200	200	144	0.72
2	500	500	320	0.64
3	500	500	303	0.61
4	500	271	169	0.62
5	500	355	199	0.56
6	500	301	155	0.51
7	500	195	129	0.66
8	300	300	154	0.51
Total	**3500**	**2622**	**1573**	**0.60**
Average		**328**	**197**	**0.61**

From the third webinar onwards an attempt was made to characterize the audience by job function. More than one quarter of the audience was made up of DOT Designers. Consultants represented almost a quarter, as did the combination of DOT Construction and Survey staff. Another one fifth of the audience comprised FHWA Division Office staff, other DOT staff and Contractors. The final five percent

of the audience was comprised of staff from other FHWA departments and federal agencies, local authorities, vendors and industry organizations. Figure 1 is a pie chart representation of the overall audience.

Figure 1: Overall Webinar Audience Job Functions



Unfortunately, several technical issues were encountered in webinar delivery. The most common issue was with the VOIP audio broadcast. At times it was intermittent and in Webinar 6 it ceased to function approximately 26 minutes into the webinar. On some webinars with large registration the VOIP was not enabled, however many of the participants preferred the VOIP to telephone audio, especially those broadcasting to conference rooms. In future, webinars should include the need for telephone audio in the marketing materials. Other technical issues involved dropped connections and asynchronous slide progression. These issues were minor and are typical of webinar interfaces.

Overarching Themes

At the start of the webinar series, only half of respondents recognized that their agency used 3D modeling already to some extent. By the second webinar, responses to a similar question showed only about one quarter did not recognize the existing use of 3D modeling within their agency. As the series progressed, the poll questions became more sophisticated, and the responses indicated that the viewers' knowledge was keeping pace.

This rapidly progressing understanding of the role of 3D modeling in highway design and construction was also shown by a growing sophistication in the questions asked. Early questions were frequently about basic hardware and software or the relationship between 2D plans and 3D models. By the third webinar questions delved deeper into the specific content of 3D models and how that content related to construction activities.

Some topics were recurring. It became clear that most contractors used entirely different 3D modeling software to that used for design development. The format and content to deliver to contractors pre-bid was frequently returned to, and the consensus was that LandXML alignments, profiles, coordinate geometry and surfaces were preferred, but that 3D line strings were also important in any CAD format. Disclaimers were consistently the most common approach to handling perceived liability associated with delivering 3D models to contractors, both pre-award and post-award. It became acknowledged that it was possible to develop sophisticated 3D models during design, but that added design cost and the value of doing so was not clear. Providing simpler 3D models that were used to create 2D plans with a disclaimer emerged as a popular compromise, but by the sixth webinar more than three-fourths of respondents indicated that they were expanding the use of 3D modeling for design and more than half acknowledged adding more detail to design models.

The most common uses of 3D models in construction were for checking quantities and executing earthwork and excavation construction with Automated Machine Guidance (AMG). Use of AMG for paving is growing, as is the use of 3D models for planning construction means and methods, especially crane lifts. The use of 4D and 5D modeling is small, but there is a lot of interest. Contractors were recognized to be much more sophisticated creators and consumers of 3D models in construction than owners. The most significant challenges identified were a lack of guidelines and best practices, a lack of expertise and training, and the ability to learn new methods while responding to accelerated deadlines for design.

Next Steps

The biggest gap identified was the use of 3D models by owners for construction engineering and inspection. The fourth and sixth webinars showed some best practices, but these were still evolving. It may be reflective of the captive audience (less than 15% from DOT Construction), but the majority of consultation for 3D modeling implementation appeared to be with DOT designers, contractors and consultants. The important role that DOT construction and survey staff should play in setting policies and procedures for implementing 3D Engineered Models for Construction did not seem to be broadly recognized.

The use of 3D modeling for construction engineering and inspection has the potential to bring large safety and efficiency benefits to the owner and can play a significant role in the proliferation of e-Construction. Post-construction surveying to develop 3D digital as-built records is one focus area for the 3D modeling activity under EDC-3. There is an opportunity to connect the use of 3D digital as-built records to measurement and acceptance workflows and continue to support this area under EDC-3.

Webinar 1: Overview of 3D Engineered Models for Construction

Date and Time of Live Broadcast: November 20, 2013, 1:00 pm
Recording Link: https://www.youtube.com/watch?v=11en-f8xGfA

Description

This webinar was an overview of the past and current state of 3D engineered models in the A/E/C industry. Each presenter showed the history and current state of adoption from a different perspective, including that of contractors using the tools to build, designers using 3D to design, and DOTs using 3D Engineered Models for all phases of a project's life. Common terminology and methods were presented and defined, and metrics for value gained by application of 3D engineered models was put forth. Also under discussion was the common barriers to and legal framework for adoption. Finally, some specific instances of the application of 3D+ modeling and related tools were presented for consideration.

Learning Outcomes

After this webinar, each participant will be able to:

- Use terminology to describe using 3D Engineered Models for Construction
- Describe the history and developments that have made 3D modeling for construction accessible
- Describe the qualitative and quantitative benefits of using 3D Engineered Models for Construction
- Identify barriers to adopting 3D Engineered Models for Construction

Speakers

Presenter: Rich Juliano
Position: Senior Vice President
Company: American Road & Transportation Builders Association
Topic: Overview from Contractor's Perspective

Rich represented the contracting community's perspective on 3D modeling, starting with the legislative direction from MAP-21 (Moving Ahead for Progress in the 21st Century Act). He noted that several sections refer to and encourage the use of 3D models, and that funding-based incentives for the application of these technologies is provided for. A position paper issued in 2012 by the AASHTO-ARTBA-AGC Joint Committee closely aligns to the MAP-21 provisions, providing several best practices for electronic data sharing between DOTs and contractors. Finally, it was pointed out that the field of vertical construction is well ahead of the horizontal and civil field, and contractors will be an instructive resource.

Presenter: Bryan Cawley
Position: Construction Management Team Leader
Company: FHWA Office of Infrastructure
Topic: Overview of the EDC-2 Activity for 3D Engineered Models for Construction

Bryan presented on the basis of 3D design and the tools and technologies which may be utilized once 3D is implemented. Clash detection, automated quantity takeoff, 4D modeling, 5- and 6- D modeling, and Automated Machine Guidance are briefly described. Through surveys, it is shown that the application of 3D engineered models increased productivity by substantial margins. Case studies on alternative delivery projects from Texas confirm the value brought to projects by 3D engineered models, which included benefits such as time savings, reduced rework, and improved public relations. Bryan also

noted that the major challenges to be overcome involve access to and provision of training, the technical issues of implementing new software, and the institutional resistance to change. Workshops, webinars, and other resources were outlined for 2014 which will aid stakeholders in the adoption of 3D engineered models.

Presenter: Dan Belcher
Position: Project Manager
Company: Michigan Department of Transportation
Topic: DOT Perspective on 3D Engineered Models

Dan identified that 3D engineered models are already in use, and identified reasons for expanding the use of 3D modeling. From Michigan DOT's perspective, contractors already use 3D modeling and related technologies to save time, reduce rework, and improve the quality of the constructed product. Michigan DOT believes that providing models at bid will greatly enhance the bid process for contractors', enabling innovation. Dan pointed out that the challenges to be overcome are: training staff, applying as-yet-unknown standards, and developing robust QA/QC workflows.

Presenter: Alexa Mitchell
Position: CAD Services Engineer
Company: Missouri Department of Transportation
Topic: DOT Perspective on Creating and Delivering 3D Models for construction

Alexa's presentation reiterates many of the benefits of applying 3D Engineered Models, especially the reduction of change orders, conflicts between disciplines, and the value contractors have found using AMG. From the experience of the Missouri DOT, there are 8 deficiencies:

- Lack of guidelines and synthesized best practice
- Lack of funding for technical infrastructure
- Lack of consistency in technical advances
- Lack of available expertise
- Lack of investment in technology and the hardware required to support it
- Accelerated deadlines which require work and do not allow for re-training
- Lack of consistency of modeling formats from contractors

Presenter: Eric Cylwik
Position: Senior Virtual Construction Engineer
Company: Sundt Construction
Topic: Contractor's Use of 3D engineered models in Bidding and Construction

Eric presented from the perspective of a contractor that already uses 3D modeling extensively in bidding and construction. At the time of the webinar, Sundt had implemented Automated Machine Guidance for earthwork and paving, which require robust 3D models of the design surface. Using the example of a two-mile long trenching operation, it was demonstrated how Sundt uses 3D models to innovate with construction means and methods, estimate and execute construction in the field. Sundt found the application of 3D engineered models to be a competitive advantage in the market and to reveal cost savings.

Registration Information

Total Registrants:	200 (capacity)
Number of State DOTs represented	23

Live Audience Demographics

Peak live audience: 144 connections

No demographic information was captured

Participant Interaction

Figure 2: What format do you provide or plan to provide to contractors?

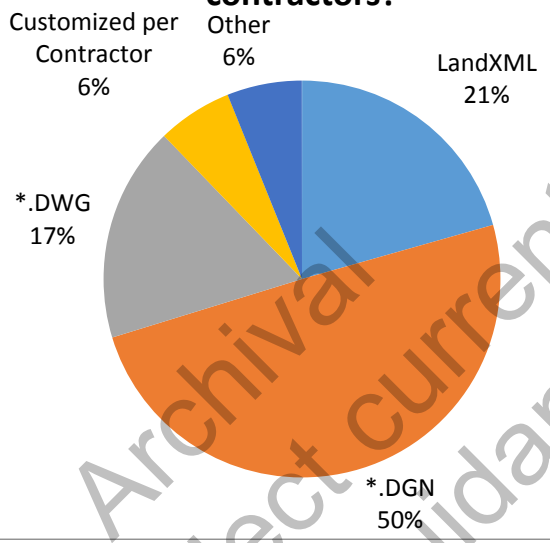


Figure 3: When does your agency provide 3D deliverables to contractors?

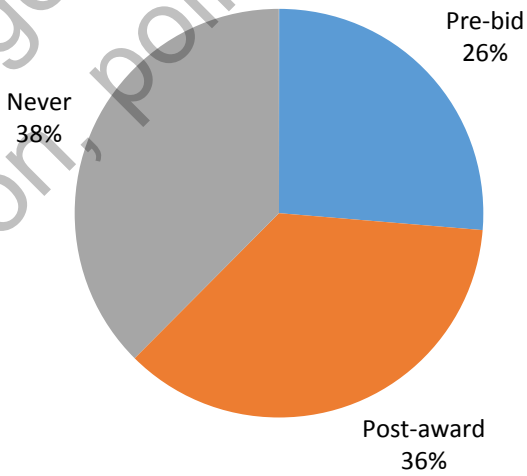
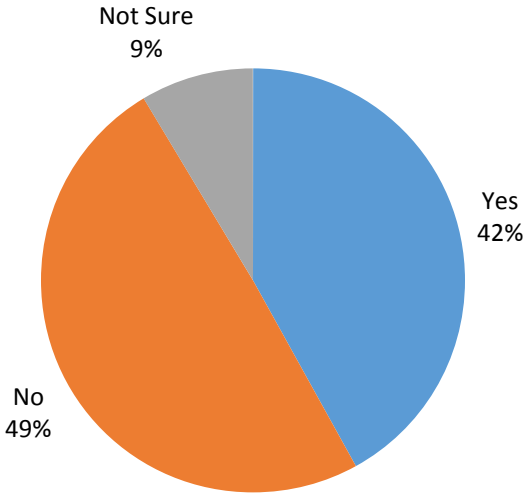


Figure 4: Does your agency produce 3D deliverables?



Question & Answer Summary

Q: Is a 3D model submitted along with a 2D set of plans, or is the electronic 3D model the only thing submitted?
A: Currently, 3D models are submitted on a For Information Only basis along with the legally required 2D set of plans. The goal is to sign and seal electronic data rather than the 2D plans, but currently that is not the case.

Q: It was said that there can be a 30% savings on large project. How large of a project?
A: This was a savings related to the use of AMG. That figure is realized by a range of improvements in productivity. It isn't based on the project, it's based on the type of work. There's a large misconception that this technology is only useful for large project, however, Sundt has found that the more the technology is used, regardless of project size, the larger the value added.

Q: Would 3D models be required to be used on all construction projects?
A: All projects once you are confident and proficient in it. Eventually, 3D design will be the standard and will be the only viable design method, regardless of legally required deliverables.

Q: Are these 3D models or are they 2.5D models. The distinction being 2.5D = xyz Cartesian coordinates whereas 3D would be in a state plane, ellipsoid projection system.
A: Michigan and Missouri uses state plan coordinate systems with projection factors. It's a very important point to consider before beginning a modeling effort.

Q: What 3D model format does MoDOT and Sundt use?
A: MoDOT works with Bentley Power GeoPAK, providing native format (DGN) and LandXML when possible. Sundt uses Autodesk software but notes that Autodesk and Bentley software systems generally work well together. Occasionally there are some issues when receiving non-standard data, but there are solutions available. It's the contractor's job to be the expert anyway, so this is generally not an issue.

Webinar 2: Creating 3D Engineered Models

Date and Time of Live Broadcast: January 8, 2014 11:00 am – 12:30 pm EST
Recording Link: https://connectdot.connectsolutions.com/p1nxzelz0vg/

Description

- Brett Wood, PSM, from the Florida DOT Survey Office identified methods of capturing aerial photogrammetry, terrestrial static and mobile LiDAR.
- The Florida State Surveyor John Krause, PSM, discusses how Florida shares data with the contractors as well as the timing that the data is made available. Additionally, the methods Florida uses to reduce the point cloud data into a more usable form will be explained.
- Mike Pullen from Portland, Oregon will explain how Multnomah County was able to use 3D models to present a complex project in a public outreach campaign for the Sellwood Bridge Project.
- Francesca Maier, PE, will discuss the level of detail required to create a 3D model for construction, as well as how the 3D model can be passed and refined through the project life cycle phases. Rapid 3D modeling tools using GIS data will be identified along with developing 3D models for plans and construction during the design process.

Learning Outcomes

Each participant will be able to:

- Identify methods of capturing existing conditions, including traditional survey and LiDAR
- Describe the difference between aerial LiDAR, terrestrial static and mobile LiDAR
- Identify rapid 3D Modeling tools using GIS and other data
- Describe the types of 3D models developed during the design process
- Describe how 3D models are modified for estimating and means-and-methods planning
- Describe how 3D models are prepared for Automated Machine Guidance

Speakers

Presenter: John Krause
Position: State Surveyor
Company: Florida DOT
Topic: Surveying Methods for 3D Models

In John's experience with the Florida DOT the feedback about the application of 3D to approximately 30 projects was distinctly positive. Demand for 3D project data by contractors was on the rise, and Florida DOT adapted to this demand. Photogrammetry, Aerial LiDAR, and other related technologies were applied by Florida DOT and several benefits were realized. An important lesson learned was that the greatest impact 3D design was had when applied to the earliest phases of design.

Presenter: Brett Wood
Position: Aerial Mapping manager
Company: Florida DOT
Topic: Surveying Methods for 3D Models

Brett's experience with the Florida DOT has been that pre-design survey to support the use of 3D models in construction has many benefits but several large challenges. One such challenge is the sheer size of the data involved by LiDAR scanning and photogrammetry, which requires a new set of technical ability on the part of DOT staff. Training is required, and the bulk of time associated with a

survey generally shifts to processing time as opposed to field time. Florida's approach was to form a task team; this team investigated 3D engineered models and issued a guideline which is flexible enough to apply to unique projects but provides a framework for standardization. Benefits were also revealed by combining multiple survey datasets into a single virtual representation of the project.

Presenter:	Francesca Maier
Position:	Virtual Design & Construction Engineer
Company:	Parsons Brinckerhoff
Topic:	Creating 3D Models in Design

Beneficial uses of 3D Engineered Models are demonstrated at each stage of design; from pre-conceptual through final design. The need for durable and portable data formats was illustrated through an example with fifty-year old as-built records; to this end, standards should be developed that may be easily understood. One example presented was the LandXML schema, which already has some widespread adaptation. Examples demonstrated how 3D models with sufficient levels of detail may be given to AMG-enabled tools, which may result in several value additions to horizontal projects. It is also recommended that careful consideration is made of the survey control datum, units, and origin for 3D design, as any error or miscommunication can easily perpetuate through calculations and result in large systematic errors.

Presenter:	Mike Pullen
Position:	Communications Officer
Company:	Multnomah County
Topic:	Using 3D Models in Public Outreach

In Portland OR, the Multnomah County DOT was building a bridge across the Willamette River. In a CM/GC procurement, the successful contractor proposed a new approach to construction that reduced the schedule and cost significantly, while reducing the required closure window substantially. The contractor had used 3D modeling to create images and a video of the construction sequence to include in their bid. The public information office then used these images and the video in the new public outreach effort to inform the public of the new plan for construction The ability of the public information office to communicate with the public was successful and enhanced by the application of 3D modeling, and from the perspective of a non-technical background, 3D models have many potential ancillary benefits in arenas other than engineering design.

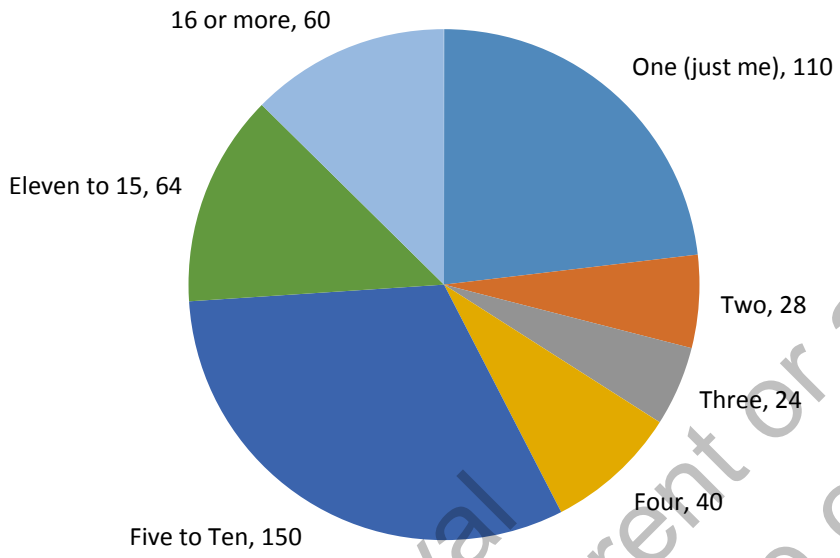
Registration Information

Total Registrants	500 (capacity)
Number of State DOTs represented	34

Live Audience Demographics

Peak live audience: 320 connections

Figure 5: How many people are watching with you for this presentaiton:



Participant Interaction

Figure 6: Do you have concerns about releasing digital data for information only?

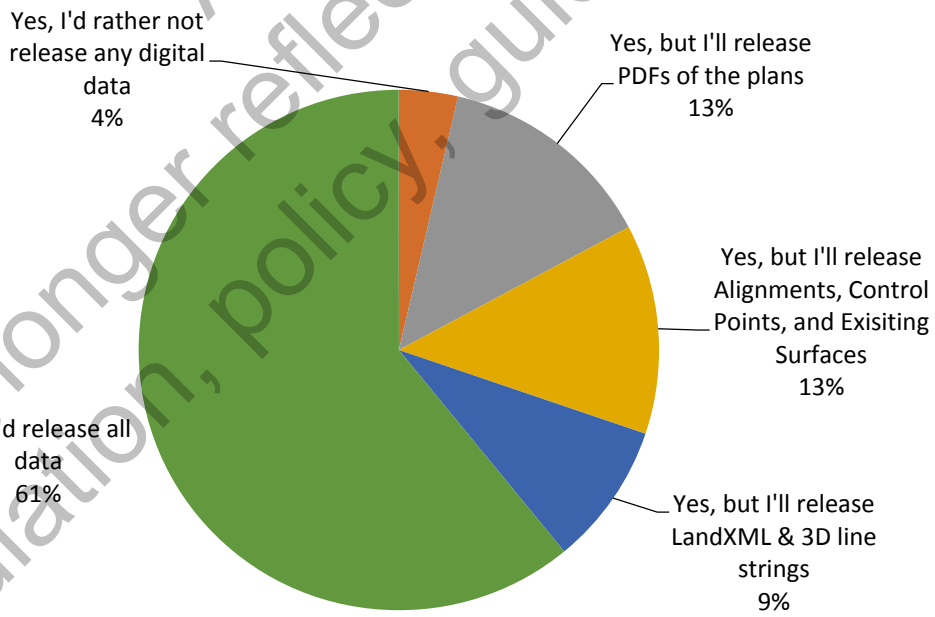


Figure 7: Does your agency design in 3D?

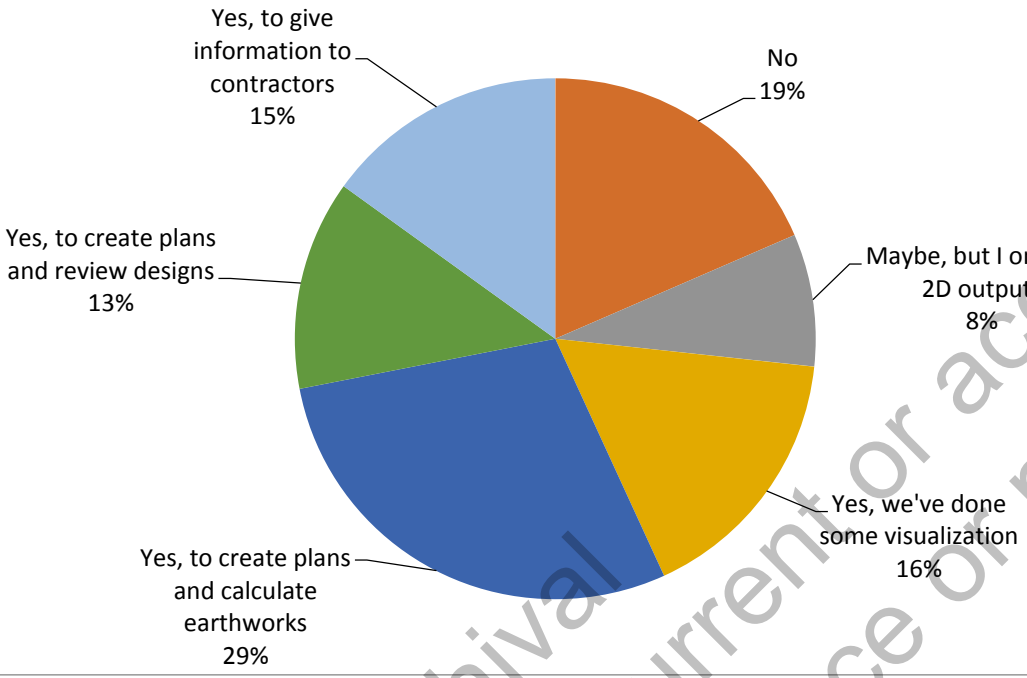


Figure 8: Which picture do your models most resemble?

