Ron Singh, PLS  
Chief of Surveys  
Engineering Automation Manager  
Oregon Department of Transportation

AGC Annual Meeting  
19 February, 2016
Agenda

- Section Mission
- Initiatives (Current and Near Future)
- Work in Progress
Highway Lifespan

Engineering Automation

STIP Project Lifespan

Engineering Documents

Engineering Data

Survey | Design | Construction
Mission

- To Provide Leadership in all Aspects of Engineering Automation
  - Survey
  - Design
  - Construction
  - Supporting Systems

- Research New Technology
  - Stay Informed of Industry Trends
  - Plan for the Future

- Initiate, Develop, and Implement New Initiatives
- Provide Training, Technical Support and Guidance

In Collaboration with Regions, Technical Services Sections, other ODOT Partners, FHWA, Industry, and Academia.
By

- Inspiring
  - Informing (visiting Regions/webinars)
  - Exciting (hands-on demonstrations)
  - Fostering Collaboration (involving users)

- Leading
  - Taking Input from Regions
  - Making Decisions to Standardize Across ODOT

- Advising
  - Providing Direct Consultation
By

- **Removing Obstacles**
  - Understanding Region and Industry Needs
  - Developing Systems and Processes to Meet Needs

- **Implementing Initiatives**
  - Providing Training and Guidance
  - Reviewing Work Performed
    - Modifying Standards
    - Updating Training

- **Taking Responsibility**
  - Customer Feedback
  - Improving
Engineering Automation

Supporting Systems

3D Everything

3D Survey

3D Design

Construction Automation
Single Point of Contact for Regions

Regions
- Project Delivery

Engineering Automation
- Initiatives

SSDM
- PM Support

Information Systems
- IT Support
Engineering Automation Section

- Geometronics Unit
- Engineering Technology Advancement Unit
3 Components of Machine Control

1. The design and resulting data
2. The machine w/computer, sensors, hydraulic controls, and data communication
3. The positioning system – GPS, TPS, laser, or combination
Machine Control

The ultimate system:

- No stakes required
- No grade checker required
- Records data for quality control
- Records data for volume computation
- Data could be transmitted to engineer, inspector, or surveyor for “real time” checks
Benefits (short list)

- **Contractor**
  - Less Bid Risk
  - Reduced Material Handling
  - Less Error
  - Increased Profit

- **Oregon DOT**
  - Reduced Construction Costs (~6% by FHWA estimate)
  - Conveys Design Intent Better
  - Better Quality (increased life expectancy)
  - Reduced Construction time (~30% by FHWA estimate)
  - Increased Safety (workers and motorists)
  - Better Material Quantity Management
ODOT’s Approach to AMG

- 3D Pre-Design Survey
- 3D Design
- Digital Bid Packet
- Pre-Construction Survey
- 3D Model Provided to Contractor
- Tools for Inspectors
- Post Construction Surveys (future)
- Integration with 3D Virtual Transportation Corridor, Asset Management, and GIS (future)

Automated Machine Guidance FAQ (Chris Pucci)
Current Initiatives

3D Survey
- LiDAR
  - Static
  - Mobile
    - Survey Grade
    - Statewide

Construction Automation
- Automated Machine Guidance (AMG) – Limited Features
- Positioning Tools for Inspectors
- eConstruction (Paperless Construction Documentation)
- Intelligent Compaction
- 3D Milling

3D Design
- Roadway Prism
- eBids (Preliminary Data at Bid Letting)
- Survey Handoff Package
- 3D InRoads Training

Supporting Systems
- Engineering Data Management (ProjectWise)
  - Document Management
- Digital Signatures
Near Future Initiatives

3D Survey
- Unmanned Aircraft
  - Quarry Mapping
  - Bridge Inspection
- Subsurface Utility Engineering (SUE)

Construction Automation
- Automated Machine Guidance (AMG) – More Features
- Post-Construction Surveys
- Data Integration
  - Asset Management
  - GIS/TransInfo

3D Design
- Beyond Roadway Prism
- Bridge
- Subsurface Features

Supporting Systems
- Engineering Data Management (ProjectWise)
  - Workflow Management
  - Geospatial Attributes and Search Capabilities
Work in Progress
Documents, Specifications, Training, etc.
3D Roadway Design Web Site

www.oregon.gov/odot/hwy/3drdm

3D Roadway Design

Effective January 1, 2015: ODOT Requires Delivery of Roadway Digital Data Bidding Reference Packages

Contractors have been looking for, and adopting, many tools and methods to cut costs and improve highway construction projects. But they are increasingly using machine control equipment in order to provide more cost-efficient project delivery of a digital data bidding reference package for most roadway construction projects. This tool is anticipated to yield construction savings on the order of 6% and time savings of 30-40%, according to Casey Alicea, senior project manager at ODOT, which will result in a more accurate and accurate budget.

