OREGON DEPARTMENT OF TRANSPORTATION

Highway Division

Ron Singh
Geometronics Manager
Chief of Surveys

Gary Holeman
Automation Engineer
Traffic Roadway Section

Dave Brinton
Lead Surveyor
Geometronics Unit

Ed Cantrell
Senior Designer
Region 2 Roadway

Ray Thwaits
Senior Designer
Region 4 Roadway

Scott Ohmer
Survey Crew Chief/Inspector
Region 2 Construction

Eric Fosgard
Construction Designer
Region 1 Construction

Mike Maley
Information Systems
Engineering Application
Support Analyst

Construction Machine Automation

Six Year Plan

May 4, 2010

Machine Control Standards Committee

VISION

The overall Construction Automation plan (as envisioned today) could be developed and accomplished in (3) 2 year phases, beginning in 2009 and being fully implemented by 2015. We fully expect that technologies will change over time, and the plan will be adjusted as necessary to adapt to those changes.

Construction Automation including Machine Automation (Guidance and Control) is described in "Engineering Automation – Key Concepts for a 25 Year Time Horizon".

The following is an excerpt from that document:

- *Construction Machine Automation – Design data should be available for machine guidance and control systems; surveyors should be trained to manage the supporting data and performing quality control checks; as-constructed data developed by the machine automation system should be accepted for intermediate pay quantities; and real-time tracking, monitoring, and recording of construction equipment should be utilized.*

- *Handheld Computers for Inspectors – These devices should be GPS enabled to provide an inspector reasonably accurate real-time positions on the project coordinate system. The device should contain project design elements to allow the inspector to validate the positions of items being constructed. Inspectors would also use these devices for managing their construction records, daily progress reports, material certification and testing, and access to specifications and standard drawings. These devices should be capable of wireless communication for email, online meetings, transmittal of engineering data, and access to ODOT servers.*

- *Enhanced use of GPS – The use of GPS devices in construction surveying has been minimal and needs to be further exploited. The Oregon Real-Time GPS Network facilitates the use of GPS for construction surveyors, inspectors, and machine guidance and control systems, at a significantly reduced cost, providing accurate, reliable, and repeatable positioning on the construction coordinate system.*

- *Remote Construction Site Monitoring – Construction engineers, inspectors, and administrators should be able to monitor certain construction activities by remote means. Web cameras facilitate monitoring and recording construction work progress; contract compliance; jobsite conditions; actual construction schedules; as-built information; and safety compliance.*

- *Materials Delivery and Certification – Radio Frequency Identification (RFID) tags have been used extensively for product inventory, tracking, identification; and payment. This, and other related technology could be utilized in construction material delivery, certification, and payment. Since the RFID tags are passive (not requiring any internal power), their use could be further exploited in managing assets once installed. For example, all signs delivered and installed during construction would have RFID tags containing information tying it to the asset inventory database. Future maintenance, asset inventory, or surveying activities could query a specific sign's RFID tag to gain access to all the database information. RFID tags could also be placed on existing asset features as part of the asset management program. Future surveys performed in the area could update the coordinate position of the asset by referring to its RFID identification.*

The work of the Machine Control Standards Committee will be limited to the first item in the overall Construction Automation vision – Construction Machine Automation.

Excerpt from DRAFT document

Excerpt from DRAFT document

GOALS

In order to manage a fairly significant task that requires a change in paradigm; new training; research, testing, and deployment of technology; and additional budget, this effort must be staged over some time. The goals for each biennial period are listed below:

2009-2011

1. Digitally signed Contract Plans and related documents
2. Continued 2½D design data – standardized and formatted to support this period's machine control and survey stakeout goals
3. Digital "Engineering Data" available to contractor in stages as needed by their schedule.
4. Machine Control focused on roadway excavation and grading, and trench excavation for pipe installation
5. Continue the concept of Contract Plans as "Primary" and Engineering Data Packet as "Secondary"
6. Construction surveyors available for high precision positioning checks, stakeout, and Post Construction Surveys
7. Inspectors utilizing mobile devices to manage construction documentation – they would not have access to high precision positioning tools.
8. Post Construction Surveys (short list)
9. Designers, Drafters, Surveyors, and Inspectors trained to accomplish these goals