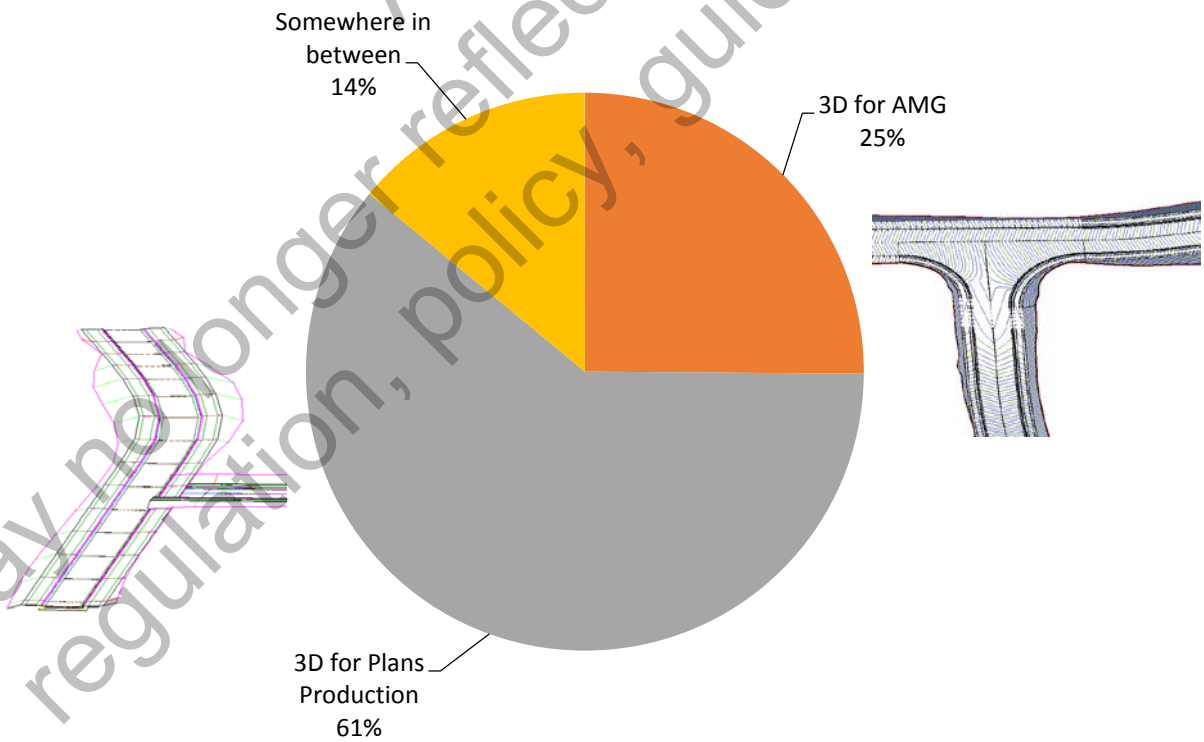


Figure 9: Does your organization use 3D models for public outreach?

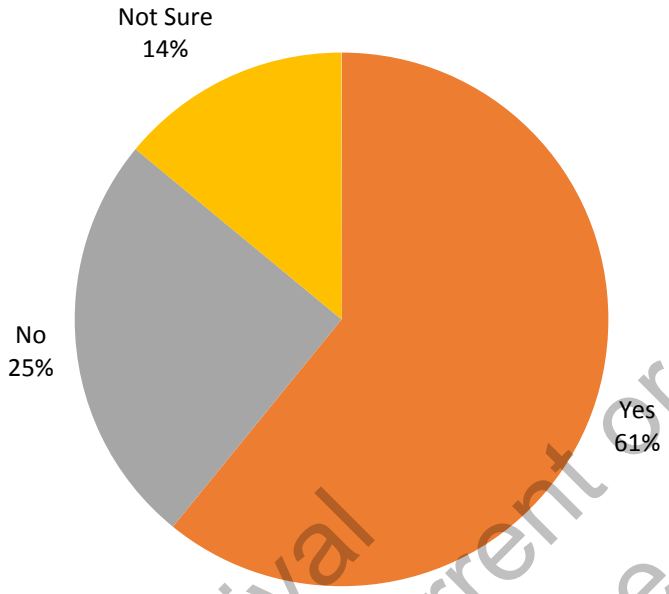


Figure 10: What's in your design workflow?

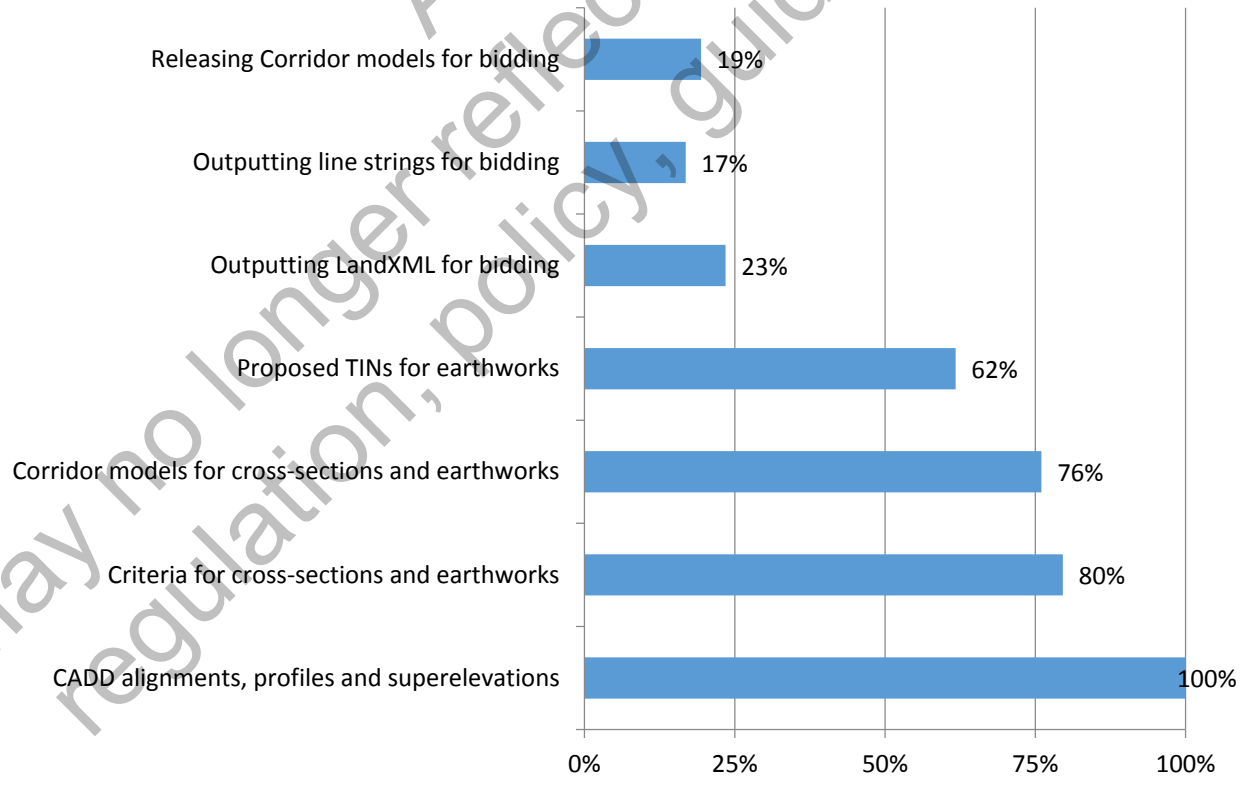


Figure 11: What type of coordinates does your organization use?

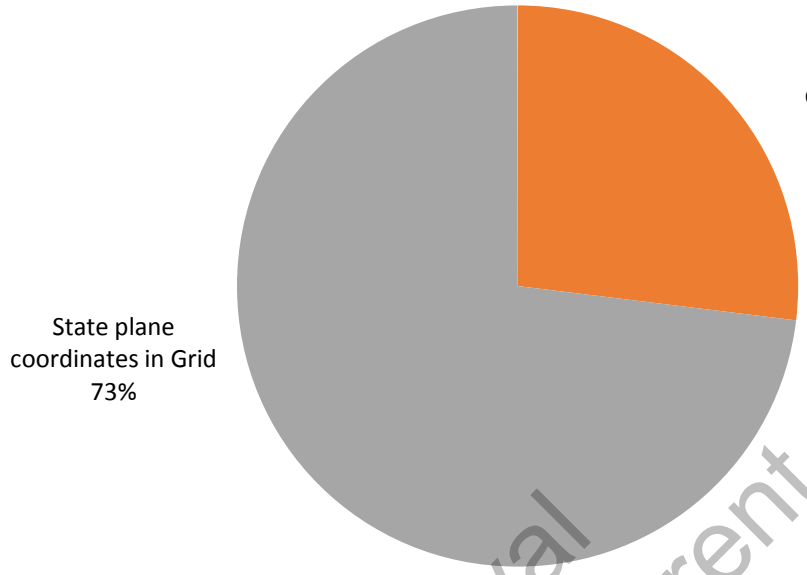
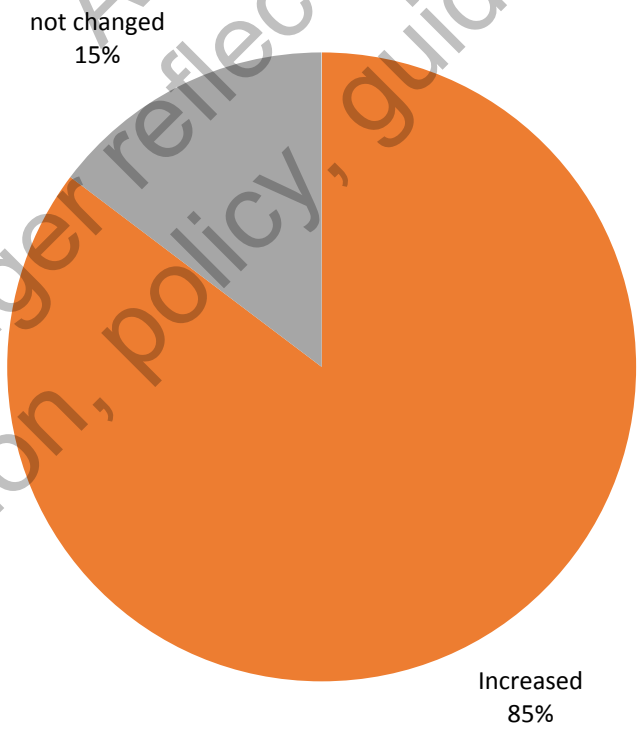


Figure 12: As a result of this webinar, my knowlege of creating 3D Engineered Models for Construction has:



Question & Answer Summary

Q: Does Florida own their own sensors?
A: As of this webinar Florida DOT owns an aerial camera and aircraft; most of the collection done with these tools is county-level orthographic mapping. Photogrammetry done in support of design road projects is done mostly by consultants. Terrestrial LiDAR information is often collected through contractors.

Q: What is SBET?
A: Smooth best estimate of trajectory. This is a technology which corrects for the movement of platform on which a mobile LiDAR scanner is attached to.

Q: What software are you using?
A: Florida DOT uses Certainty 3D's TopoDOT and Blue Marble Global Mapper as of this webinar.

Q: What is the photogrammetry cloud point generated from?
A: Florida DOT is using ISAE-extended as of this webinar.

Q: Francesca, what software was used to create the visualizations you demonstrated?
A: MicroStation Inroads SelectSeries 3 was used for these visualizations.

Q: Are ground state plane coordinates used?
A: All LiDAR scans done by Florida DOT are controlled via geodetic control makers. Every effort is made to correct surveys based on the best information available to the DOT at the time of the survey control.

Webinar 3: Applications of 3D Models in the Construction Office

Date and Time of Live Broadcast: February 19, 2014 1:00 pm – 2:30 pm EST
Recording Link: https://connectdot.connectsolutions.com/p3mu68qdkzw/

Description

One of the technologies for the Federal Highway Administration's (FHWA) Every Day Counts (EDC) initiative is 3D Engineered Models for Construction. A series of eight webinars have been developed to assist the FHWA's transportation partners in adopting this proven technology. The webinars are given in a "cradle to grave" sequence. Participants will hear how contractors incorporate 3D engineered models in their workflow of bidding and preparing to execute construction. Topics and guest speakers include:

- Brian Deery (AGC) presented the Contractor Organization's Perspective on 3D models
- Brian Smith (IMCO Construction) presented on how to use available data to create construction models
- Karthik "RK" Ramkrishnan (Walsh Construction) presented on planning construction activities with 4D modeling and utilizing clash detection in 3D
- Ryan Forrestel (Cold Spring Construction) presented on how construction is executed using 3D Engineered Models

Learning Outcomes

Each participant will be able to:

- List different ways to create 3D Engineered Models for Construction
- Describe how 3D models can be used for Quantity Take-off
- Describe different ways to test construction means and methods with 3D models
- Describe different ways to plan construction activities using 3D models
- Discuss different uses of clash detection

Speakers

Presenter: Brian Deery
Position: Senior Director Highway Division
Company: Association of General Contactors
Topic: Contractor's Organization Perspective

Brian Deery identified that contractors have been using 3D engineered models for many years. This, and several other factors, led to the AGC forming a BIM Forum group in 2006 to study the adoption of BIM in the realm of horizontal construction. The BIM Forum has found that most state DOTs are reluctant to share digital data, mostly due to the lack of legal precedent and the lack of contract language which addresses the use of digital data.

Presenter: Brian Smith
Position: Senior Civil Design/BIM Coordinator
Company: IMCO Construction
Topic: Using Available to Create Construction Models

Presenter: Sam Kloes
Position: GPS Manager
Company: IMCO Construction
Topic: Using Available to Create Construction Models

Brian Smith and Sam Kloes co-presented, beginning by demonstrating different methods of creating 3D digital models and how these models may be used for quantity takeoff, with several examples. It was shown that quantity takeoff models, construction-ready models, and rework models are created with those goals in mind, in order to build the model efficiently and maximize value. Also presented are the cost savings provided by using AMG on a work site. Other benefits of AMG included a reduction in risk, as AMG allows safer operations in hazardous environments through exposing fewer individuals to the hazardous materials and reduces the exposure of individuals through fewer total machine hours.

Presenter: Karthik Ramkrishnan
Position: BIM Task Force Leader
Company: Walsh Construction
Topic: Planning Construction Activities and Clash Detection

"RK" presented several methods Walsh has used to create models from LiDAR data. For example, cranes must clear power lines by 20'; by capturing LiDAR survey data of the crane's work area, Walsh was able to validate and optimize equipment placements virtually. 3D models created for the Milton-Madison Bridge in Madison, Kentucky allowed for better understanding of construction lift sequences, and a virtual lift plan allowed Walsh to simulate the effect of high wind conditions on specific lifts. RK showed resources available to contractors, such as publically available 3D model libraries of standardized equipment which cut down on the time required for 3D modeling.

Presenter: Ryan Forrestel
Position: Vice President Engineer
Company: Cold Spring Construction
Topic: Executing Construction with 3D Engineered Models

Ryan discussed how to prepare 3D models for use by Automated Machine Guidance. So long as there are sufficient checks and controls in place, there is a dramatic reduction in the manpower required to complete a given task, which also leads to safety benefits. AMG leads to higher accuracy at a reduced cost in several representative examples for earthwork, fine grading and paving.

Registration Information

Total Registrants	500 (capacity)
Number of State DOTs represented	40

Live Audience Demographics

Peak Live Audience: 303 connections

Figure 13: How many people are with you as you watch today?

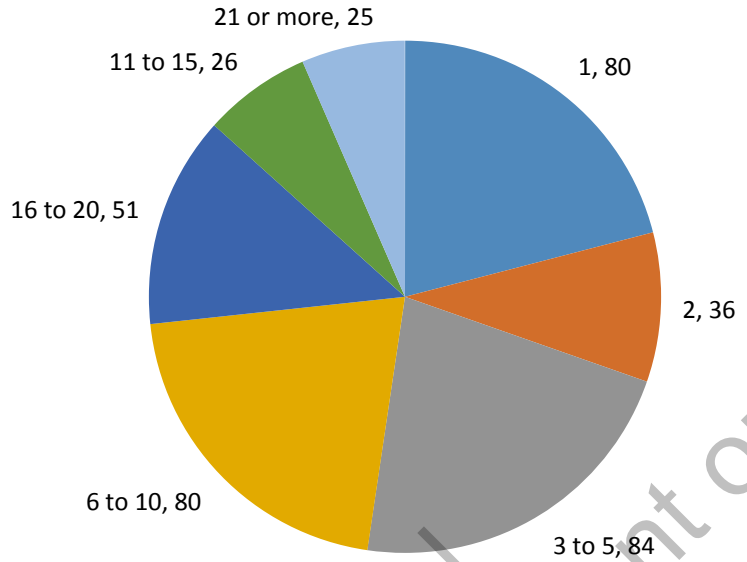
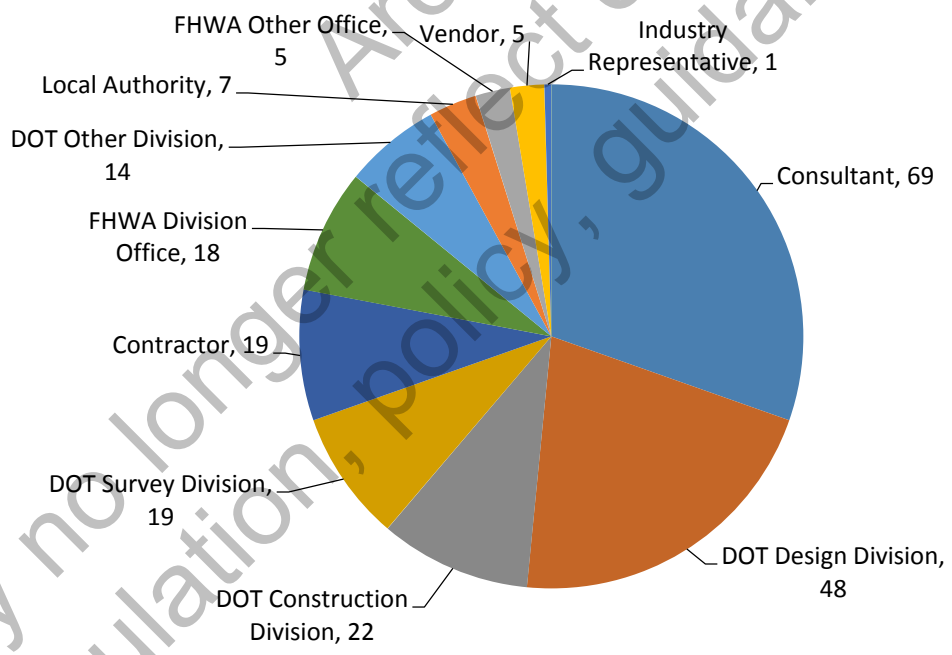


Figure 14: What type of organization do you represent?



Participant Interaction

Figure 15: Are the contractor's 3D models reviewed by the owner/designer prior to construction?

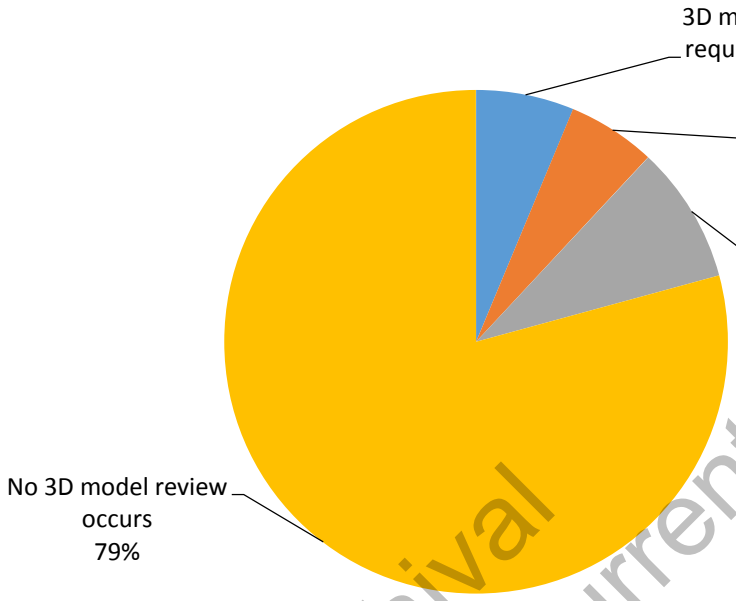


Figure 16: Do you use 3D clash detection?

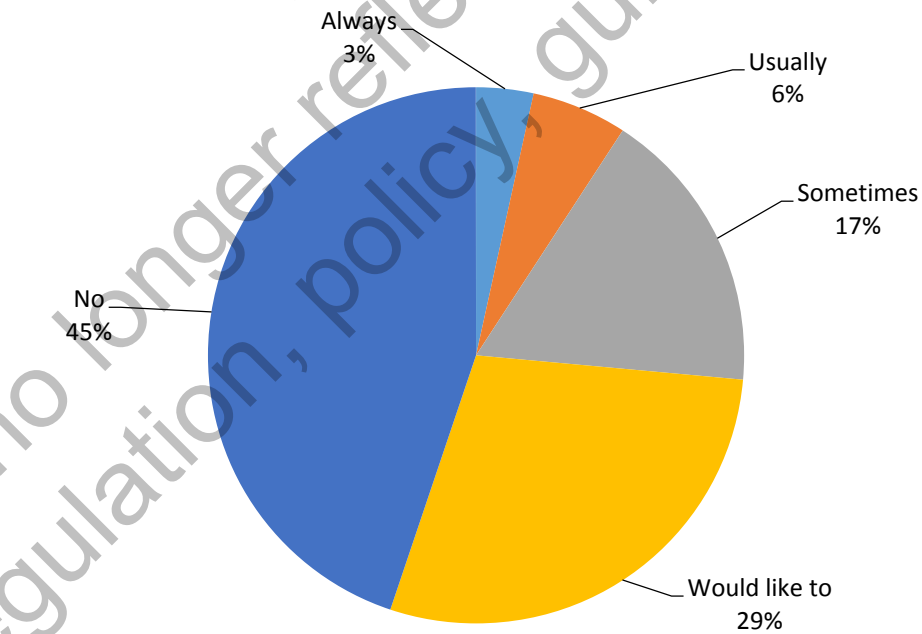


Figure 17: How often do you recieve useful data pre-bid?

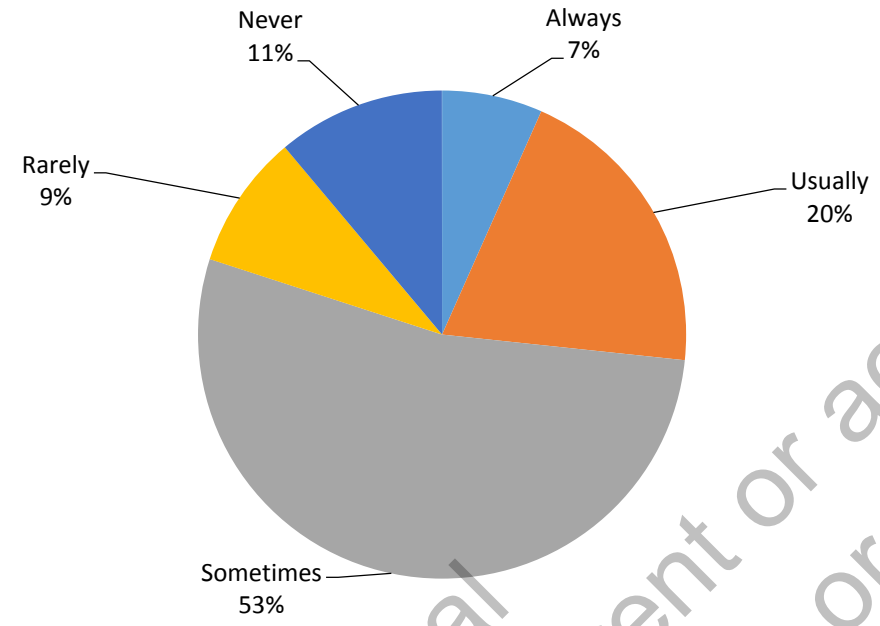
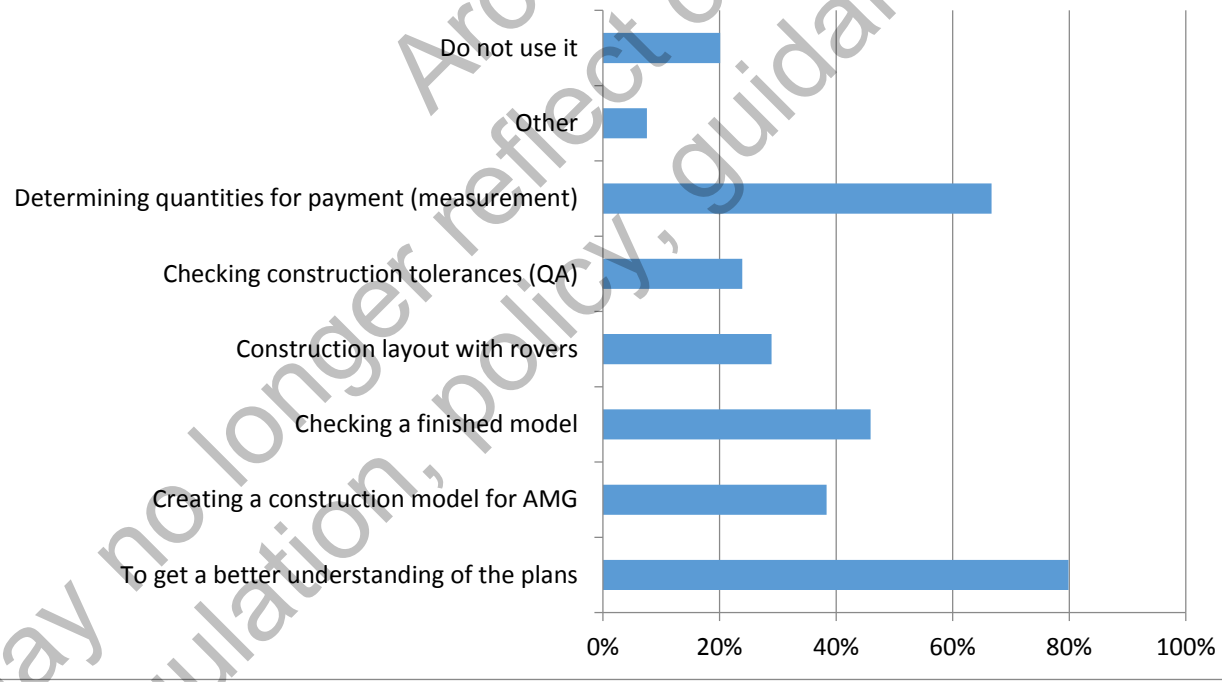


Figure 18: How do you use electronic design data?