Video: ODOT 3D Design to Build

How Many Roadway Digital Data Packages has ODOT Provided to Bidders?

2014: 10 Projects from 4 Regions
2015: 16 Projects from 5 Regions and 2 Consultant Partners

3D Roadway Design Related Documents

Frequently Asked Questions
- ODOT Highway Design Manual (HDM) Chapter 16: 3D Roadway Design
- ODOT HDM Appendix M: Digital Design Packages
- ODOT HDM Appendix N: Digital Design Quality Control
- ODOT Technical Bulletin: 3D Roadway Design

Upcoming 3D Roadway Design

January 2016: “Just in Time Training” 3D Roadway Design
These ODOT-specific InRoads SS2 Labs were created modules on Advance InRoads Design. From Giant to you. Download the lab you want and learn the software.

2016: FHWA Every Day Counts 3. 3D Engineered
3D Roadway Advanced Training

- Demonstrates the use of advanced InRoads modeling techniques that can be used in the creation of 3D engineered models
- The modules can be taken sequentially or as-needed
- Accessing the modules through iLearn.Oregon.gov will create a transcript that can be used to document PDHs.

Ray Thwaits
# 3D Roadway Advanced Training

<table>
<thead>
<tr>
<th>Title</th>
<th>PDH</th>
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<tbody>
<tr>
<td>Introduction To Use Of Training Modules/Lab Exercises</td>
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<tr>
<td>Visualization of InRoads Data</td>
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<tr>
<td>Working With InRoads Features</td>
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<td>Rock Slope Benching Using InRoads</td>
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<td>Overburden End Condition Using InRoads</td>
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<td>Retaining Walls Using InRoads</td>
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<td>Abutments Using InRoads</td>
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<td>Minor Approaches and Driveways Using InRoads</td>
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<td>Guardrails Using InRoads</td>
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<td>Overlay Tools and Widening Using InRoads</td>
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<td>Modeling Gores Using InRoads</td>
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<td>Intersection Modeling Using InRoads</td>
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www.oregon.gov/ODOT/CS/east/Pages/Training.aspx
## 3D Design Project Stats

### 2014

10 projects in 4 Regions

<table>
<thead>
<tr>
<th>Contract No.</th>
<th>Project Name</th>
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<tr>
<td>14658</td>
<td>OR39: MERRILL NCL - CALIFORNIA STATE LINE</td>
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<td>14662</td>
<td>OR 42: COUNTY LINE CURVES PHASE 1</td>
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<td>14671</td>
<td>FFO-US97@CHERRY LANE &amp; FFO-US26@DOVER LANE MADRAS</td>
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<td>14742</td>
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<td>14761</td>
<td>FFO-US97 @ 1ST STREET (LAPINE)</td>
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<td>14766</td>
<td>US97: J STREET INTERSECTION (MADRAS SOUTH Y)</td>
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<tr>
<td>14765</td>
<td>I-205 AT SE STRAWBERRY LANE OVERCROSSING</td>
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# 3D Design Project Stats