2011-2013

1. True 3D design data (short list)
2. Design data should be on the new low distortion Oregon Coordinate Reference System
3. Digital "Engineering Data Packet" available to contractor upon Invitation to Bid (short list)
4. Redefine Engineering Data Packet as "Primary" and Contract Plans as "Secondary"
5. Revise Specifications to reflect changes
6. Post Construction Surveys (complete)
7. Designers, Drafters, Surveyors, and Inspectors trained to accomplish these goals

2013-2015

1. 4D design data (3D Design coupled with construction schedule)
2. Digital Engineering Data Packet to include all elements of construction
3. Inspectors utilizing hand held high precision positioning tools with onboard design data for field verification
4. Project Connected Site – Wireless data hub
5. Designers, Drafters, Surveyors, and Inspectors trained to accomplish these goals

Excerpt from DRAFT document

ACTIVITIES

2009-2011

1. Digitally signed Contract Plans and related documents (Being developed by separate committee)

Activity
Coordinate with Digital Signature Committee to make sure that this task is completed before July 1, 2011
Work with Bentley Systems to develop digital signatures on DTM files

2. Continued 2½D design data – standardized and formatted to support this period's machine control and survey stakeout goals

Activity
Coordinate with InRoads Standards Committee who is currently developing standards for products delivered from Design to Construction A. DTM specs including point and template spacing completeness B. Pipe flow lines and bedding depth
Develop a training program utilizing Technical Services and/or EAST staff
Geometronics to work with vendors to further develop their support for TransXML and provide data requirements to InRoads Standards Committee
Research engineering software capabilities of moving towards 3D design

3. Digital "Engineering Data" available to contractor in stages as needed by their schedule.

Activity
Machine Control Standards Committee to provide a digital engineering data list to the InRoads Standards Committee

4. Machine Control focused on roadway excavation and grading, and trench excavation for pipe installation

Activity
Convey expectations to designers (Tech Bulletin?)
Deliver training to designers

5. Continue the concept of Contract Plans as "Primary" and Engineering Data Packet as "Secondary"

Activity
Communicate to everybody – Designers, Drafter, Inspectors, and Managers

6. Construction surveyors available for high precision positioning checks, stakeout, and Post Construction Surveys

Activity
Communicate to Region Project Manager offices the need to maintain construction surveying capabilities
Update Special Provision 00305 to convey this expectation to the contractors

Excerpt from DRAFT document

7. Inspectors utilizing mobile devices to manage construction documentation – they would not have access to high precision positioning tools

Activity
Communicate with construction section regarding this expectation
Develop requirements for these tools and expected results

8. Post Construction Surveys (short list)

Activity
Develop policies and procedures
Develop contract language
Develop and provide training
Coordinate with EDM committee for data storage
Communicate expectations to construction Project Managers
Ensure construction budget includes this activity
Develop short list

9. Designers, Drafters, Surveyors, and Inspectors trained to accomplish these goals

Activity
Develop and provide training

<u>2011-2013</u>

1. True 3D design data (Short List)

Activity
Develop 3D (CAD and inroads) workspace and standards A. 3D cell libraries B. Font styles C. Components
Develop short list
Develop and provide training
Develop guidance documents
Software and hardware Upgrades
Update Quality Control plans

2. Design data should be on the new low distortion Oregon Coordinate Reference System

Activity
Communicate expectations
Develop and provide training
Develop guidance documents

3. Digital "Engineering Data Packet" available to contractor upon Invitation to Bid (short list)

Activity
Develop Engineering Data Packet short list
Communicate expectations

4. Redefine Engineering Data Packet as "Primary" and Contract Plans as "Secondary"

Activity
Research and change any necessary: A. Policies B. Regulations C. Contract language
Communicate expectations

5. Update Specifications

Activity
Work with Specification Unit to identify and update related specifications

6. Post Construction Surveys (complete)

Activity
Develop policies and procedures
Develop contract language
Develop and provide training
Coordinate with EDM committee for data storage
Communicate expectations to construction Project Managers
Ensure construction budget includes this activity
Develop complete list

7. Designers, Drafters, Surveyors, and Inspectors trained to accomplish these goals

Activity
Develop and provide training

<u>2013-2015</u> *The activities for this biennium will be developed during the 2011-2013 biennium*

Excerpt from DRAFT document