-

Figure 19: How extensive is your 3D pre-planning?

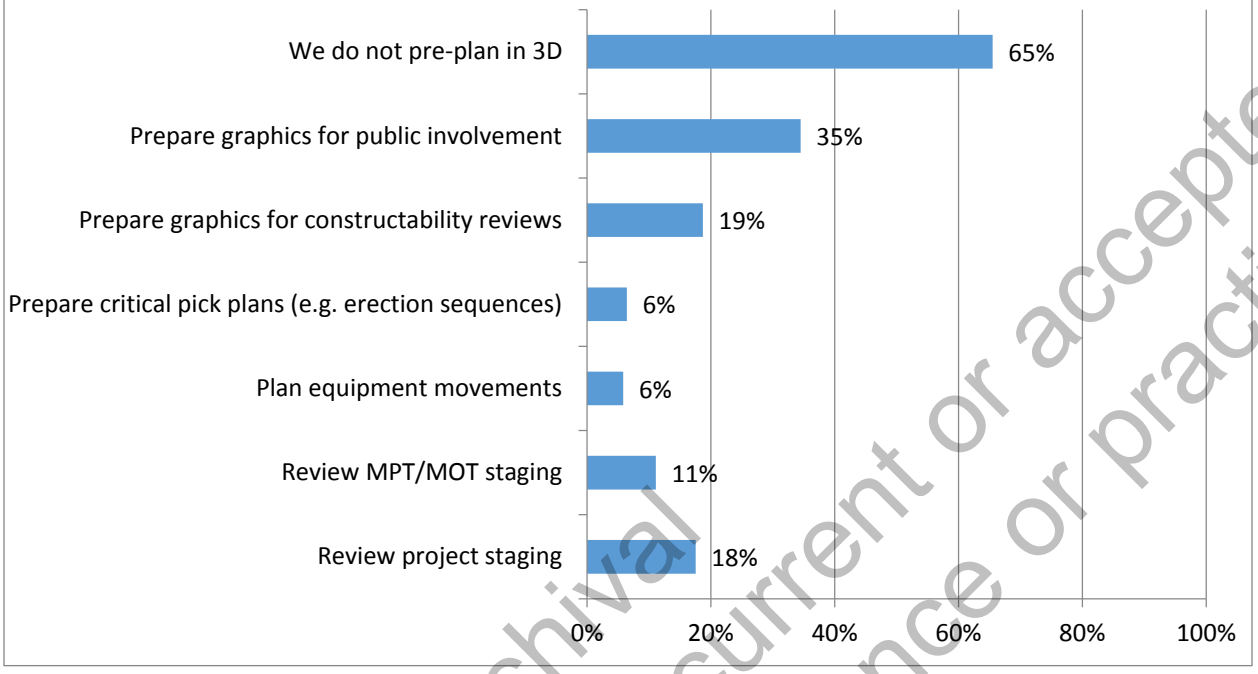
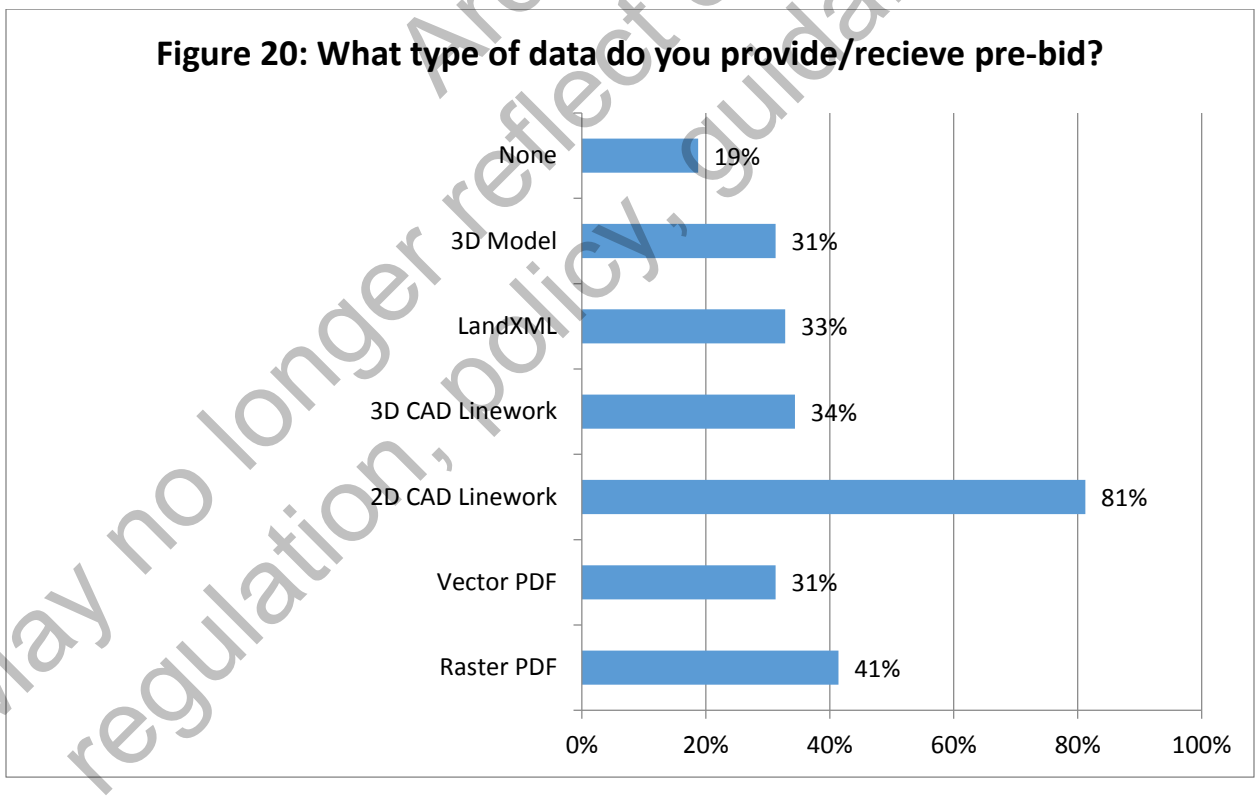


Figure 20: What type of data do you provide/recieve pre-bid?



Question & Answer Summary:

Q: What software packages are typically used for modeling horizontal construction?
A:
Ryan: Trimble business center and Civil 3D.
RK: Bentley products, especially InRoads and GeoPAK

Q: Would contractors prefer to receive 3D models from consultants or build them themselves?
A:
Ryan: Yes, which reduces contractor risk.
Sam: We agree, but have to recognize that the PDF is currently the contract document; sometimes this requires changing the 3D model to conform to the plan.

Q: What is the additional cost to a contractor if the contractor has to build a 3D model? Is that cost documented?
A: It's a normal part of doing business for contractors now, data isn't really available for this question.

Q: Contractors, what other forms of data would you wish to receive from clients?
A: Brian: At a minimum, 3D polylines. Beyond that, as much as possible, especially grading surfaces.

Q: What format do contractors prefer to receive data in?
A: Ryan: LandXML; it's the easiest to get across platform regardless of vendor, and it may be used for AMG.

Q: What are the file outputs on the AMG output? Is it blade position or sewn together?
A: ASCII or CSV, which can then be made into a surface TIN.

Q: Are there any suggestions on how to supply better data?
A: Use LandXML. Otherwise, just be sure that the model information issued is the same that was used to generate the contract documents. Paramount to all this is having an open exchange between stakeholders.

Q: It takes designers more time to create a 3D model for construction, especially if it includes all features. For a roadway project are there certain features that you are looking for more than others?
A: Line strings for face of curb, back of curb, shoulder break points, etc.

Q: How do contractors deal with uncertainty in XYZ locations of underground utilities?
RK: Collaborate as much as possible with every utility and stakeholder as possible and do due diligence.

Q: When setting PCCP with wireless robotics how do you do your Quality Assurance?
A: There is a dedicated total station that is used with a hand-held data collector that someone uses to check elevations behind the paver almost constantly.

Q: What is the value of having mobile or static LiDAR pre-bid?
A: Very large, rich data sources which capture conditions accurately is valuable.

Q: Are there limitations on the size of 3D model files that you can put on the grade control equipment?
A: There are technical limits, but most technology solutions have solutions which minimize raw size requirements.

Q: How much of an advantage are Vector PDFs over Raster PDFs?
A: Sam: Raster PDFs can be out of scale, scanned incorrectly, low quality, and require rework. Vector is a direct data transfer and may be used for automatic data extraction.
Brian: The slide we used to present was from an actual takeoff I did. 33,000 yards of cut and roughly 38,000 yards of fill, and everything was provided. Working from the PDF was verified +/- 3%. The whole turnaround was about 15 minutes with that kind of accuracy.

Webinar 4: Applications of 3D Models on the Construction Site

Date and Time of Live Broadcast: April 2, 2014 1:00pm – 2:30pm EST
Recording Link: https://connectdot.connectsolutions.com/p1onidyy8xk/

Description

This is the fourth webinar in a series of eight that are focused on 3D Engineered Models. During this webinar participants will hear from three or more owner/agencies about the employee safety benefits of employing 3D Modeling on a transportation construction project. Two state DOT representatives will discuss how they train, prepare and equip their construction inspection staff to perform Quality Assurance (QA) on a project where a contractor is using 3D modeling. The benefits of having a contractor 3D work plan will be discussed. Examples of state specifications for specifying 3D Modeling will be reviewed.

Learning Outcomes

Each participant will be able to:

- Describe how 3D models can enhance safety on the construction site
- Describe applications and support activities using 3D and 4D models for construction
- Discuss construction site survey requirements for using 3D models
- Discuss how a contractor's work plan can manage use of 3D models on site
- Discuss training needs for Construction Engineers and Inspectors
- Describe Different Approaches to procuring equipment and training for the owner's representatives
- Describe how 3D models can be used to perform stringless/stakeless construction
- Describe the benefits of using Automated Machine Guidance

Speakers

Presenter:	Douglas Townes, P.E.
Position:	Construction Engineer
Company:	FHWA Resource Center
Topic:	Welcome, Introductions, Safety Message, Closing

According to a letter written by Charles Brown, PE, State Location & Surveys Engineer for North Carolina DOT, the use of GPS/GNSS on a project site contributes to safety, as it removed line-of-sight as a constraint on siting control, which elevated safety as a factor in the location of control points. GPS/GNSS also reduced the field time and number of people required to be in the field for a survey. This is yielding significant benefits for construction inspection, where job functions are becoming more about managing and verifying data than a need to move amongst mobile heavy construction equipment performing direct observations. James Tynan, PE, Director, Office of Construction at New York State DOT, related by letter how New York State DOT has increased use of survey equipment by inspectors since 2005. The continued investment has been motivated by noted time savings, accuracy improvements and overall safety benefits. Another benefit that has been noted is a reduction in the amount of disputed work on projects by resolving discrepancies at the project level, avoiding potential litigation or time delay claims.

Presenter: Lance Parve
Position: Senior Transportation Engineer
Company: Wisconsin DOT
Topic: Supporting 3D/4D Construction Applications in Preconstruction

Lance Parve presented on Wisconsin DOT's use and observed use among contractors of digital models, with a focus on how integrated models are leveraged during construction and post-construction. These models reduced Contract Change Orders, Requests for Information, and Design Intent Notifications. Using clash detection on 3D models and construction simulation in 4D models revealed design clashes and scheduling gaps. When provided at advertisement, 3D/4D models were found to increase coordination between all parties of a project.

On several pilot projects, rovers with GNSS were used and revealed several workflow enhancements, particularly when related to Quality Assurance. Robust as-built models are a byproduct of AMG construction which were used to issue progress reports and completion reports. Other, more experimental procedures are also being examined which leverage Wifi-enabled tablet computers, UAVs, and augmented reality.

Presenter: John Lobbestael
Position: Supervising Land Surveyor
Company: Michigan DOT
Topic: Supporting Automated Machine Guidance for QA

In John's experience, the contractor community has been more advanced than owners in the application of 3D engineered models. Contractors have been realizing efficiency gains and other cost savings through use of 3D models, and continue to find new value as their staff gain proficiency. Owners face challenges with procurement and investment in training, and are generally less agile than contractors. He identified some ways to procure and apply these technologies to specific projects, and noted benefits and drawbacks. Michigan DOT is committed to a long-term strategy to adopt 3D workflows with an end goal of a full implementation of paperless, "e-Construction."

It was important for project staff to maintain open communication with vendors and support staff. While the new tools were able to enhance workflows, they were specialized and required specific skills to use and maintain. John recommended that existing staff be trained, rather than hiring new people with specific skills. In this way workflows may be adapted. Finally, John stressed the importance of selection, calibration, and protection of the project's control points and setup.

Registration Information

Total Registrants	271
Number of State DOTs represented	36

Live Audience Demographics

Peak Live Audience: 169 connections

Figure 21: What type of organization do you represent?

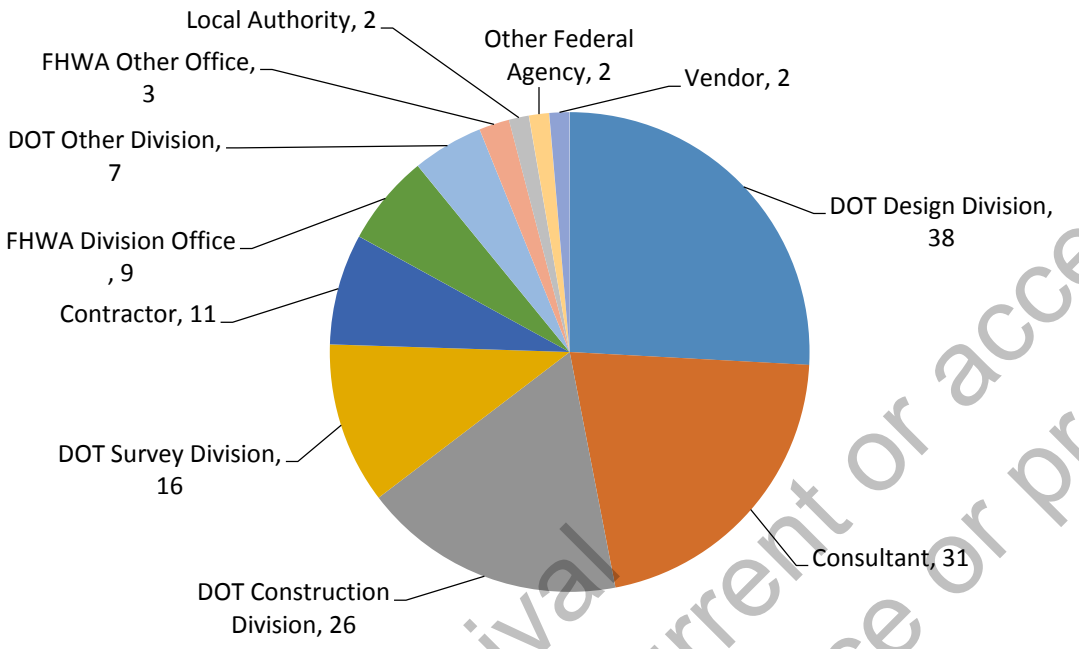
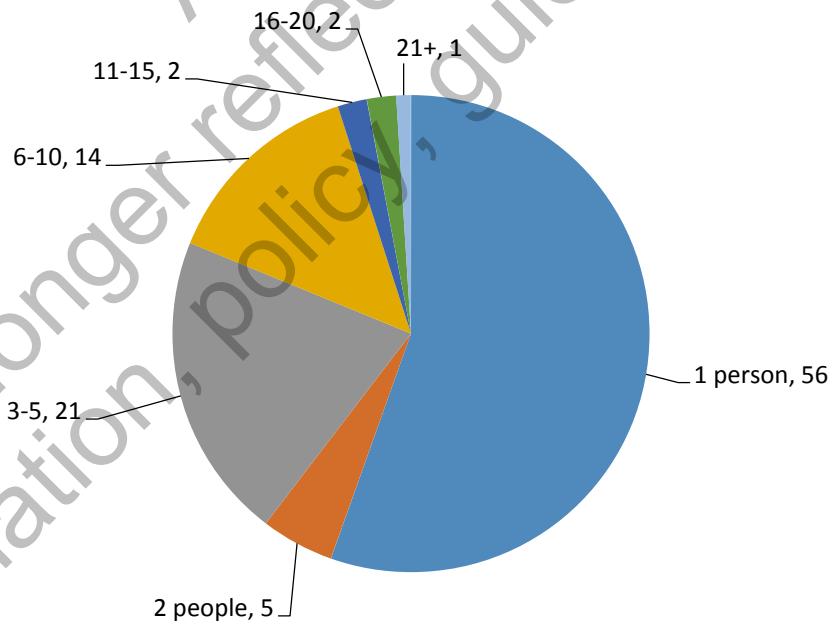


Figure 22: How many people are watching on your line?



Participant Interaction

Figure 23: What equipment do you use on site for QA and Measurement? (select all that apply)

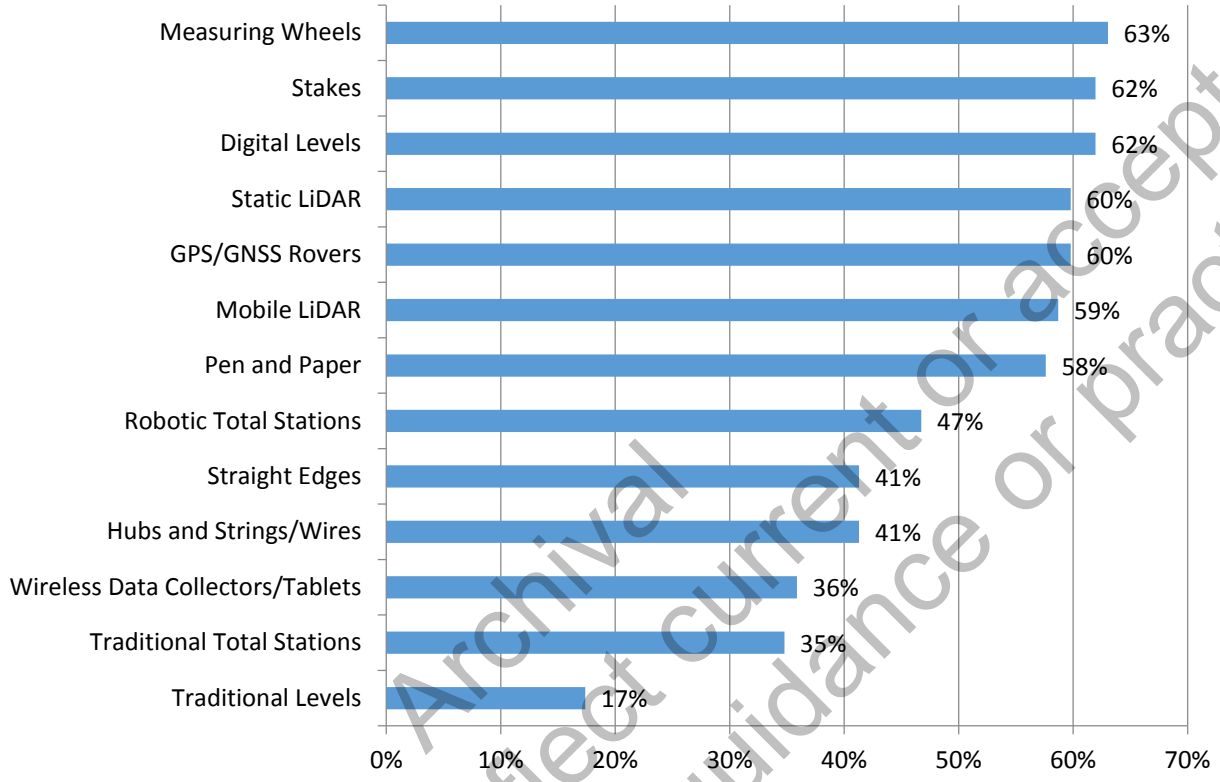


Figure 25: Who uses 4D Modeling on your projects?

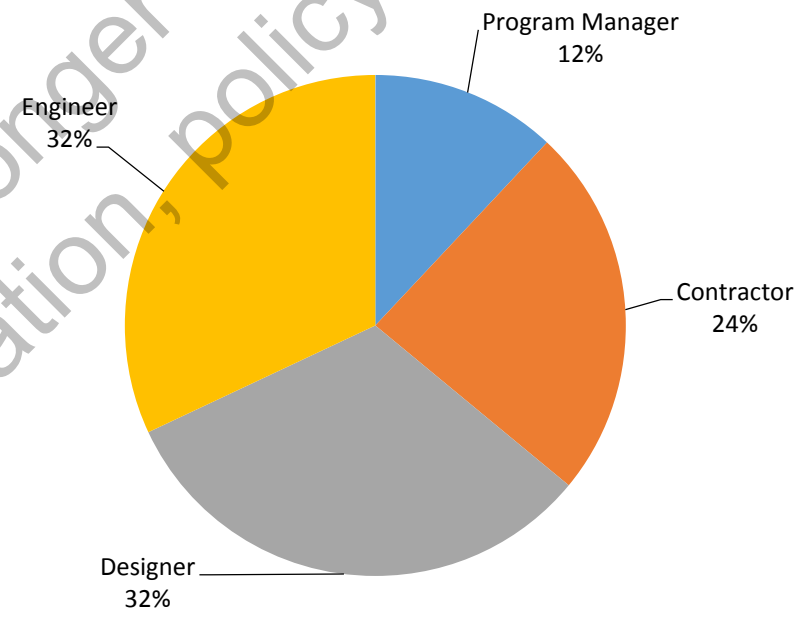


Figure 26: Do you capture as-built data digitally?

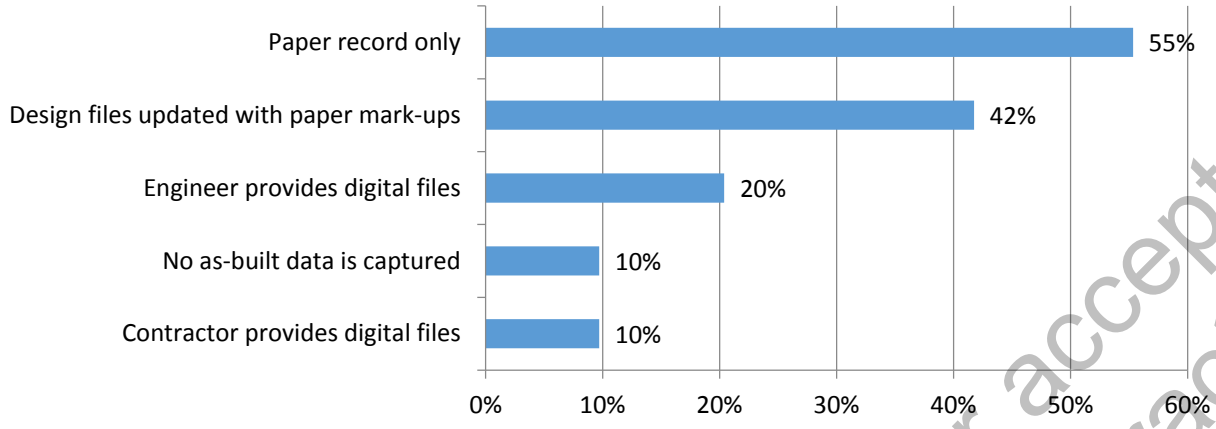


Figure 27: How do you QA stakeless/wireless/ stringless construction?