## 2015

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<td>I-5: ANLAUF - ELKHEAD RD PAVING</td>
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<td>14785</td>
<td>I-5: EXIT 61 (LOUISE CREEK) INTERCHANGE IMPROVEMENTS</td>
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<td>14793</td>
<td>US97: MORO-MADRAS SEC</td>
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<td>OR62: FORT KLAMATH SIDEWALK IMPROVEMENTS</td>
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<td>14803</td>
<td>OR224 (CLACKAMAS HWY): SE 197TH AVE</td>
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<td>14810</td>
<td>OR140: BOWERS BRIDGE AND QUARTZ CREEK CULVERTS</td>
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<td>14808</td>
<td>FFO-OR 138E: CORRIDOR SOLUTIONS (ROSEBURG)</td>
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<td>14825</td>
<td>OR8: SW 185TH AVE.</td>
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<td>I-5: SISKIYOU REST AREA (ASHLAND)</td>
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<td>EMPIRE BLVD: NEWMARK AVE-WASHINGTON RD (COOS BAY)</td>
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<td>OR224 (CLACKAMAS HWY): SE 232ND DR SECTION</td>
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<td>14851</td>
<td>I-5 SB: BROADWAY-WEIDLER EXIT RAMP (PORTLAND) PROJECT</td>
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<td>14853</td>
<td>ROGUE-UMPQUA SB: GUARDRAIL &amp; TURNOUT IMPROVEMENTS</td>
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<td>14859</td>
<td>LOOKINGGLASS CR RD: LOOKINGGLASS CR BR REPLACEMENT</td>
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<td>US97 @ WICKIUP JCT (LA PINE) SEC</td>
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<td>OR38: LUDER CR CULVERT REPLACEMENT</td>
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<td>14861</td>
<td>US101 @ NE DEVILS LAKE RD</td>
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# 3D Design Project Stats

## 2016 (to date)

### 6 Projects in 3 Regions

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<td>OR42: GRAY CREEK CULVERT REPLACEMENT</td>
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<td>14875</td>
<td>17TH AVE TRAIL: SE OCHOCO - SE MCLoughlin</td>
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<td>14872</td>
<td>US20 PME: ENVIRONMENTAL MITIGATION MEASURES</td>
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<tr>
<td>14879</td>
<td>OR18 @ CHRISTENSEN ROAD SECTION</td>
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</table>

Special thanks to Della Mosier (Region 4 Roadway Manager) for her leadership and dedication to the development of the 3D Roadway Design program. Her efforts, along with the 3D Roadway Design Committee, are greatly appreciated.
Intelligent Compaction

- Rollers equipped with GNSS positioning, thermal sensing, and/or accelerometer based measurement systems for soil, aggregate and asphalt.

- Advantages
  - Real-time monitoring of compaction efforts
  - On screen visibility for night work
  - Identification of weak spots, material changes
  - Evaluate efficiency of paving operations (paver stops/lay down temperature)
  - Troubleshooting tool
Intelligent Compaction

- ODOT Pilot Projects
  - 2014: 1 Project, CCO
  - 2015: 3 Projects, CCO
  - 2016: 3 Projects, Special Provision

- Developing training for PM offices

- Pooled Fund Study for Veta Software
  - Provide input on future development of analysis software
  - Collaborate with other agencies on practices and specifications
Intelligent Compaction

Intelligent Compaction Users Guide (Chris Harris)
3D Milling

- Uses 3D model (line strings or surface) to adjust elevation and slope
- Accurately correct pavement cross slope without the use of an asphalt wedge
3D Milling

- Accurately construct pavement cross slope on shifted alignments
- Improve pavement smoothness
- Control PCC quantity on inlay projects
- Provide surface for uniform paving and compaction

White paper on the uses and benefits of 3D Milling (Chris Harris)
AMG Specifications

- Including reference to 3D Design Model
- Quality assurance and acceptance procedure for contractor model
- Construction tolerances
  - Proper references and unit uniformity
  - Appropriate tolerances for each construction activity
  - Separate OG DTM confidence points and construction grade checks
  - Clarify requirements for inside and outside roadway prism

Chris Pucci, Chris Harris, and Ray Thwaites
Inspector Positioning Tablet

- Rugged Tablet with built in GNSS antenna +/- 2cm accuracy
- Can be used “handheld”
- Or with an external antenna and rod for higher accuracy
- Software to display and use XML files for alignment, surface and design files
Inspector Positioning Tablet

- Rugged Outdoor Tablet
- 9 ½” x 7” x 1 ½” body
- 9” Screen
- Touchscreen
- Full computer
- Survey tool

Deployed 9 Systems Statewide.
Evaluating effectiveness and benefits.
Inspector Positioning Tablet

- FieldGenius Survey Software
- Uses XML Files Directly, No Conversion
- Full Survey Software

Chris Pucci
Thank You!
Ron Singh, PLS
Engineering Automation Manager/Chief of Surveys