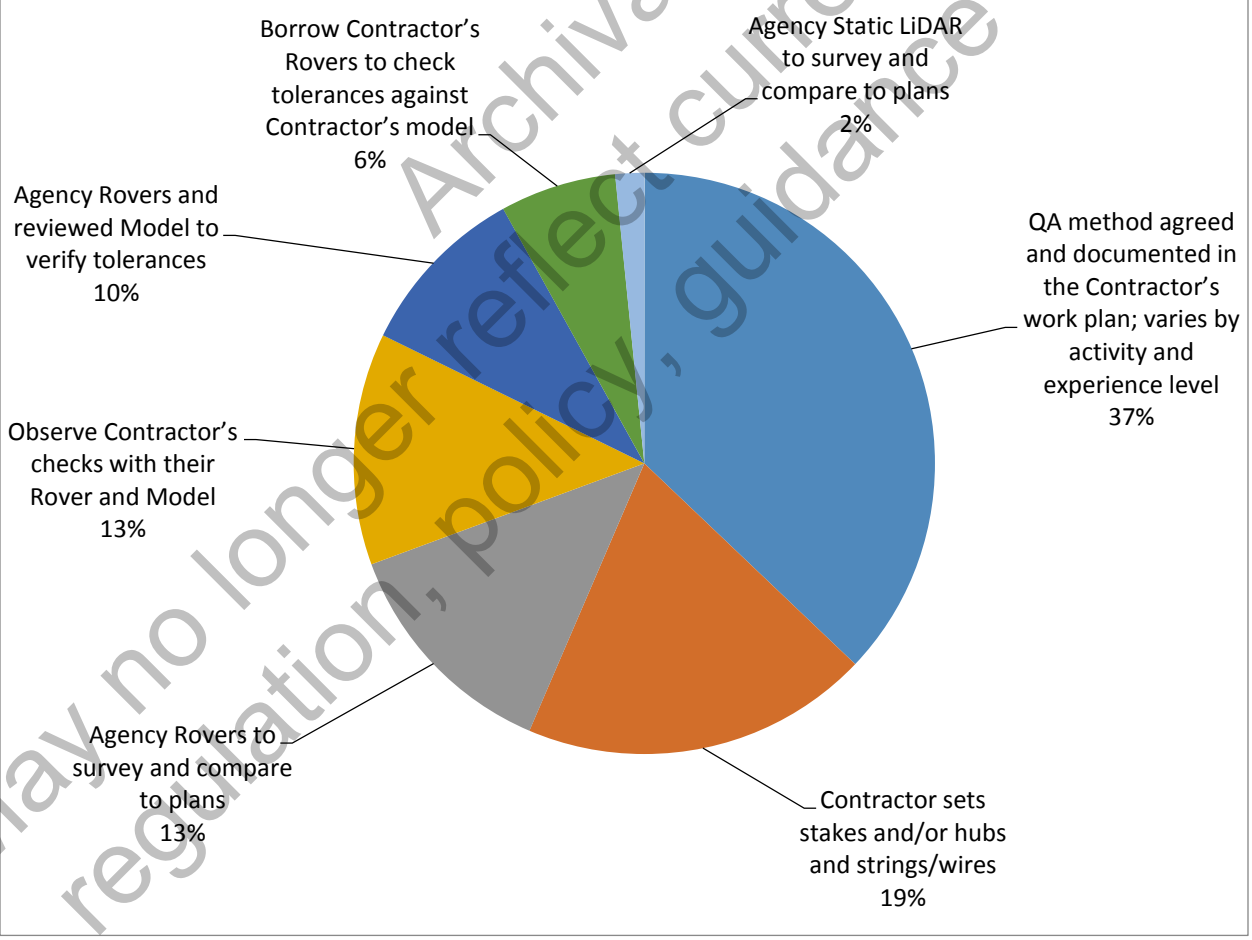


Figure 28: Are contractors using AMG on your projects?

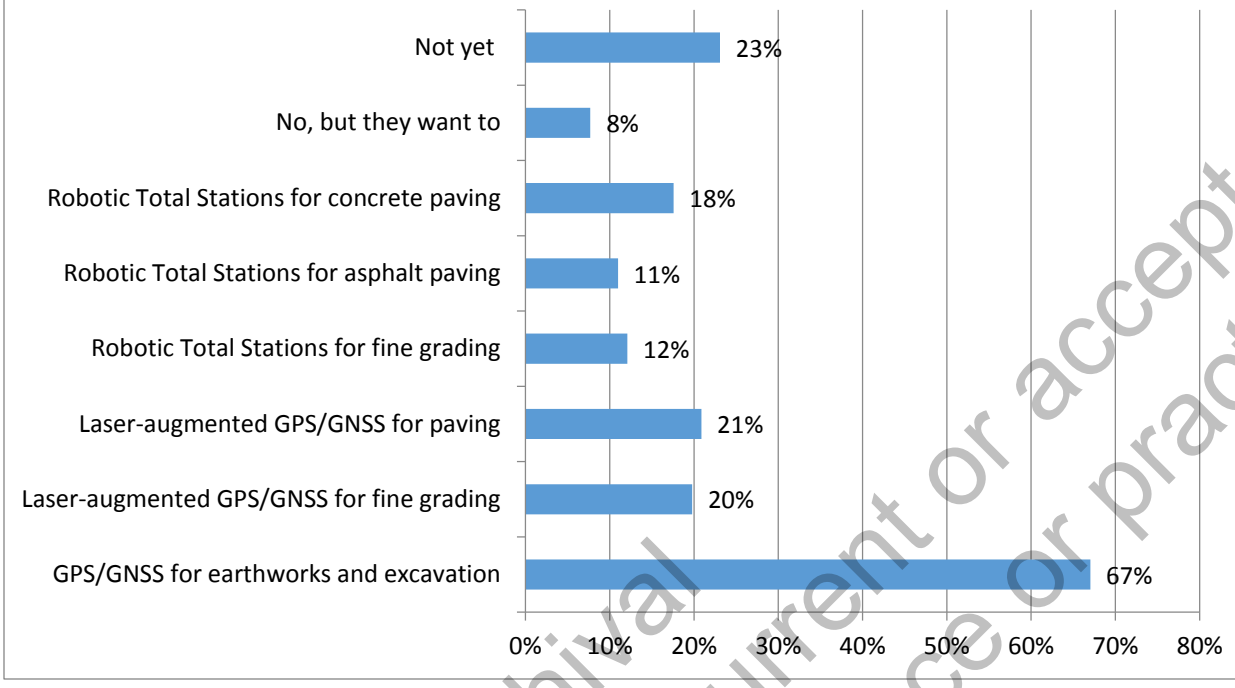


Figure 29: What Coordinate System do you use?

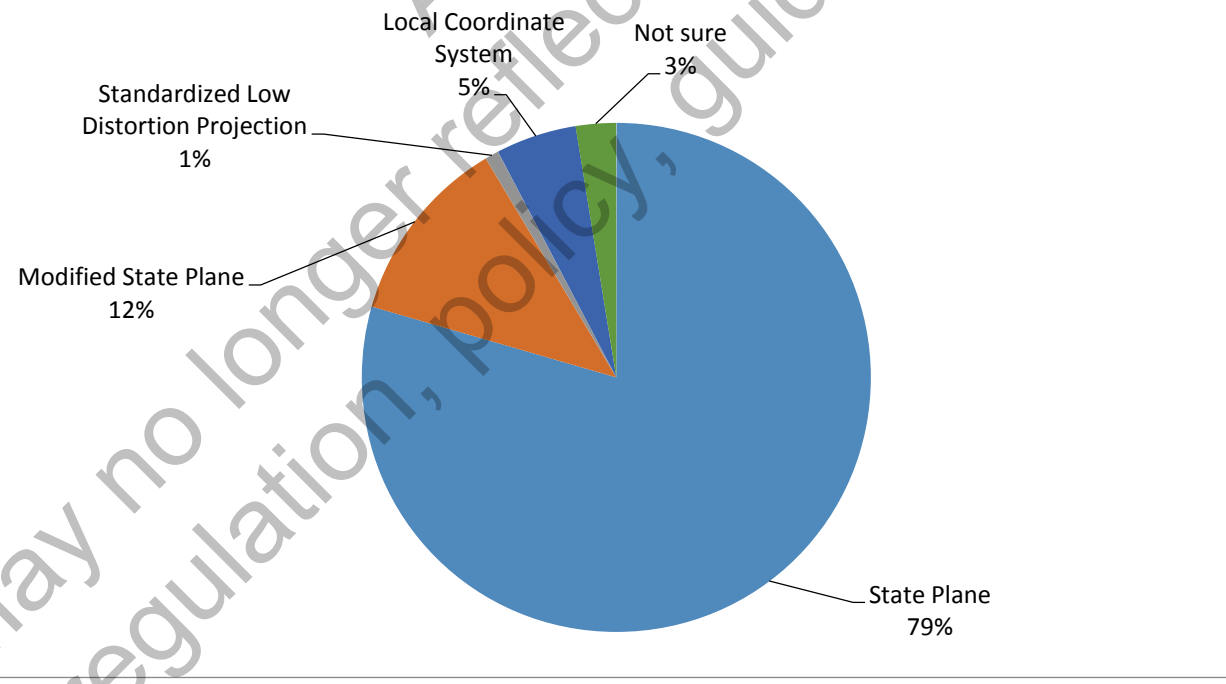


Figure 30: Do you review design models pre-construction?

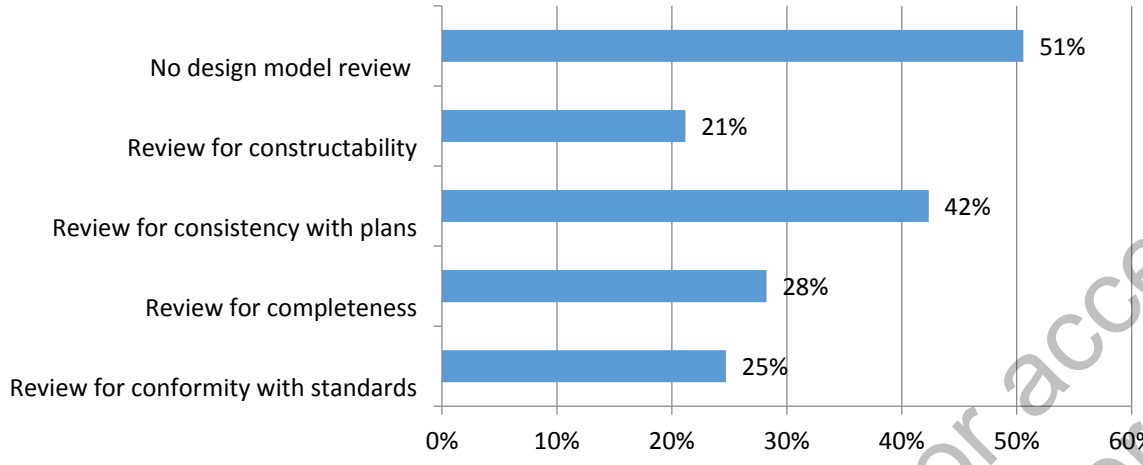
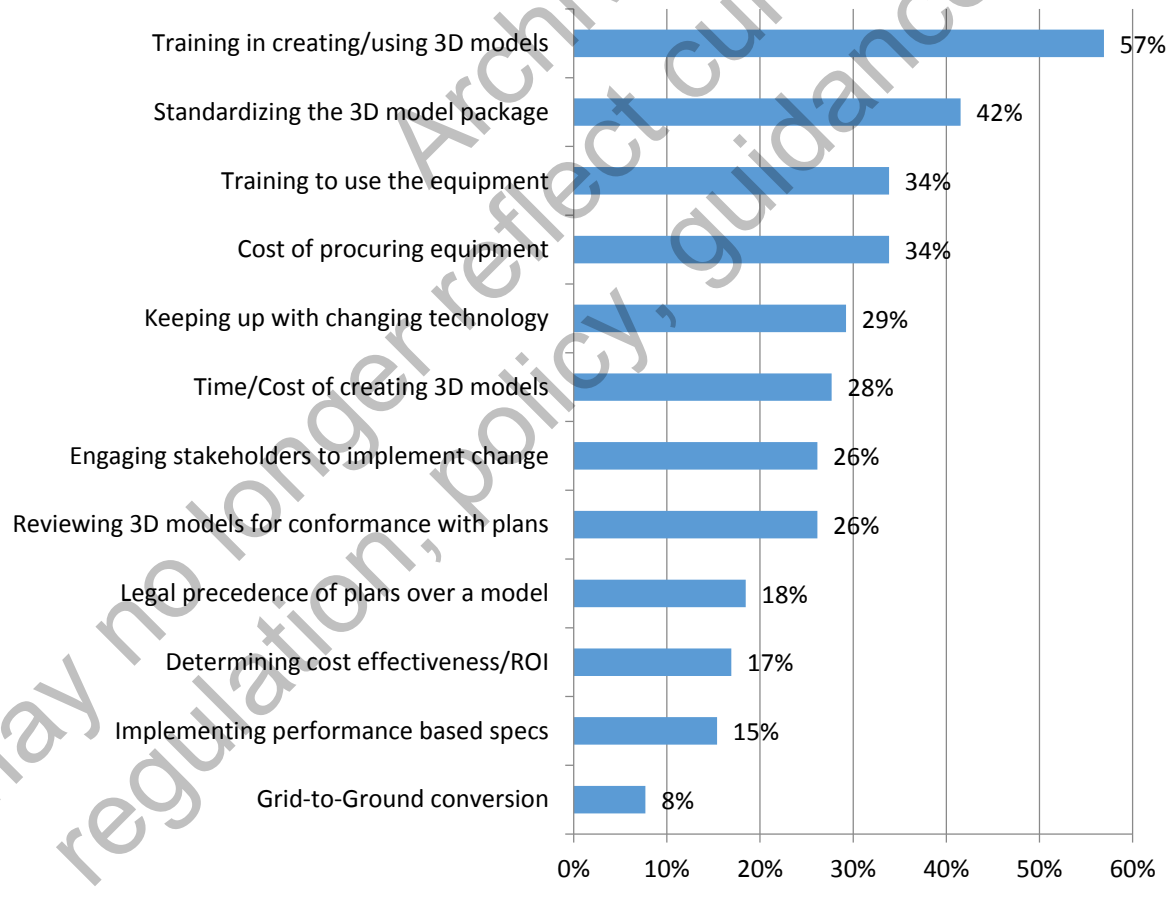


Figure 31: What challenges do you face in implementing active quality assurance measures with modern surveying technology?



Question & Answer Summary

Q: What level of detail is provided to bidders?
A: Lance: The base course, subgrade, and top surface at a minimum. Boundaries of areas such as protected wetlands and right of way are helpful. Each project must be examined case by case.

Q: What is the "utilities FTMS"?
A: Freeway Traffic Management System. It relates to dynamic message signs and the fiber optic cables that connect them.

Q: Does your state use the as-built data for future projects and how does the DOT store that?
A: John: There is no catch-all solution. One example solution is ESRI's ArcMap.
Lance: The Department is examining the use of this data, but it is not standardized yet.

Q: What experiences have you had with Unmanned Aerial Vehicles?
A: Lance: Wisconsin DOT doesn't have the Certificate of Authority from the FAA to operate UAVs. There appear to be many uses and the tools can be quite robust.
John: Michigan DOT has been watching Michigan Technological Institute's advances with different platforms for photogrammetry and LiDAR data collection, and related material in the industry, but nothing is standardized.

Q: Who from the DOT provides Q&A in the field?
A: John: Michigan DOT has mixed workflows for Q&A; it varies from project to project.
Lance: Wisconsin DOT has survey data coordinators whose job is dedicated to this. Some larger projects with GPS/GNSS do have QA checks done by Construction Engineering Contractors. Often, contractors have their own QA procedures in addition.

Q: Is there a minimum earthwork quantity where AMG becomes more efficient?
A: John: I don't have a specific value, but good question.
Lance: Quantities go from hundreds of thousands of yards to millions; AMG is used whenever possible. Static LiDAR can be used for obtaining accurate results.
A: Douglas: About 10 states have direct control over the survey office. The other 40 states' DOTs subcontract AMG. The FHWA is asking state DOTs to maintain an independent check in addition to any subcontractors for survey.

Q: Are contractors really ready for this?
A: Most contractors are equipped for this already, and those that are not are investing.

Webinar 5 Managing and Sharing 3D Models for Construction:

Date and Time of Live Broadcast: May 7, 2014 1:00 pm – 2:30 pm EST
Recording Link: https://connectdot.connectsolutions.com/p44k84qmu6r/

Description

During this webinar, #5 of the *3D Engineered Models for Construction* series, participants will gain insight into some of the practical challenges of sharing data with contractors, and best practices to overcome them. Each participant will be able to discuss which files in the Design Model are helpful in construction. They will also be able to describe how standardization and documentation of the delivered model enables recipients to consistently and reliably interpret the data. In addition participants will be able to discuss signing & sealing digital files and discuss effective ways for transmitting models including timing of the delivery.

Learning Outcomes

Each participant will be able to:

- Discuss which files in the Design Model are delivered, and why
- Describe the purpose and need for standardization and documentation of the delivered model
- Discuss effective ways for transmitting models
- Discuss different approaches to signing &sealing digital files
- Describe best practices for delivering files for effective construction

Speakers

Presenter: Brian Smith
Position: Methods Engineer, Road Designs Group
Company: Iowa DOT
Topic: File Delivery to support Automated Machine Guidance at Iowa DOT

Iowa DOT's experiences with AMG during the past decade are presented by Brian. Most commonly, digital data was communicated to machine controls using the DXF and LandXML format. These files contained at a minimum the horizontal and vertical alignments, as well as the terrain model of the existing ground, terrain model of the proposed ground, and 3D break lines. Due to their efforts to standardize the data delivery, Iowa DOT provided a detailed breakdown of their standard naming conventions in addition to the model files. Among the best practices demonstrated by Brian, one of the most impactful procedures was to keep an open line of communication with contractors after delivering the data. The DOT identified a strong need for standardization and meticulous recordkeeping; many legacy projects are in the process of being brought up to date with new digital standards.

Presenter: Paul Wheeler
Position: Technology Advancement Specialist
Company: Utah DOT
Topic: Signing & Sealing Digital Documents

Utah DOT has been examining electronic signatures on contract documents, and Paul presents the lessons learned. Electronic signatures are usually advantageous, allowing a person to sign documents rather than one at a time, and digital files are easier to secure than paper. At the time of the webinar, true digital signatures came in a variety of formats; usually a digital or hardware "token" which was carried by the signatories. The adoption of Uniform Electronic Transactions Act and Electronic Signatures in Global and National Commerce Act (ESIGN) in 2000 provided legal framework for a

genuine digital signature. The advantages were listed as being: Authenticity, integrity of content (signatures do not allow changes to the documents), decreased printing costs, ease of distribution. However, implementation of digital signatures required a strong IT team to solve compatibility issues; software versions had to be monitored and kept up to date, which was a new challenge for the DOT to overcome.

Presenter:	Bruce Flora
Position:	Owner
Company:	Flora Surveying Associates
Topic:	Best Practices for Supporting Estimating, Construction Layout and Automation

Bruce presents on the technical issues faced by surveyors and the uses of raw survey data. Since its inception, there have been a huge number of adjustments to the NAD 83 survey, which is often used as the reference datum by state DOT projects. Legal action can hinge on adjustments used on the datum, and those adjustments can propagate small errors out to large estimation errors unless the survey metadata, describing the original horizontal and vertical datum, is properly documented and in the construction contract documents.

For AMG construction, it is important to set up control points which covered the project from several angles. On linear projects, it's important that control extends perpendicular to the alignment or scale errors can be introduced. Traditional survey methods still apply to new survey tools; adoption of LiDAR scanners requires training people who are familiar with standard survey best practice or advertised accuracy thresholds will not be achieved. Bruce addresses the various technical challenges of using scan data as project datum.

Registration Information

Total Registrants	355
Number of State DOTs represented	41

Live Audience Demographics

Peak Live Audience: 199 connections

Figure 32: What type of organization do you represent?

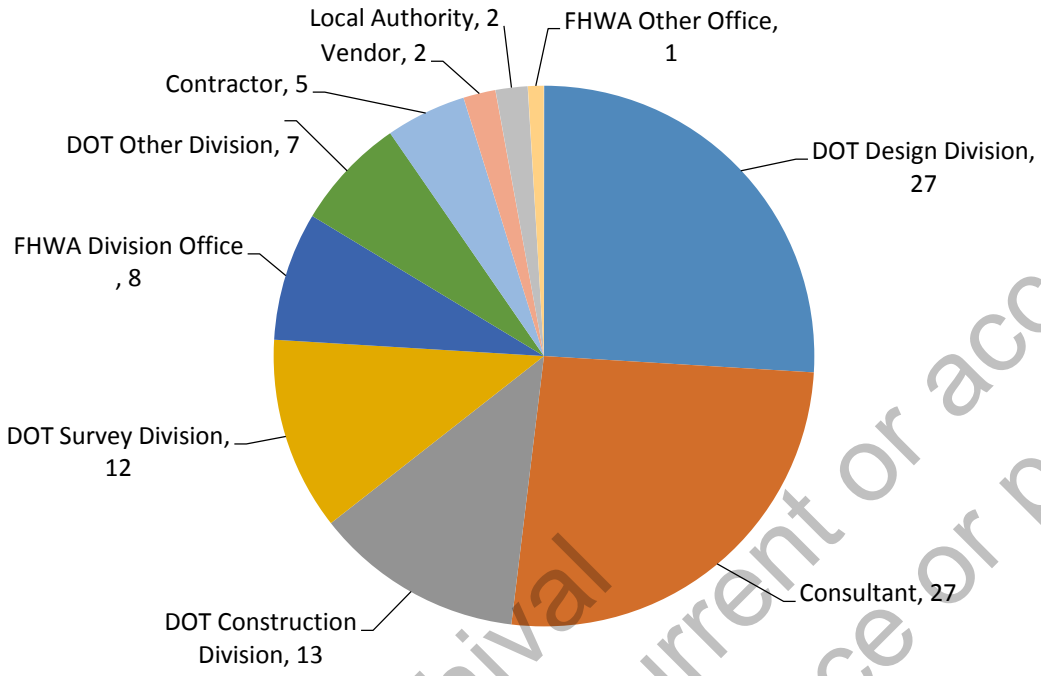
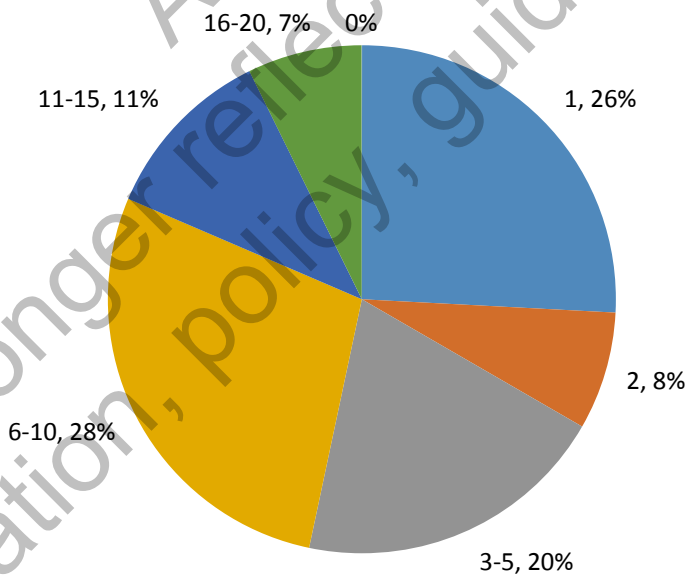


Figure 33: How many people are watching on your line?



Participant Interaction

Figure 34: What data could/would/should you release pre-bid?

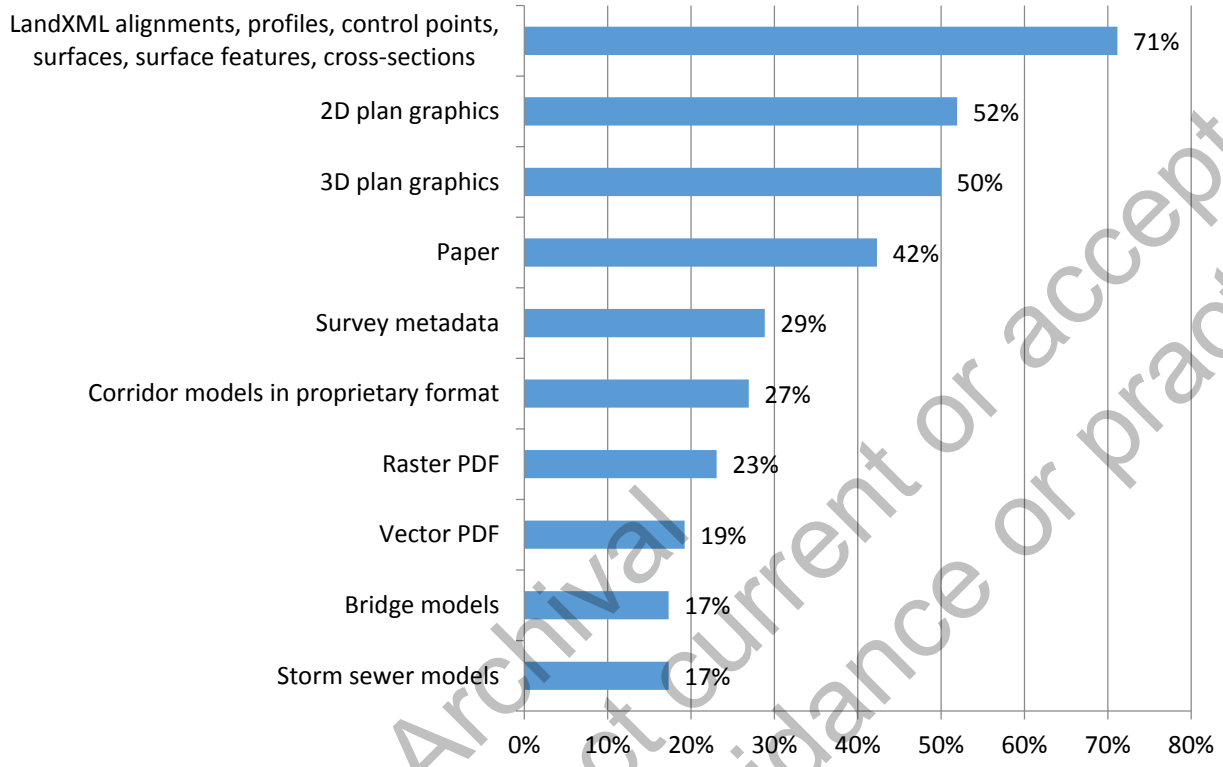


Figure 35: How do you deliver files to contractors?

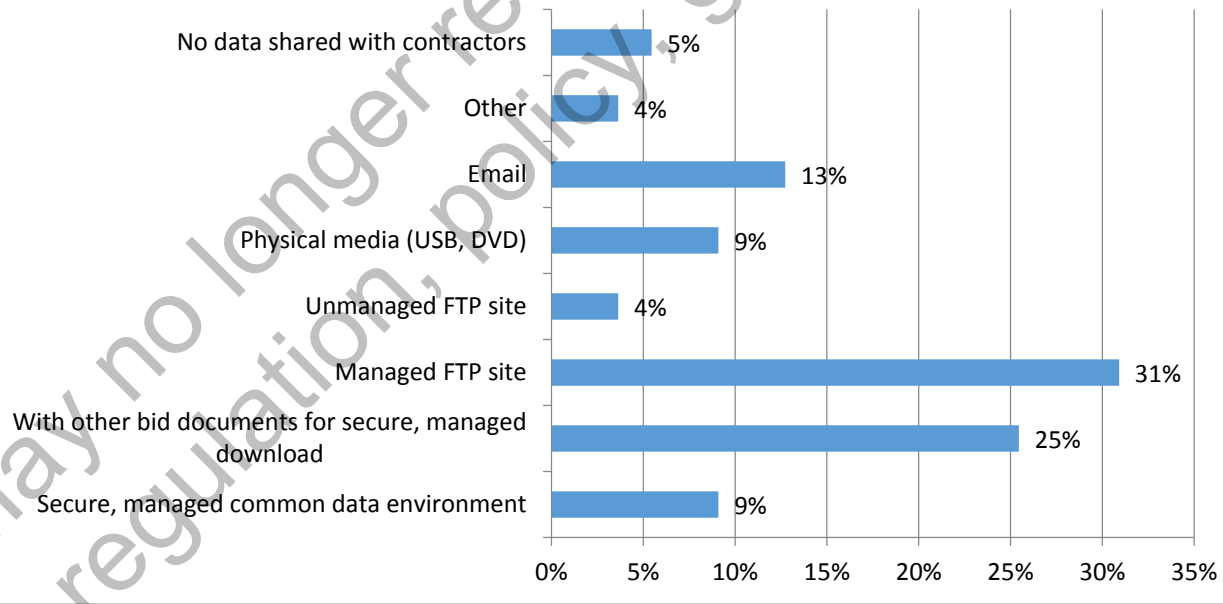


Figure 36: How is your design model format standardized?

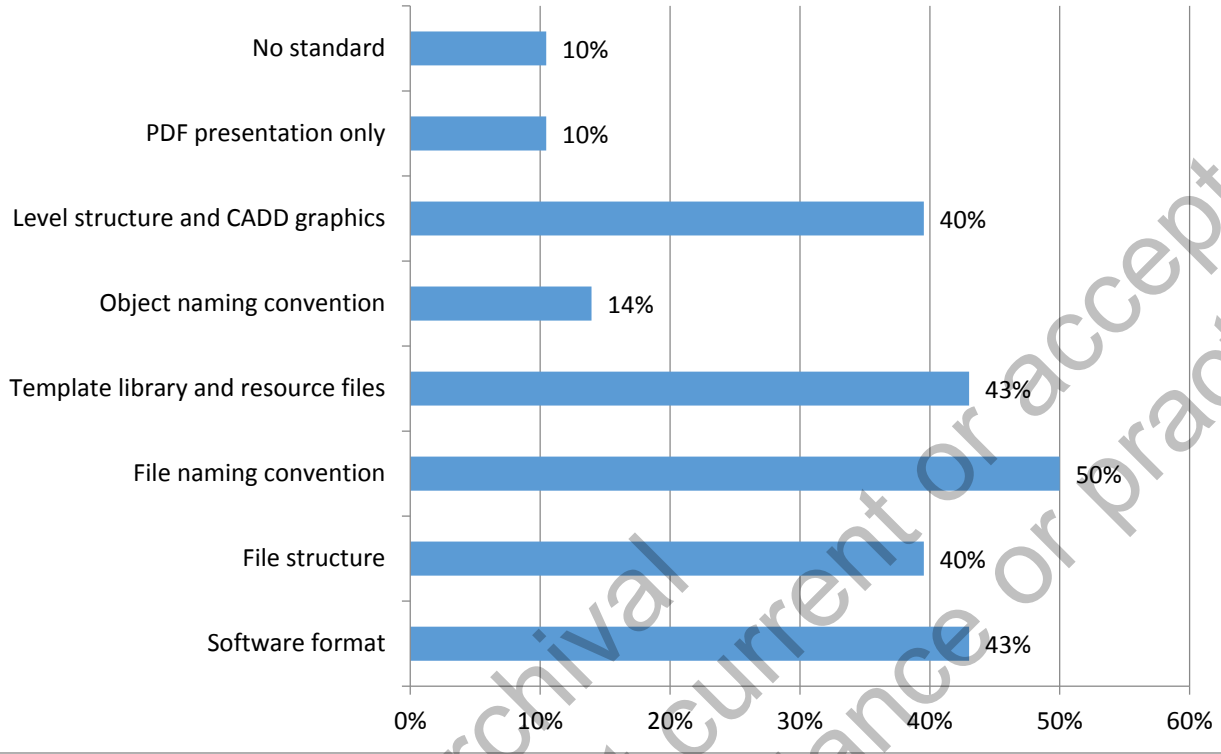


Figure 37: How is your design model documented?

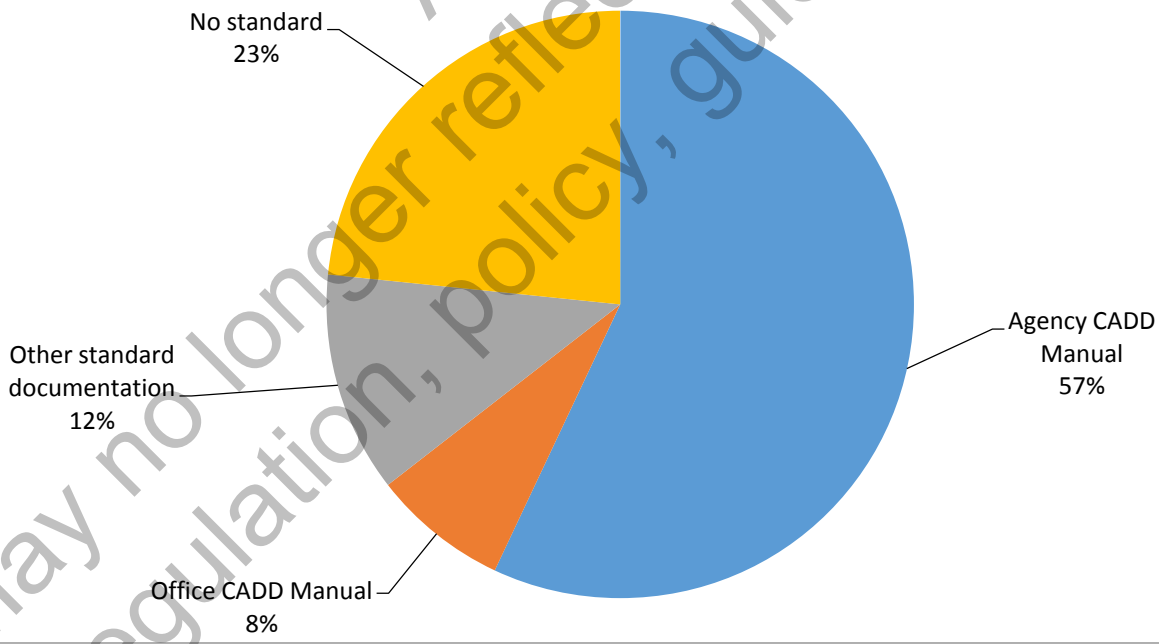


Figure 38: Do you currently sign & seal electronic documents?

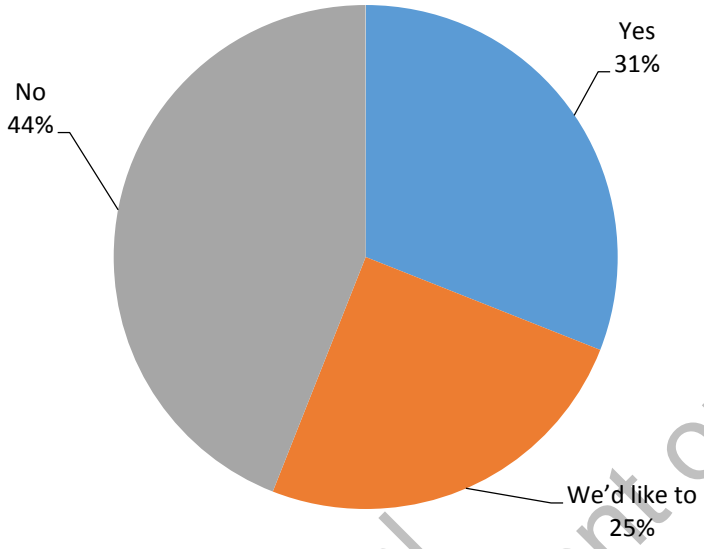


Figure 39: What file types do you sign and/or seal digitally?

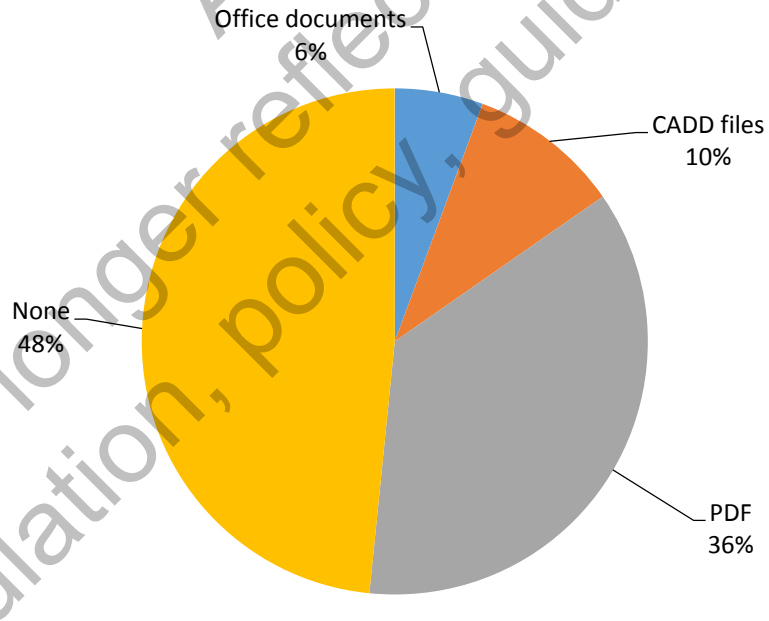


Figure 40: Is digital sign & seal of CADD documents a prerequisite to releasing models for construction?

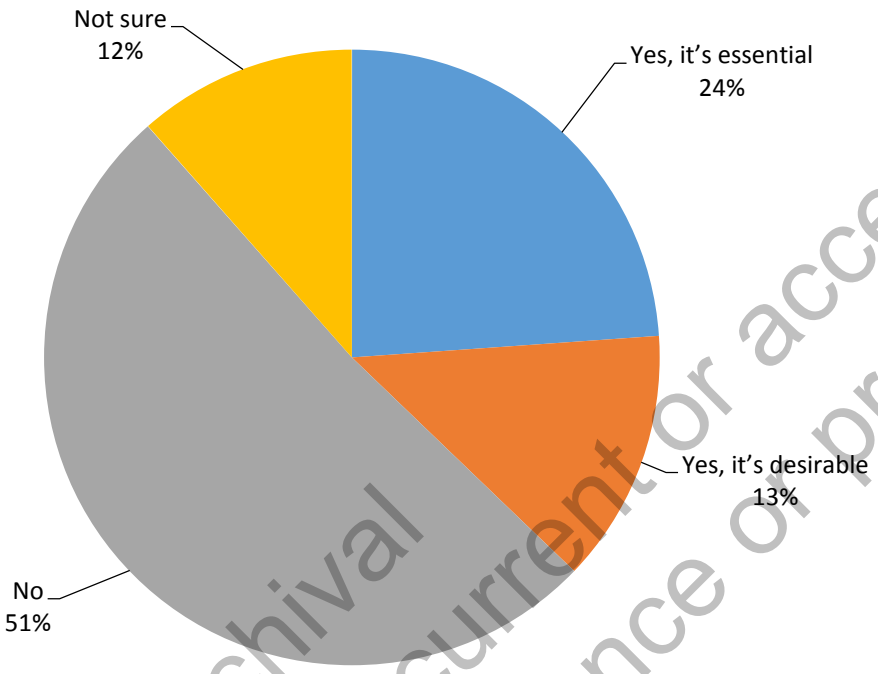


Figure 41: Do you embed survey metadata in your CADD files?

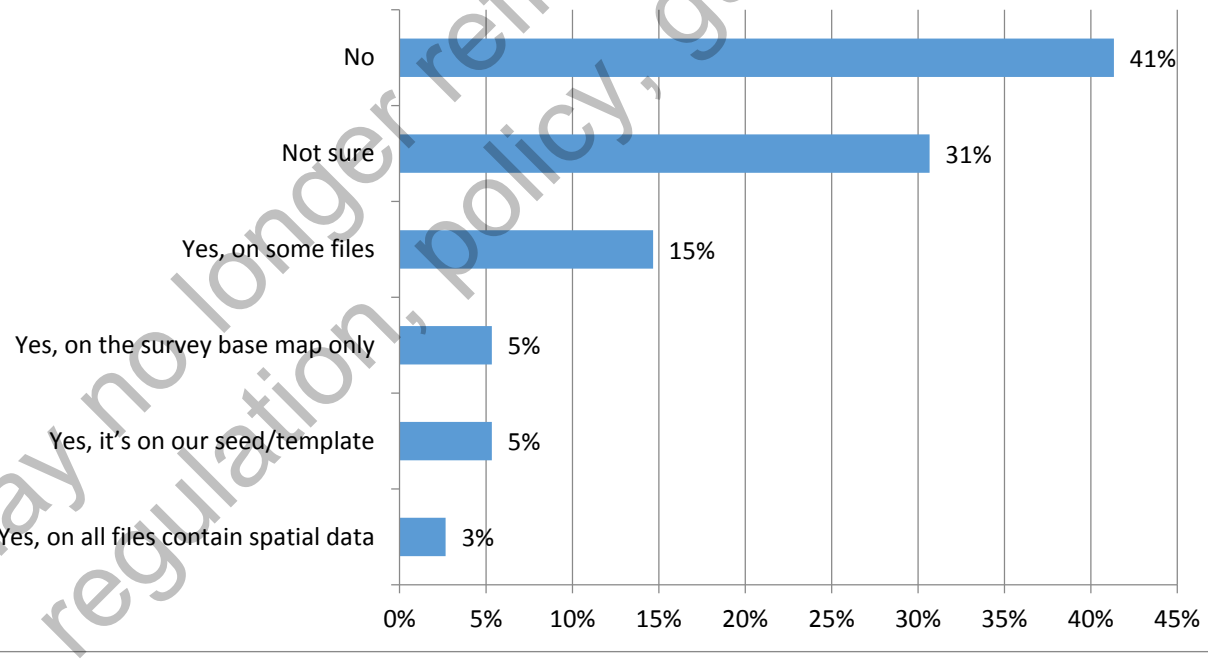
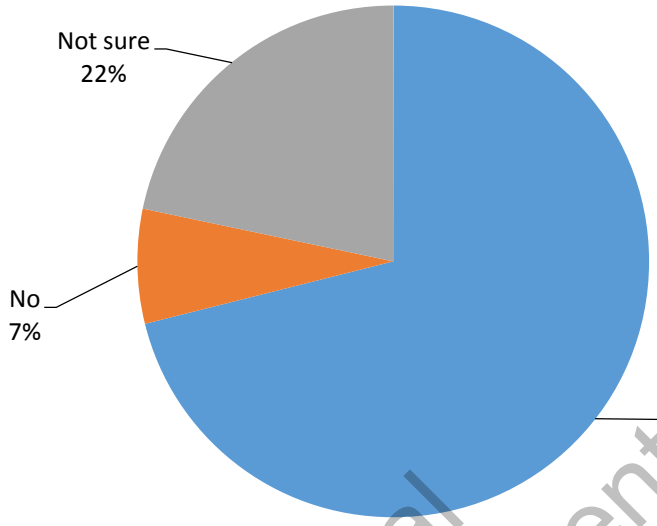


Figure 42: Does your survey metadata describe the basis for the vertical datum?



Question & Answer Summary

Q: Under what conditions would you release key files?
B: Brian: They are issued for information only, it's up to the contractor how to use them.

Q: Which format is best for a large original ground survey file?
A: Paul: LandXML is the most consumable format.

Q: What is a digital signature token?
A: It's a small piece of hardware which holds a digital signature cryptographic key. The tokens have software built into them, and some software solutions require the separate device.

Q: What did you do with signed CAD files when the consumer has a different platform?
A: Bentley has a free viewer that would allow a consumer to view the files. Occasionally Adobe Acrobat is used.

Q: How do you lock CAD files after digital signature?
A: MicroStation has an option that locks the file from being altered, or printed, or copied, etc. At the time of signing you save with those options.

Q: Bruce, was the sample job you showed built entirely in Trimble Business Center?
A: Current 3D software can handle large models; Trimble Business Center was used on that project for no specific reason.

Q: Is the metadata different from metadata in GIS?
A: Bruce:
When I talk about data, I'm talking about original raw data the mapping company used to produce the map, where the ground coordinates have to be checked against the datum. In construction, I need something more precise than one of the datums. Changing datum is risky when you're working on ½" precision. I work more with coordinate systems the designers used.

Q: Will there be a unified standard for roads?
A: It would be very difficult to have a national standard.

Q: How does the software handle station equations?
A: Bruce: All software can handle station equations. The operator needs to understand the calculations behind it, and understand how different computers handle those calculations.

Q: Is there any standard software format to go between platforms?
A: Bruce: Lots of software tools can generate the data. LandXML is exchange format for smart data that's not proprietary. You have to be careful with units when using LandXML, for instance US Survey Feet are different from International Feet, so you need to specify.

Q: What is the legal value of a digital signature? Are they acceptable in court?
A: It varies from state to state.

Q: Bruce, contractors want the original State Survey data. Why do the contractors like the original Survey data?
A: Bruce: The original survey data is what the original design is based upon; it's a liability issue. For the lawsuit I'm involved on, for example, the construction control was different than the original data used for the mapping, and nobody checked for the adjustment between the two. You have to be extremely careful about the datum used and any adjustments applied to it when the design survey was done.

Webinar 6 Overcoming Challenges to Using 3D Models for Construction:

Date and Time of Live Broadcast: September 10, 2014 1:00 pm – 2:30 pm EST
Recording Link: https://connectdot.connectsolutions.com/p98j5ye6u8i/

Description

During the next webinar in the series, barriers to implementing 3D technology in transportation construction projects will be discussed. Professionals from both a DOT and the Transportation Construction Industry will explore challenges that they have experienced in implementing 3D modeling. Our presenters will give examples of past barriers and what their respective organizations did to overcome these challenges. We will share successes from around the country for how these obstacles have been managed, mitigated, and overcome. Participants will be encouraged to ask questions and share their challenges during this webinar.

Learning Outcomes

Each participant will be able to:

- Discuss the national state of the practice for 3D Engineered Models for Construction
- Discuss common challenges to implementation
- Discuss lessons learned during the implementation process
- Identify resources to assist organizations to implement 3D Models for Construction

Speakers

Presenter: Alexa Mitchell, PE
Position: CAD Services Engineer
Company: Missouri DOT
Topic: Challenges Delivering 3D Data to Construction at a DOT

Alexa Mitchel addressed the 8 challenges to implementation 3D models for construction as identified in the first webinar of the series, from her perspective at the Missouri DOT. Five of these challenges were considered by Alexa to have been overcome, the remaining issues being directly related to the lack of funding available to transportation agencies and projects. Investment in training, hardware, and shifting to a new paradigm is a long, difficult process for any state DOT. However, Missouri has begun providing digital data, and has successfully begun using digital signatures on vector PDF contract documents. Digital 3D data is provided as a supplementary source of info but it is For Information Only.

Presenter: Mike Momrow
Position: Head Project Surveyor
Company: Rifenburg Companies
Topic: Implementing 3D Modeling as a Contractor

Mike illustrated how his organization has adopted and implemented AMG and related technologies. The early processes were rife with issues over interoperability and difficulties developing QA/QC protocols. At the time of the webinar, however, the bulk of the organization's construction fleet was equipped for AMG, with rigorous control point check-ins, and close ties to state DOTs to facilitate a streamlined data transfer. The organization became fully stakeless as of September 2014. This required providing GPS rovers for every project; training for staff and quality control processes to be established.

Presenter:	Brett Dean
Position:	Survey Engineer
Company:	New York State DOT
Topic:	Implementing 3D Modeling in a State Construction Office

Brett Dean's presentation was on the New York State Department of Transportation's efforts to implement modern survey instruments for construction engineering and inspection. Securing funding for training, hardware, and development of new workflows required a thorough understanding of the costs associated and the expected return on investment. Advocacy by the contracting community helped to secure the support needed from leadership. The ability to use the newer technologies similar to contractors' and employ more efficient workflows enables better construction outcomes for contractors and owners alike.

Other challenges centered on technical solutions to data handoff, transfer, and format between stakeholders. As noted in previous webinars, several problems are common to 3D digital data exchange. Data must be provided "as-is" and liability remains in the contract documents and not the digital models. NYSDOT efforts with these new tools have resulted in clear, positive, but unmeasured Return on Investment, but success depends on a high degree of involvement from contractors, software vendors, DOT management, and the interpersonal relationships bridging between them.

Registration Information

Total Registrants	301
Number of State DOTs represented	33

Live Audience Demographics

Peak Live Audience: 155 connections

Figure 43: What type of organization do you represent?

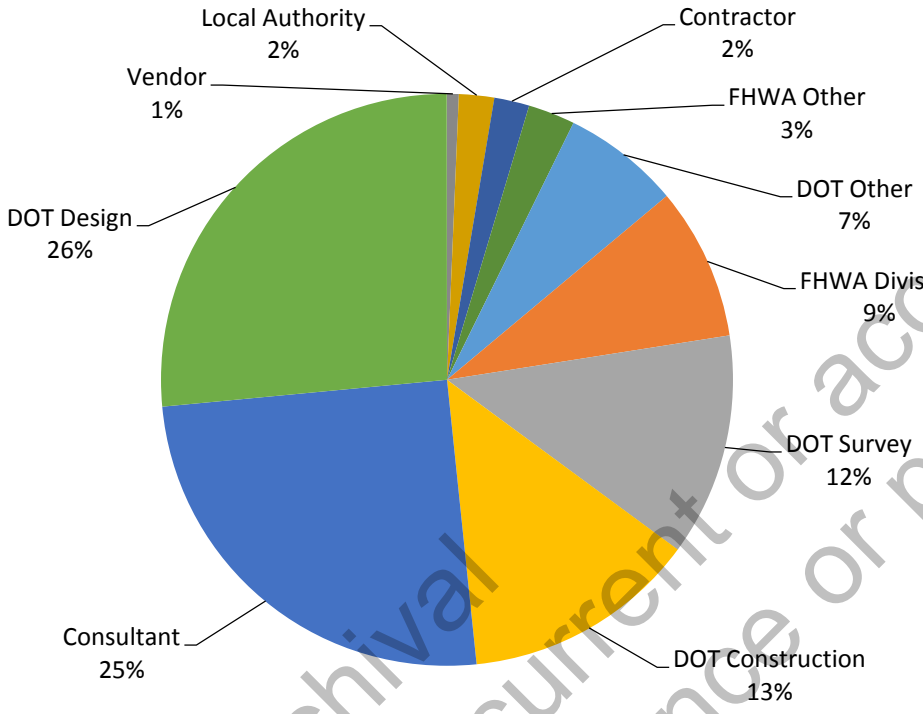
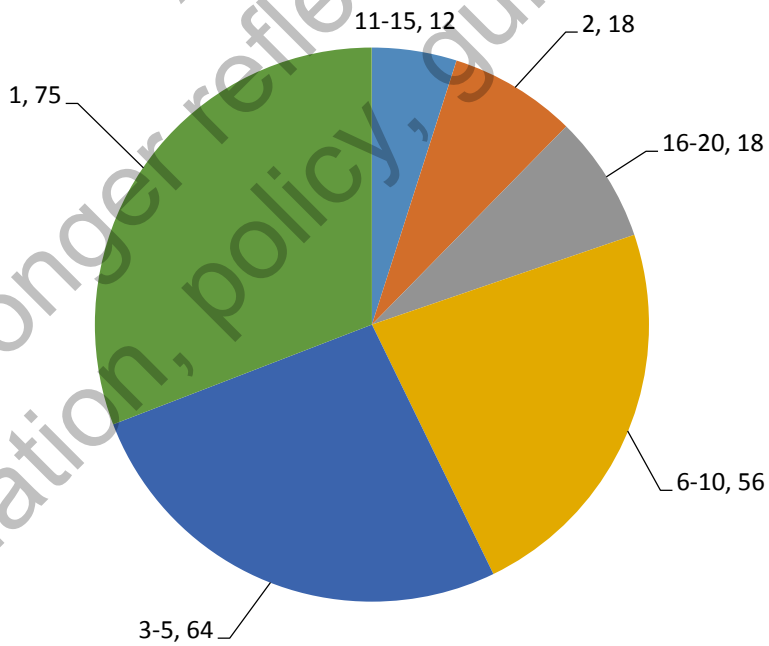


Figure 44: How many people are watching?



Participant Interaction

Figure 45: Select all uses of digital data in your organization

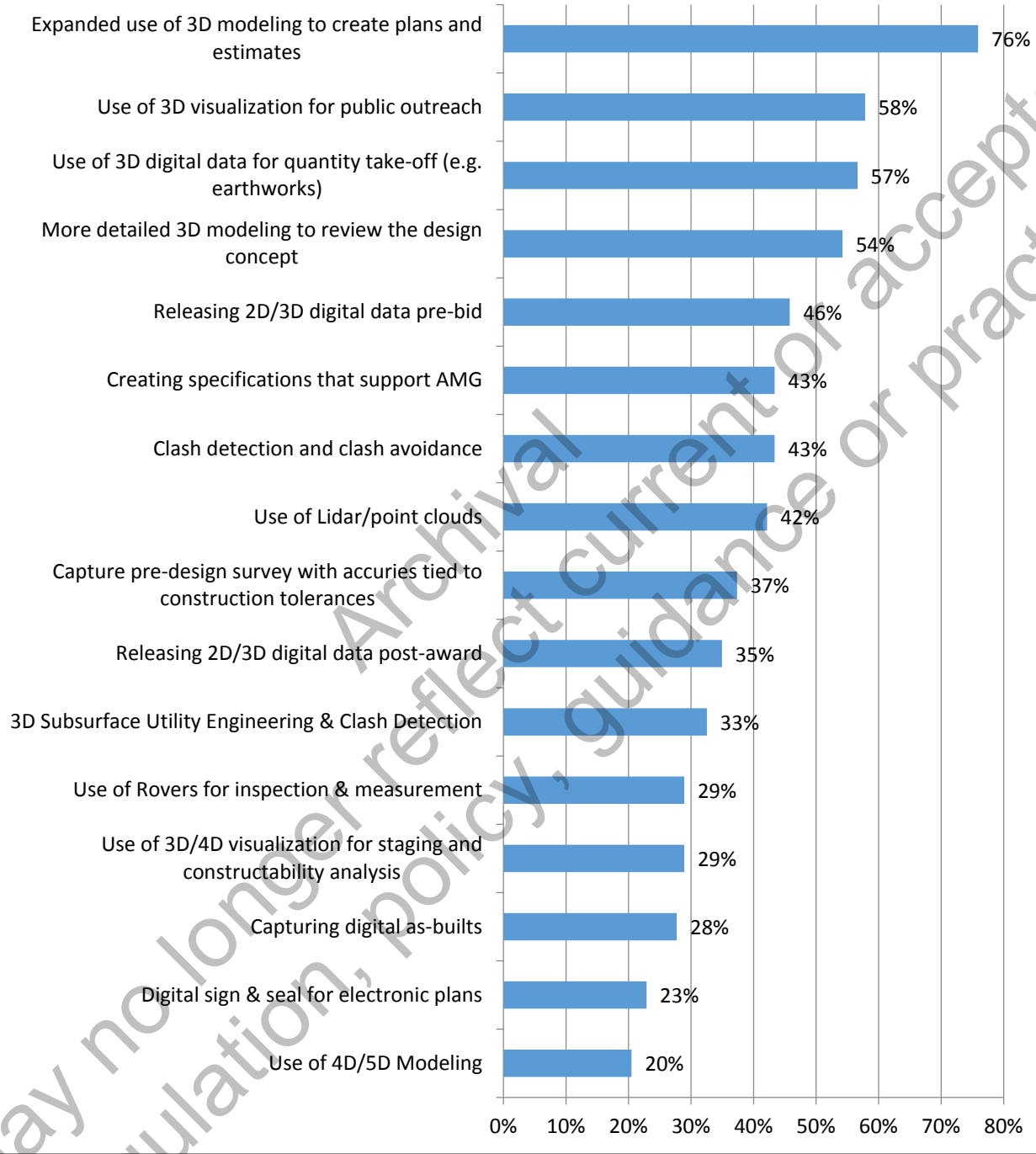


Figure 46: Which challenges do you face? (Select all that apply)

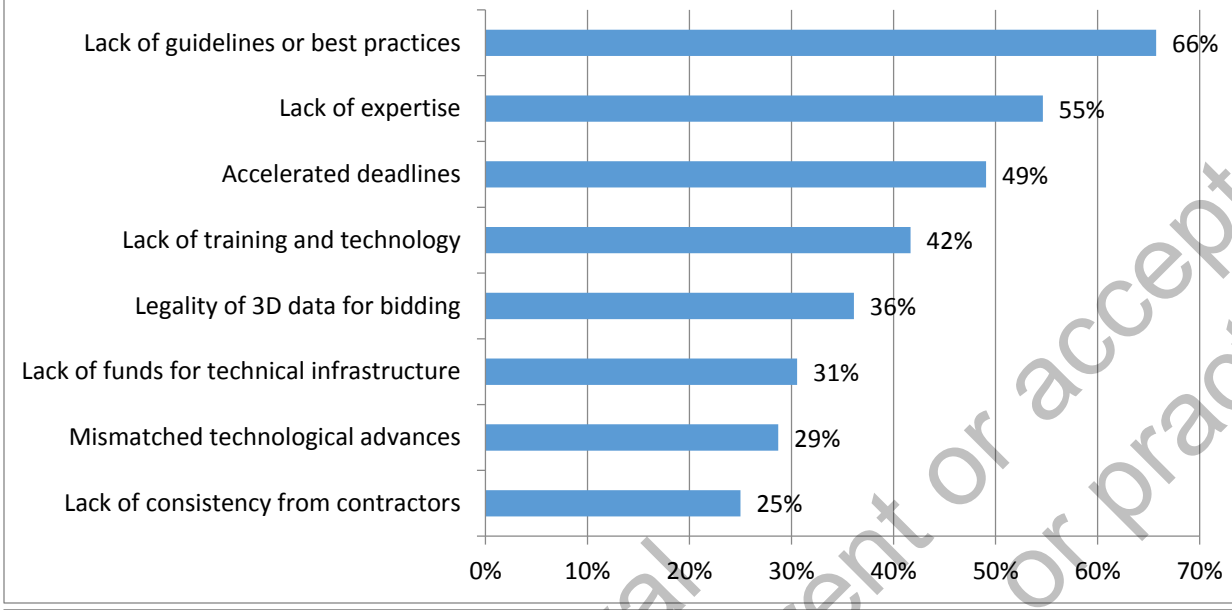
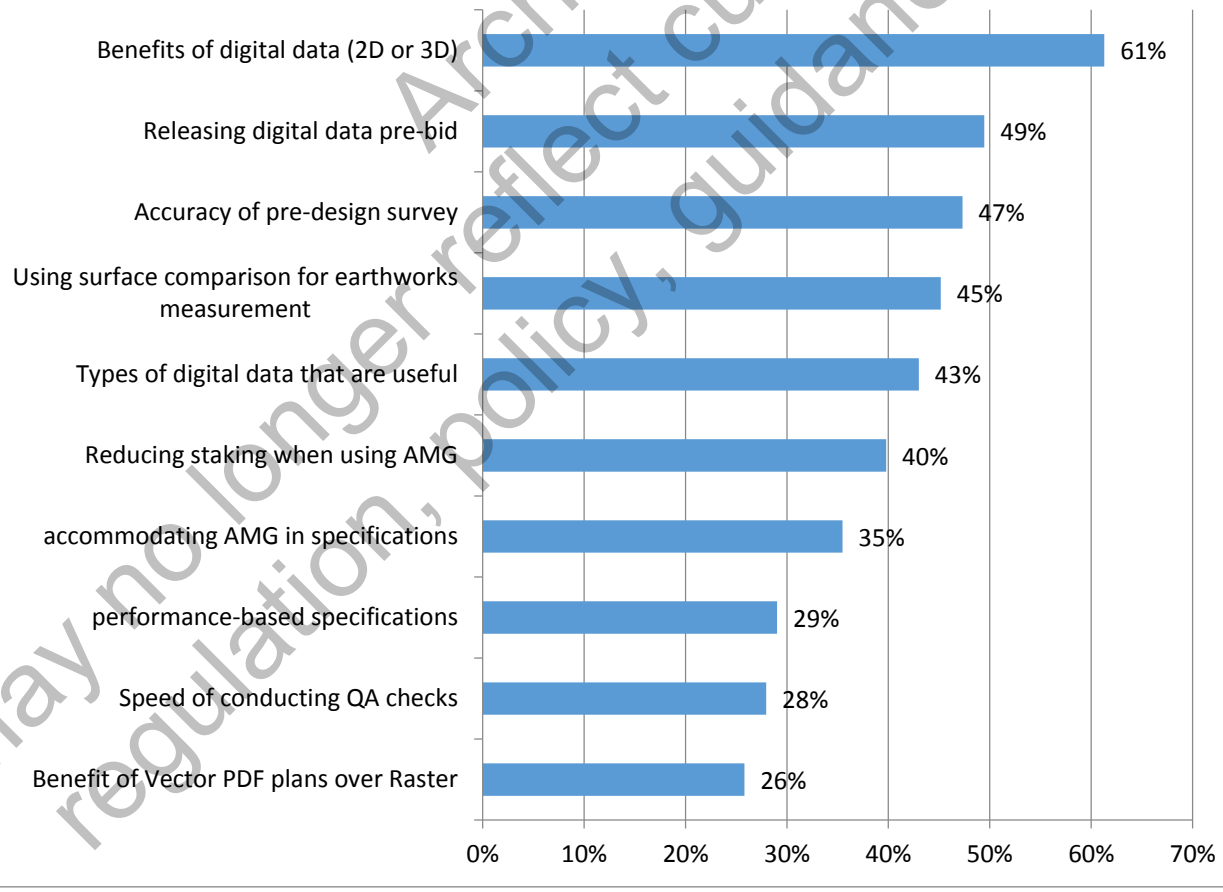
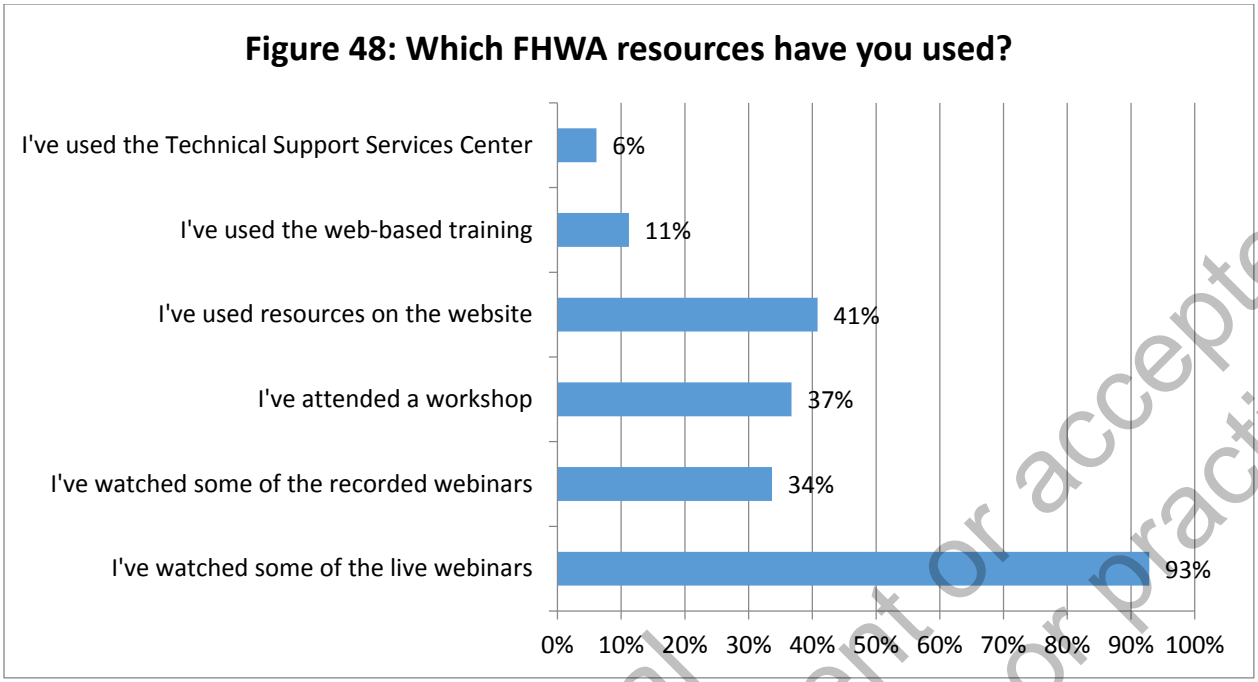


Figure 47: What topics has your contracting community raised?





Question & Answer Summary

Q: Mike, what software do you use?
A: Mike: Carlson Takeoff.

Q: Do you ask for files pre-bid, pre-letting? Percentage of pre-bid requests that provide files? Advantages of receiving files pre-bid?
A: Alexa: Missouri provides data in LandXML and native DTM format. Some contractors want the native files because they use the same software as the DOT. We do provide our files pre-bid. We know that data is used for more than just AMG. The advantage of providing pre-bid is that data can be used for estimating quantities, and as an incentive to apply innovative techniques.

Q: Alexa, is there any advice you can offer for convincing a consulting engineering company's management to train staff on using 3D models on software the DOT requires?
A: We try to have a good relationship without our contractors; we usually don't have a contractor or consultant come on board a project without the capability we require already present. We also provide training in-house for consulting workers on projects. The trainers for the consultants are the same people who trained us, so the models we build end up being the same no matter who's building it.

Webinar 7: Steps to Requiring 3D Engineering Models for Construction

Date and Time of Live Broadcast: October 15th, 2014 1:00 pm – 2:30 pm EST
Recording Link: https://connectdot.connectsolutions.com/p297nu64bwl/

Description

Webinar seven will be very informative for those owner representatives that have been entrusted with implementing 3D Modeling for construction in their respective organizations. We will have two representatives who are from states that are already in an advanced stage of 3D Modeling implementation. They will go through their planning process and explain how they got management and industry support. They will be discussing challenges they overcame as well as sharing lessons learned in implementing 3D Modeling for construction. Regardless of the stage/phase that your organization might be in, this webinar should help your team in implementation of 3D Modeling for construction as an accepted design business practice.

Learning Outcomes

Each participant will be able to:

- Describe the motivation for implementation
- Describe how implementation was managed
- Discuss key initiatives
- Describe pilot project lessons learned
- Describe approaches to providing training
- Discuss the value of 3D modeling
- Identify ongoing activities and next steps

Speakers

Presenter: Brad Hollister
Position: Lead Methods Development
Company: Wisconsin DOT
Topic: Wisconsin DOT Design Model Implementation

Brad Hollister discussed how Wisconsin DOT identified the need for an organization-wide 3D Technologies Implementation Plan. In consultation with Wisconsin University College of Civil Engineering, Wisconsin DOT engaged the Methods Development Unit to help develop specifications, just-in-time online training programs, and develop guidance and standards for implementing 3D modeling as a standard design practice.

Brad stressed the point that the approach taken met Wisconsin DOT's needs, and is not necessarily consistent with the culture of other DOTs. Of primary importance among the lessons learned by Wisconsin DOT are:

- A consistent 3D model is the goal and work done should not compromise this goal, despite the 2D requirements of the contract documents
- There is extra work associated with modeling in 3D that was not present in traditional 2D document production; budget and schedule need to reflect this
- The technical and pragmatic considerations required by changing software platforms are usually underestimated

Presenter: Della Mosier
Position: Regional Roadway Manager
Company: Oregon DOT
Topic: Oregon DOT's Engineering Automation Journey

Della Mosier presented on how Oregon DOT had been using 3D modeling for nearly two decades without formalizing the workflows and deliverables. Documents outlining a long-term vision for Engineering Automation and a 6-year plan for Construction Machine Automation set goals, but had not been adopted. After the 2010 "Design-to-Dozer" event, in which only digital exchange of 3D design data led to successful subgrade construction in a demonstration event, regional design managers became inspired to implement a more formal 3D modeling standard.

Initial efforts were to create a specification for AMG, address the need for training and creating a technical brief describing the standard design deliverables for letting and post-award. The standard is to provide LandXML format alignment and final surface data. Post-award a more comprehensive set of 3D data is provided that is customized to the needs of the successful contractor. In 2014, compliance with the technical brief was voluntary. Early indications have been that the process is easy for designers to adopt and beneficial to contractors. There has been a noted decrease in addendums for projects with 3D digital data available at advertising.

Registration Information

Total Registrants	195
Number of State DOTs represented	38

Live Audience Demographics

Peak Live Audience: 129 connections

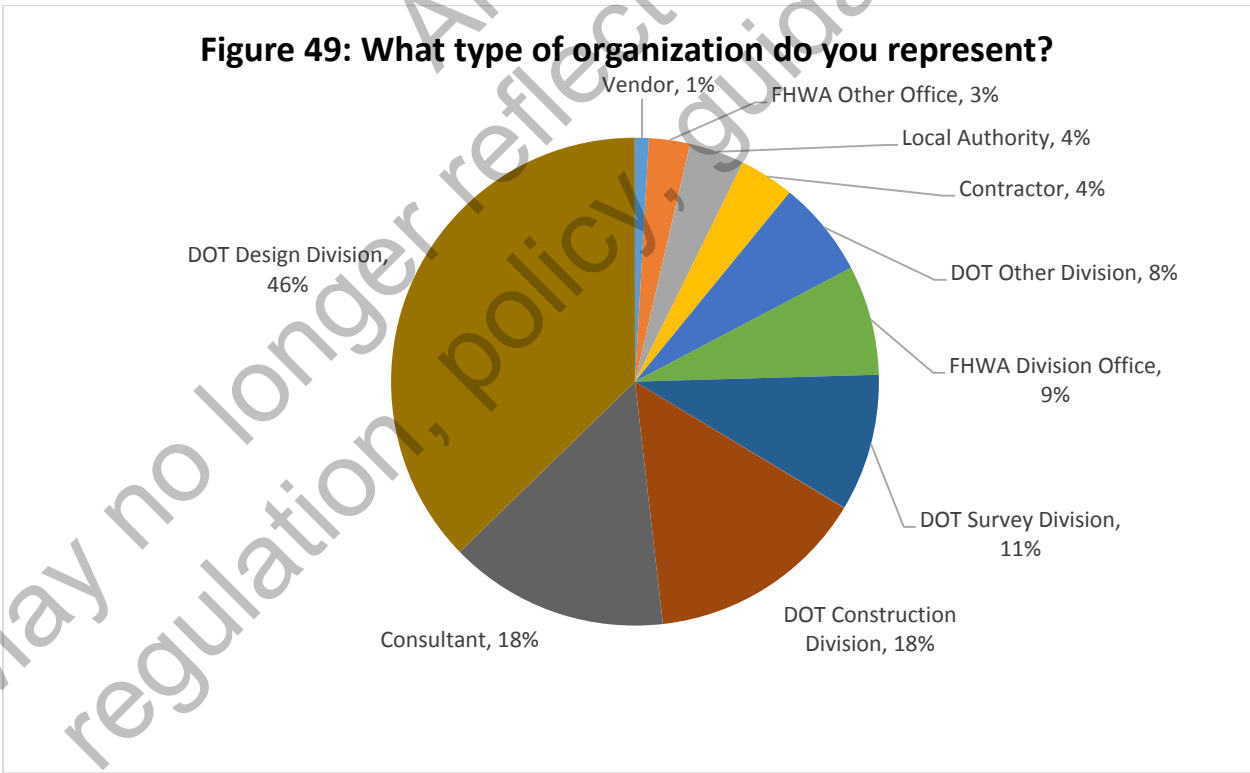
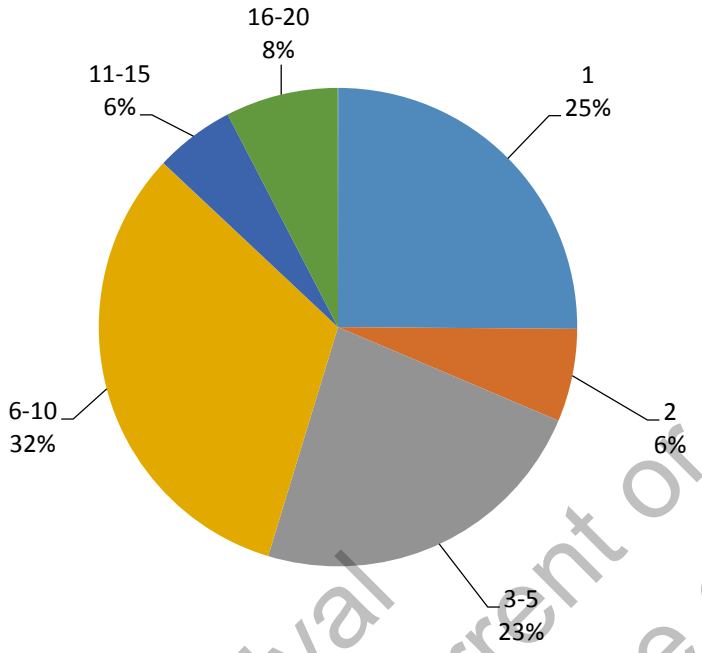


Figure 50: How many people are on your connection today?



Participant Interaction

Figure 51: Has your organization ever been involved in a claim because of 3D modeling?

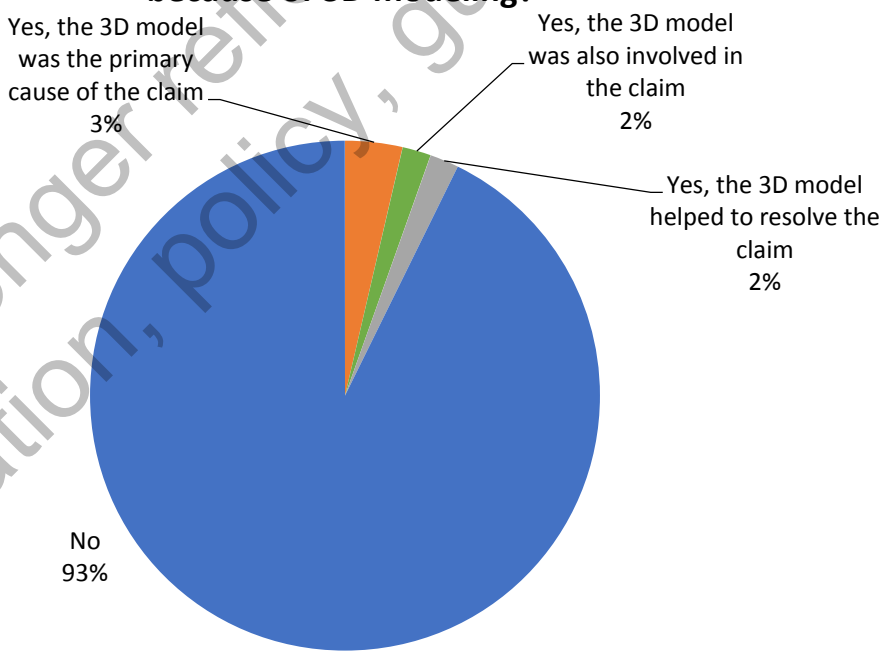


Figure 52: How does 3D modeling affect Construction cost?

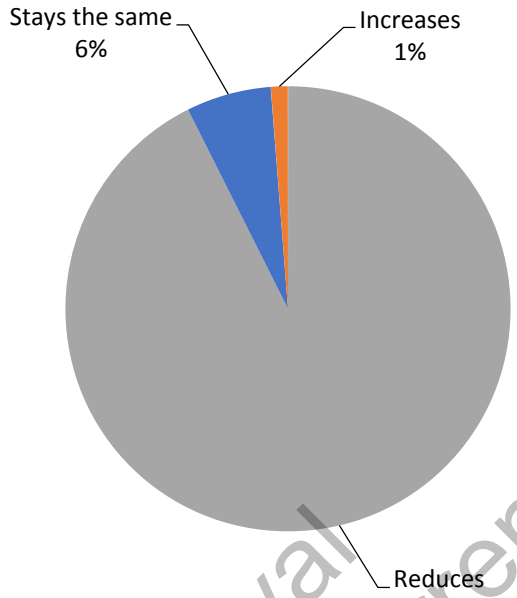


Figure 53: How does 3D modeling affect Design cost?

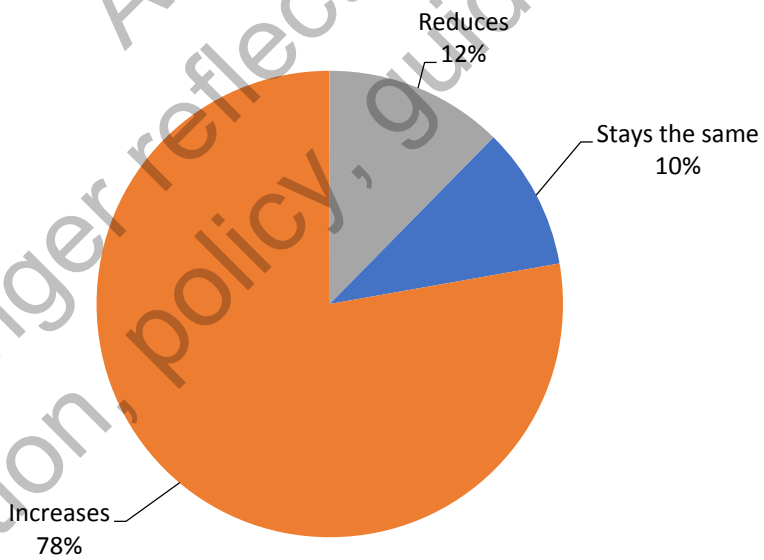


Figure 54: Does your agency have a formal strategy for 3D Modeling Implementation?

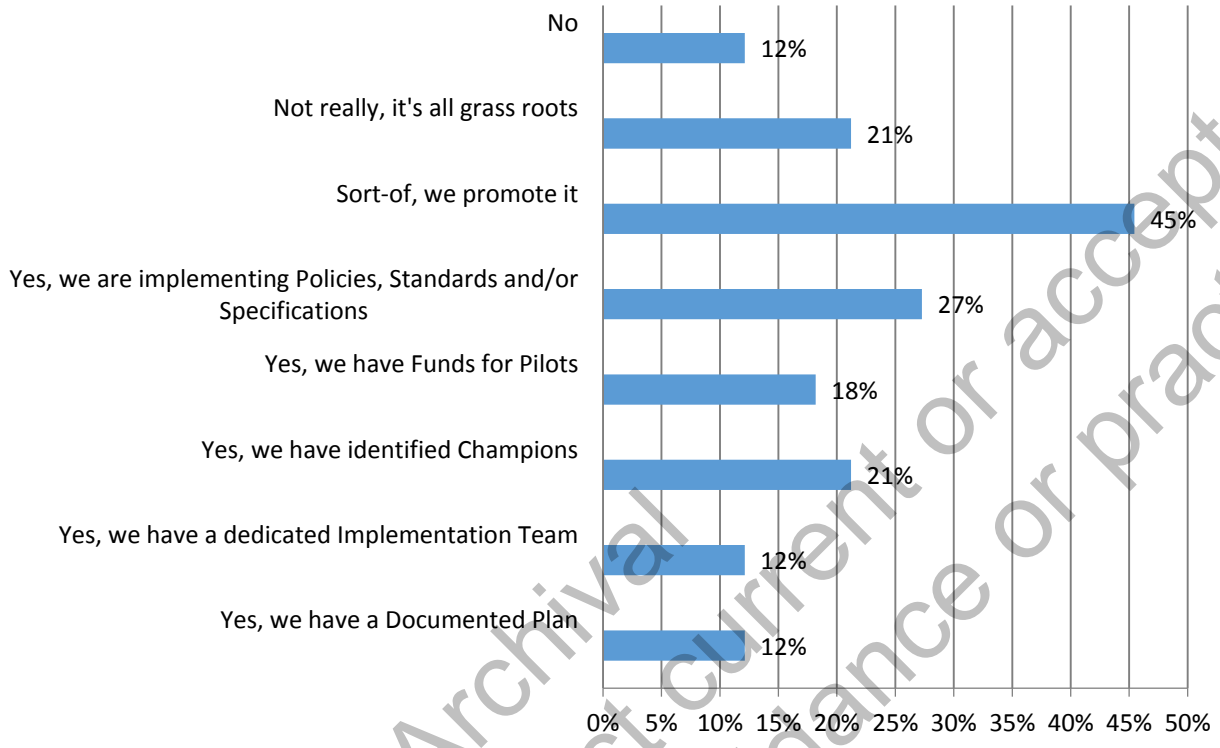


Figure 55: Which Stakeholders does your organization consult with in their 3D implementation?

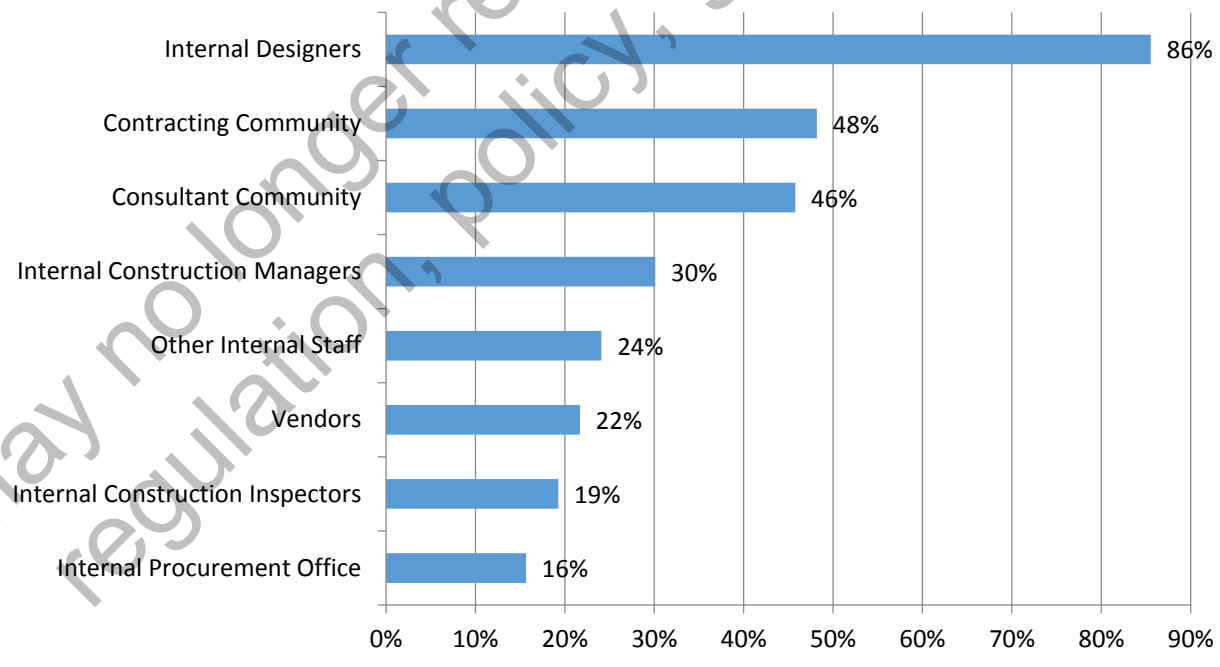


Figure 56: What training sources do you have available to you?

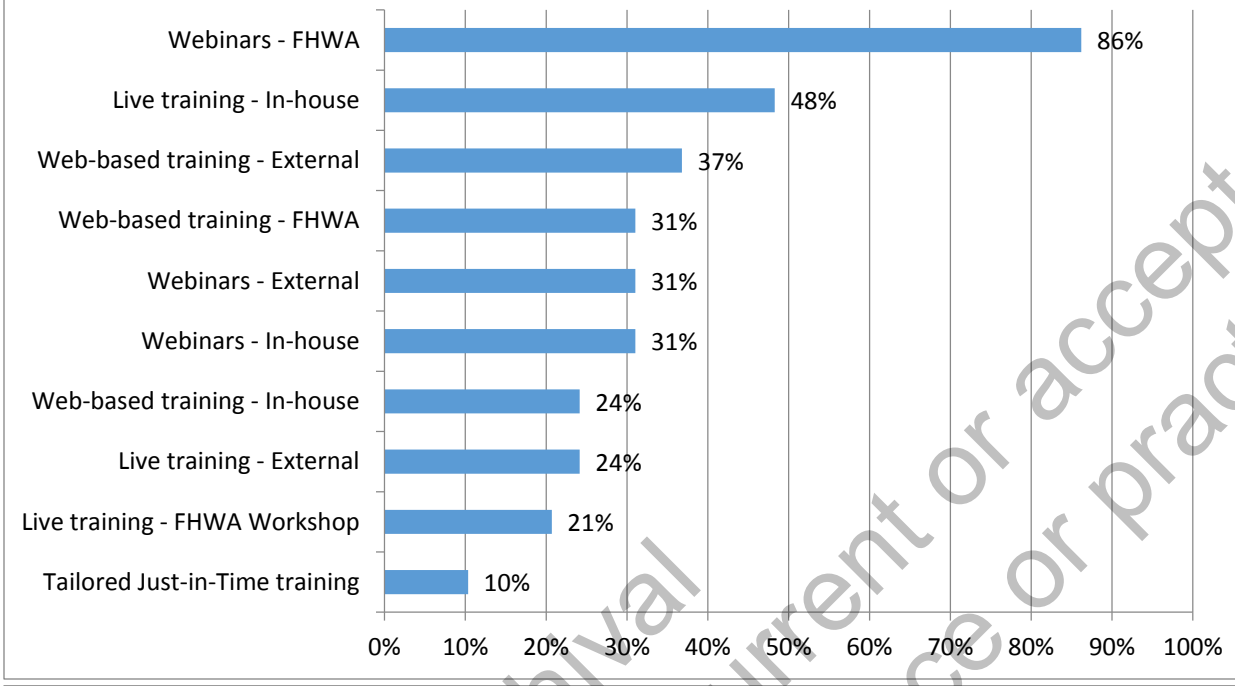
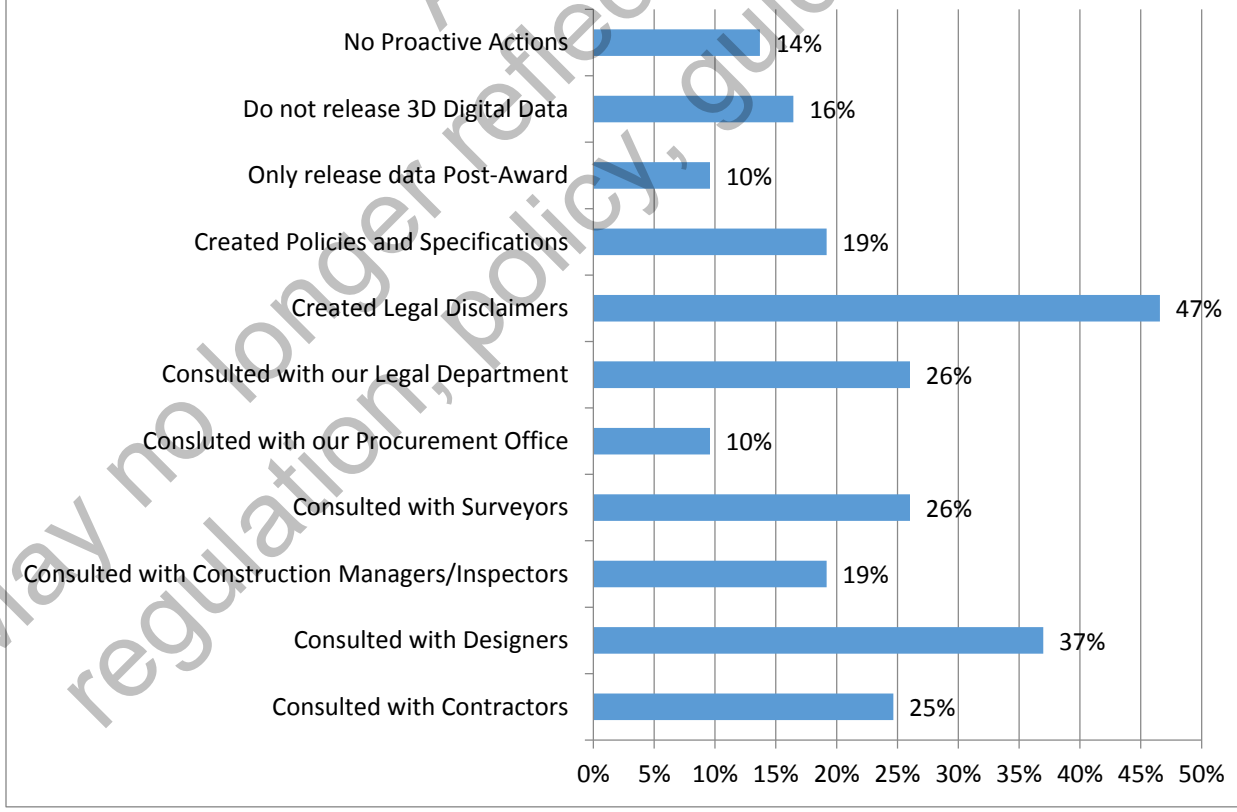
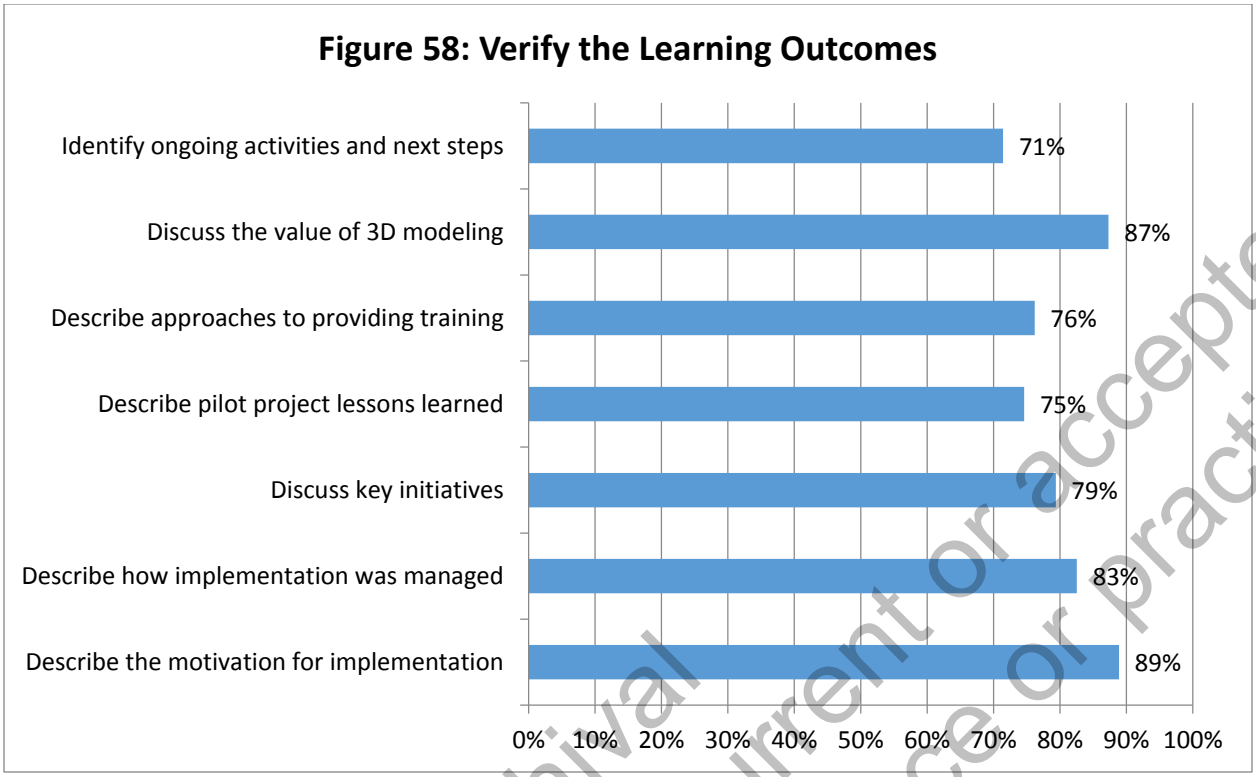


Figure 57: What has your organization done to manage risk associated with releasing 3D digital data for Construction?





Question & Answer Summary

Q: How often is there a conflict between the 2D documents you issue and the Design Model?
A: Brad: If we follow the workflow, there should be almost no conflicts. This relates to our lessons learned; when workflows weren't followed, conflicts arise.
A: Della: At ODOT our claims have been from our design not being complete. Our efforts thus far have reduced our claims.

Q: Has WisDOT made any submittal changes?
A: Brad: We have not eliminated any information we've historically provided. We've added to the information we deliver. Design Model content has the information available to replace the plan sheets, but for the foreseeable future we are providing the same information in our plan sets.
Della: ODOT has been focused on getting our digital data together between design and construction. As far as putting a model in the contract plans, we need our design quality; we need some tools that make it easy to check our level of confidence before we throw away the paper.

Q: Are you using LandXML?
A: Yes

Q: What are the pitfalls of using the design model as contract documents?
A: Brad: We haven't studied it. It's going to have more influence than we can see. It may require legislation, there are hosts of technical issues. It will be a major undertaking.
A: Della: Until we develop Quality Control workflows that reduce most claims, we can't even have a conversation about making them part of the contract.

Q: How specific are 3D deliverables you provide?
A: Della: Other DOTs have had a lot of requirements and standards. All we at ODOT are delivering is the surface; which can be developed using almost any software. We purposely (and partially selfishly) have just kicked out a finished surface and alignments, which allows the contractor to innovate with their software during bid, which we want to encourage. We've not put requirements on the model, but on the output. That said, we are still in discovery.
Francesca: We had an experience where it is good to standardize, to provide a counter perspective.
Brad: Historically we had an open software requirement. I think we could have kept it in place, but thinking forward to greater utilization of models, we were already having issues with data transfer, and we were seeing a loss of data; some of the intelligence does not get communicated with LandXML. Now we have started requiring certain standards on 3D model format to retain that intelligence.

Webinar 8: The Future: Adding Time, Cost and Other Information to 3D Models

Date and Time of Live Broadcast: November 11, 2014, 1:00pm to 2:30pm EST
Recording Link: https://connectdot.connectsolutions.com/p9he6vmo3is/

Description

This will be the last webinar in a series of eight where the focus will be on the future of 3D modeling. Participants will learn how 4D and 5D models are a natural progression of 3D modeling. The presenters will provide examples of how 3D modeling has been successfully implemented along with 4D and 5D on large Design-Build projects. Additionally, hear what the FHWA's future plans are for continuing 3D modeling in EDC-3.

Learning Outcomes

- Describe conceptually how 4D and 5D models are created
- Identify different types of 4D and 5D models and how they are used
- Identify FHWA products available to support 3D modeling
- Describe what's to come for 3D modeling during EDC-3

Speakers

Presenter: Francesca Maier
Position: Lead Engineer
Company: Parsons Brinckerhoff
Topic: Overview of 4D and 5D Modeling

Francesca provided a brief description of the definitions of 4D and 5D models. A 4D model is a 3D design model which has its constituent 3D elements linked to a construction schedule. A 5D model is a 4D model also includes cost information which can be displayed on screen and which changes as the time parameter changes. The benefits of 4D and 5D modeling appear to result from increased collaboration and timely decision-making, which leads to more predictable construction outcomes and better risk allocation and management.

Presenter: Paul DiGiacobbe
Position: Senior V.P.
Company: HNTB
Topic: Use of 4D and 5D Models in Design-Build Development

Paul showed beneficial uses of 4D and 5D modeling for design-build during the bid and delivery phases. Three chief drivers were identified: public involvement, advanced alternative analysis, and design decision support. Paul gave examples of the application of 4D models and demonstrated the impacts on projects, particularly large projects. The critical methods in the application were also presented, especially commitment to an early adoption of 3D with specific levels of detail. Several benefits, chiefly related to communication and public involvement, were enumerated. Finally, there was a brief demonstration of a web-based delivery of a 5D model which allows high-fidelity, navigable access to a project simulation, with obvious benefits to public outreach and stakeholder collaboration.

Presenter: Craig Ruyle
Position: Construction Manager
Company: New York State DOT
Topic: Use of 4D and 5D Models in Construction Management

Craig described the intended use of 4D and 5D to manage the replacement of the Kosciuszko Bridge Project, which carries the Brooklyn-Queens Expressway over Newtown Creek in New York City. As the first large design-build project for the DOT, the impetus for 4D and 5D modeling was to provide transparency and accountability for interim payments, though the many other benefits of 4D and 5D modeling were acknowledged and intended. The DOT defined detailed requirements for 3D, 4D and 5D modeling, including which elements to model, the level of detail with which to model them, and the outputs from the modeling such as images and videos, as well as the timing for delivering these outputs. The Request for Proposals also defined a Model Manager role that needed to be staffed.

Presenter: Chris Schneider
Position: Construction Management Engineer
Company: FHWA
Topic: 3D Modeling Support Products and the EDC-3 Activity

Chris Schneider described the currently available 3D modeling products developed during EDC-2. He then introduced the focus of the 3D Modeling activity for EDC-3. The primary products include the webinar archive, the website (www.fhwa.dog.gov/3d), a Technical Support Services Center, with assistance and personal responses from national subject matter experts and the four, 120-minute web-based training modules available for free at the users' convince.

Registration Information

Total Registrants 300 (all available slots were filled)

Live Audience Demographics

Peak Live Audience: 154 connections

Figure 59: What type of organization do you represent?

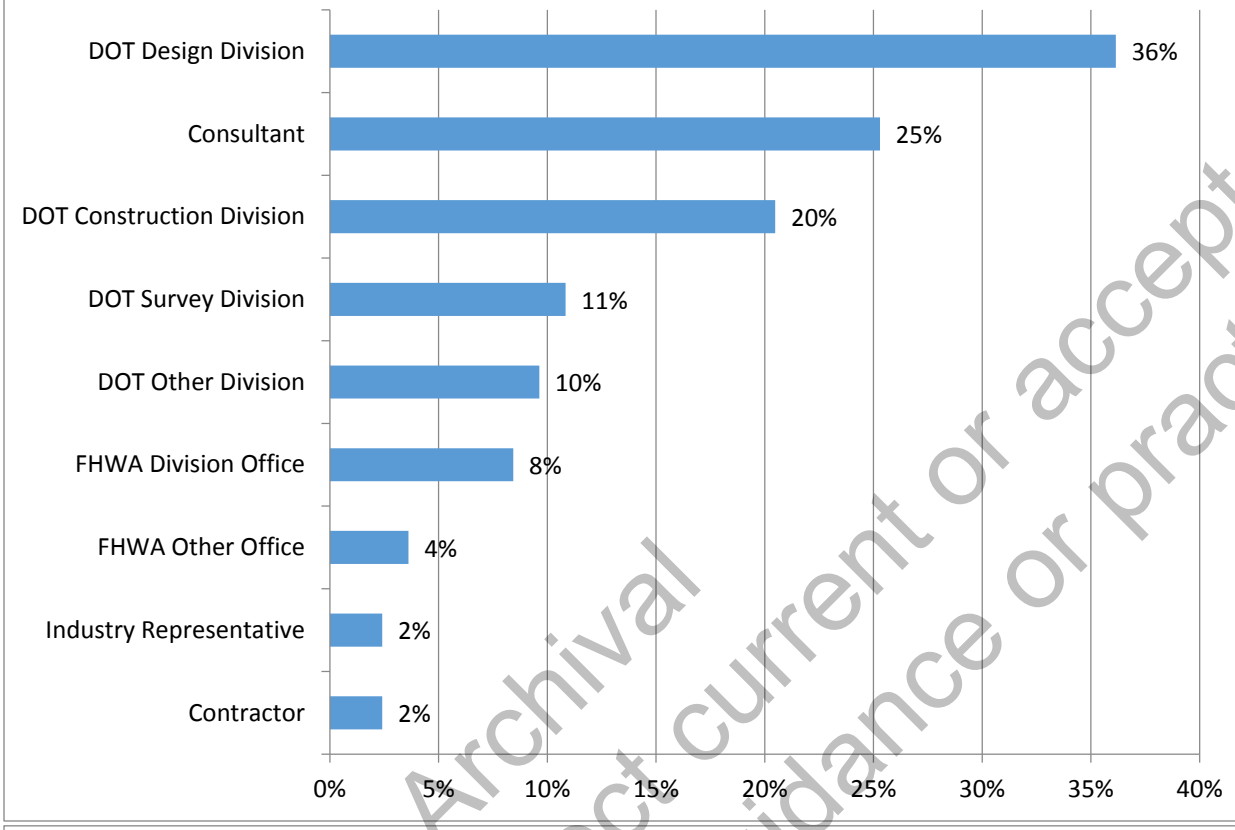
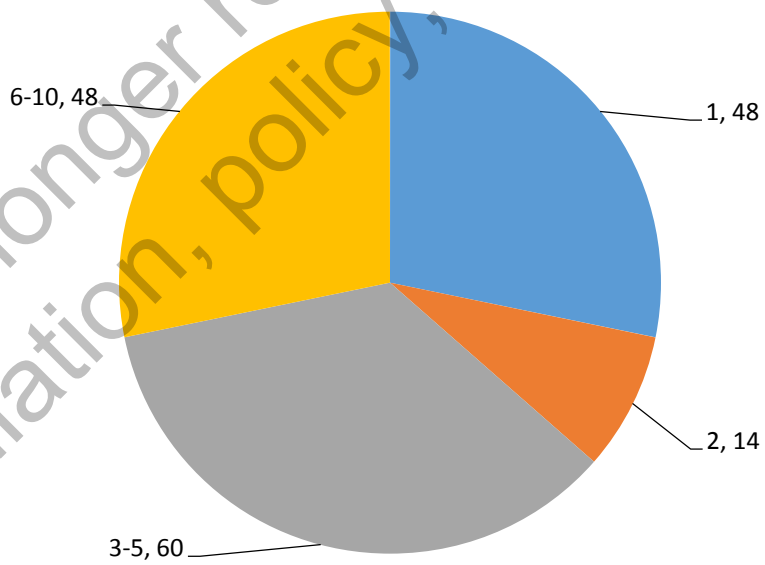


Figure 60: How many people are on your connection today?



Participant Interaction

Figure 61: How do you think 4D modeling helps project delivery?

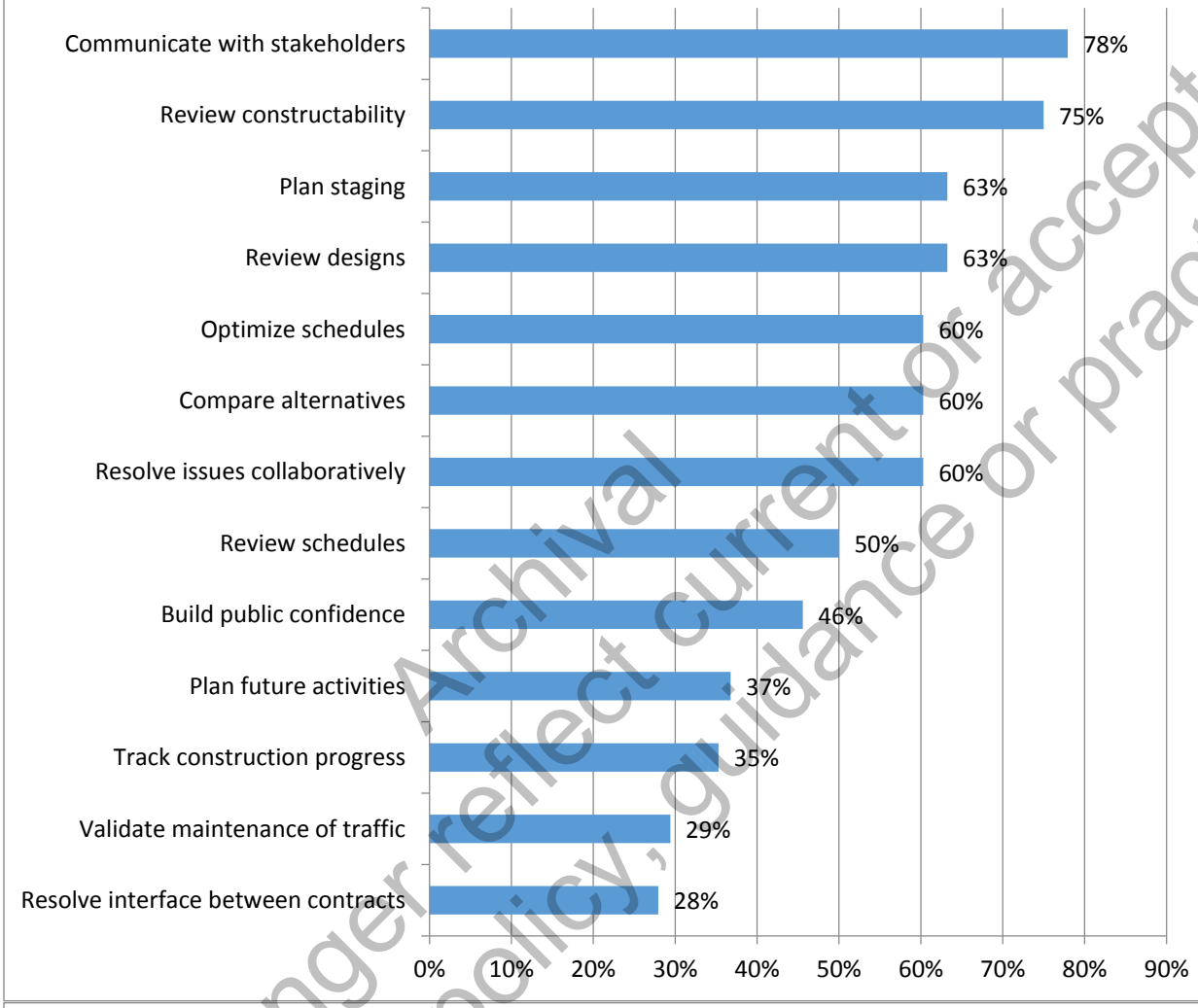


Figure 62: Has your organization used 4D or 5D modeling yet?

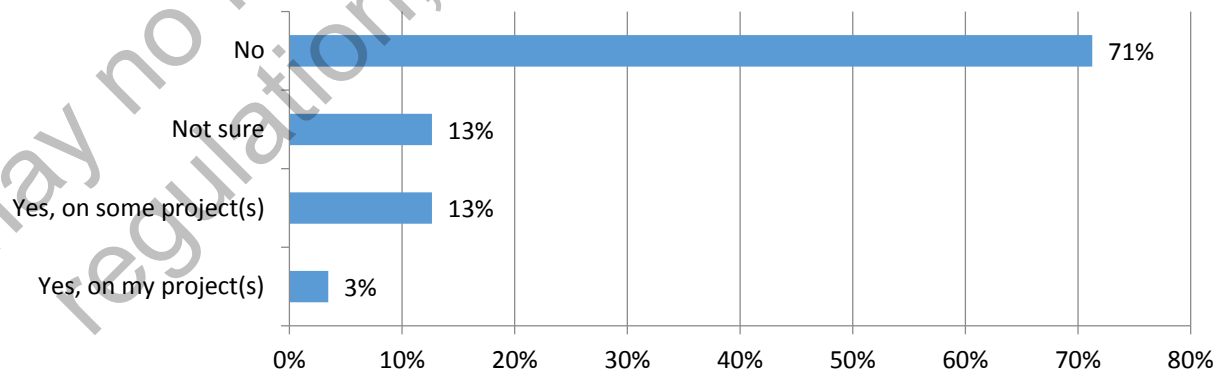


Figure 63: Who benefits from 4D or 5D modeling?

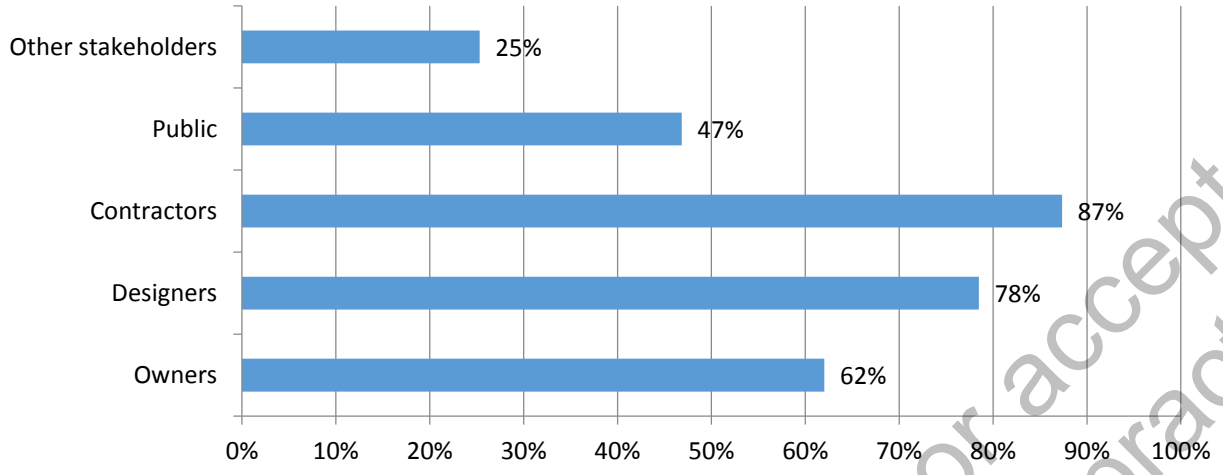


Figure 64: What types of projects benefit from 4D modeling?

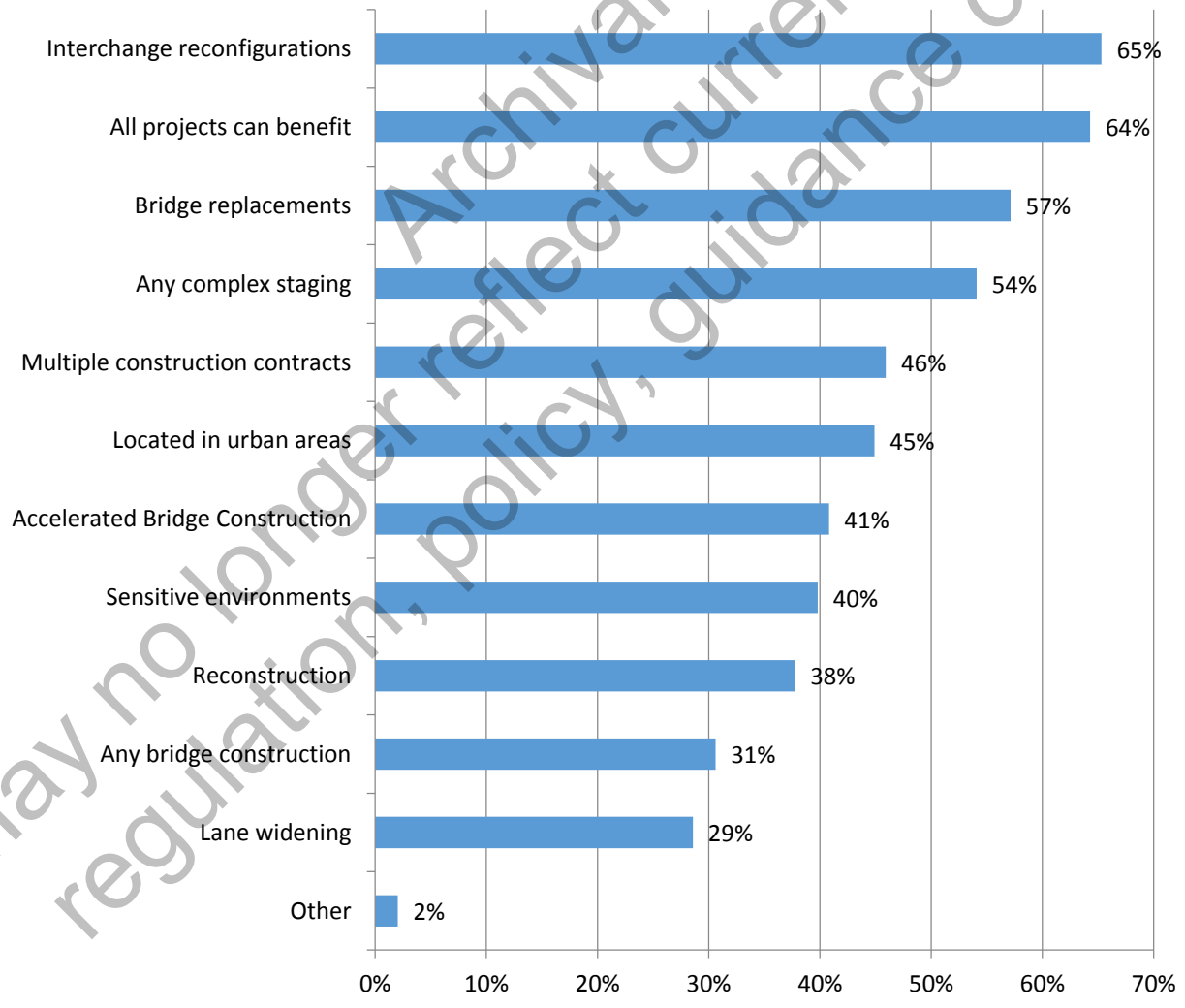
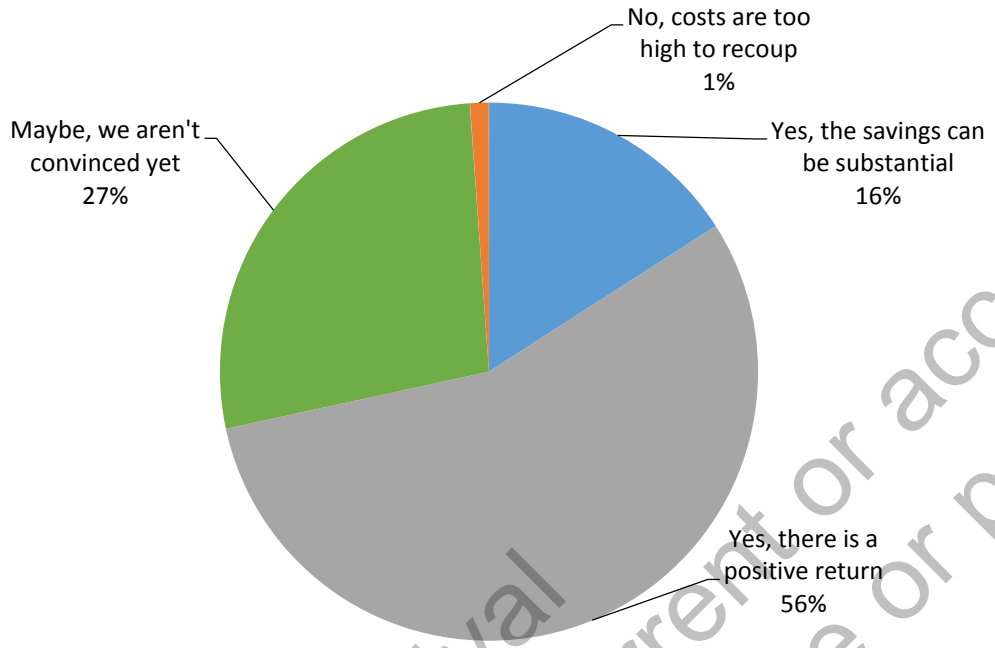


Figure 65: Is it worth owners initiating 4D or 5D modeling?



Question & Answer Summary

Q: What was the software used in the example projects shown?
A: Bentley Navigator.

Q: Can Bentley Navigator link a Microsoft Project schedule?
A: Yes, but this functionality is now included in newer versions of Bentley MicroStation.

Q: Will the Model Management Plan/Manager Specification be made available?
A: It can be found in Section 26 of the Kosciuszko Bridge RFP and can be provided upon request.

Q: Did NYSDOT have issues with discrepancies between the 2D plans and the model?
A: In this particular instance the 2D plans will only be provided as as-built plans.

Q: Was any structural design software used to create a 3D model?
A: Yes, however we are not sure precisely which platform was used. Bentley LEAP may have been used on the approaches.

Q: What risk management software was used on the design-build project?
A: On the K-Bridge project no specific software was used, but risk management procedures were heavily used.

Q: Does Synchro 4D handle model files with references or does all model information need to be packaged into a single file?
A: Navisworks, MicroStation and Synchro 4D can all handle multiple 3D files.

Q: Were the K-bridge videos considered a contract document?
A: The videos contract deliverables, but sequences shown in the videos are not legally binding.

Q: Why did NYSDOT ask for 2D as built plans when they could afford the full benefit of 3D?
A: Partly because this project required the same documentation as all previous projects, and also because the specification was for the 5D model to be used over the course of the project.

Q: What type of files are typically required and delivered for design build projects?
A: To create 4D or 5D models we deliver 3D DGN or DWG files and PrimaVera P6 files or exports. Previous webinars discussed file formats delivered for AMG, where LandXML was generally preferred.

Q: How long as NYSDOT been using 3D modeling, and can you describe briefly how it has affected CADD standards?
A: NYSDOT has used 3D modeling for a number of years. There are different levels of 3D design; for the most part, NYSDOT works at the lowest level. There are Digital Terrain Models for the projects which are typically delivered to contractors. The biggest hurdle for implementing 4D modeling is the lack of a detailed standard for solid 3D models for 4D modeling.

Q: Would NYSDOT use the same model requirements for Design-Bid-Build procurement?
A: There are some upcoming Design-Bid-Build projects where 4D is being considered. In this case the 4D modeling would likely be done in-house or through the consultant. NYSDOT is still exploring the optimal mode of using 4D modeling in Design-Bid-Build procurement.

Q: What level of utility and relocation information is required by the utility team for K-bridge?
A: Contractor is required to show all known utilities in 3D, including any information provided and captured by test pitting. As the model is maintained, all utilities should be included. They should tag all utilities with GPS for more accurate position information.

Q: Do you deliver 3D models for surfacing projects?
A: AMG is not common in New York City, where there are seldom projects with large volumes of excavation and the buildings provide challenges for GNSS reception. AMG paving would be desirable because it leads to better quality roads. There is some experience in Region 11 in Staten Island, but AMG is common in Upstate New York.

Q: Has compliance with the utility companies been a problem?
A: Part of the problem is that they don't know where everything is. Procurement of the information is always a challenge, and is not always reliable.

Q: How will the K-bridge as-built models be stored?
A: The final deliverable will be Synchro 4D model, as well as 3D files compatible with NYSDOT's current CADD platform, which is Bentley MicroStation SS3 with InRoads SS2.

Q: How does an engineer sign & seal a digital model?
A: Some states have a digital signature law. New York does not have a system, and there is no consensus. Digital signatures were discussed in Webinar 5. Those states that have implemented digitally signed and sealed drawings have limited it to 2D PDFs. Utah has explored digitally signed and sealed MicroStation files, as discussed in Webinar 5, but it caused technical issues so is now only used for standard drawings.

Q: Would it have been cost-prohibitive to use GPR for utilities?
A: In Region 11 (New York City) it hasn't been valuable, especially in Manhattan where historic and abandoned utilities are common and there are so many utilities in the ground.

Q: How much additional time is needed to develop the 3D/4D model?
A: It's an interesting question; there's no real answer. It depends on how you approach it. If your project starts in 3D, it's very easy. The ROI is hard to find as well, but the value is there. It's hard to say what the value is. Until the industry comes up with a standard practice, we can't come up with a meaningful number. For now, it takes a little extra money at the start.
A: Remember design costs are small compared to construction costs; even if you spend more on up-front modeling, you gain larger benefits in construction where costs are an order of magnitude greater.

Q: Does NYSDOT use MicroStation/Civil 3D or a combo?
A: NYSDOT uses MicroStation and InRoads with ProjectWise.

Q: How is construction inspecting work on the K-bridge without 2D plans?
A: There are plans, but they are still determining what they are. The contractors submits work plans for each operation. They are verifying tolerances and positions, but they don't have to measure quantities.

Prepared by:
Jonathan Q. Struthers Parsons Brinckerhoff
Francesca Maier, PE Parsons Brinckerhoff
Sonya Darter Applied Research Associates, Inc.

February 4, 2015