Utilizing GPS to Increase Performance

Murray Lodge
Dick Savage
Topcon Positioning Systems
Using GPS to Increase Productivity

• What is it and how it works
• GPS for machine control on the construction jobsite
• Grade Management systems
• Machine control in the future
• Telematics
GPS as a Management Tool

- It’s not just for the...
  - Military
  - Recreation
    - Hiking
    - Hunting
    - Golfing
GPS as a Management Tool

• Navigation
  – Airplanes
  – Boats
  – Vehicles
GPS as a Management Tool

• Machine Control
• Grade Management
• GIS
• Telematics
What is it?

- Real time position anywhere on the earth
- Satellites orbit around the earth twice a day

**G1 Technology**
24 Satellite Constellation

**G2 Technology**
Current Satellite Constellation: 20
Planned Constellation: 24

**G3 Technology**
Planned Constellation: 30 Satellites
How it works?

Machine Control Using GNSS determines ...
Utilizing GPS to increase performance

If I know I am here...

Then by reviewing the job plans I can determine that the Design Elevation = 396.54’
Machine Control Automation

Current elevation = 396.24’
Machine Control Automation

How is GNSS Positioning linked to the job design plans?

Paper job plans and conventional grading

GNSS Positioning
Machine Control Automation

... Convert into a 3D model
Machine Control Automation

...then transfer them into the control Box
Machine Control Automation

Job file says the Design elevation = 396.54’

GNSS says the current elevation = 396.84’

Cut or Fill:

396.84’
- 396.54’
= 0.30’ Cut
Greatest Benefits of Machine Control Technology

- Complete jobs faster and within budget: 77%
- Higher level of accuracy over conventional construction methods: 68%
- Fewer rework corrections: 62%
- Minimal to no staking: 59%
- See the data on the screen in the cab: 51%
- Gain a proprietary edge over the competition: 43%
- Check data ahead of time: 43%
- Perform daily asbuilts: 33%
- Other: 6%
Construction Cycle 2D Controls
Construction Cycle 3D Controls

- mmGPS Paver
- mmGPS+ Grader
- 3D-MC² Dozer/Crawler
- 3D-GPS+ Dozer/Crawler, Grader
- 3Di Compactor, Dozer/Crawler
- 3Di Scraper, Compactor
- 3D-GPS+ Dozer/Crawler
- X63 Excavator
- 3D-MC² Dozer/Crawler
- X63 Excavator
- mmGPS
- 3D-GPS
Satellite Positioning Weakness:

Vertical Accuracy:

+/- 0.1 ft
Improved Vertical Accuracy

Local Positioning Systems  Laser Enhanced Systems
LPS Technology

• Total Station tracks prism to provide position information
• Ideal for low visibility GPS applications
Laser Augmented GPS

- Multiple user RTK advantages with laser precision
- Large elevation working range
- More versatile than robotic machine control
mmGPS Video
Traditional 2D Controls
mmGPS Paving

• Run any combination: mmGPS, sonic or cross slope

• Same GPS components used for grading
mmGPS Paving

Elevation Control

Slope Control
mmGPS Asphalt

Joint match with Sonic

Check grade at the same time
mmGPS Paving

Joint match with ski when paving multiple lifts for improved rideability
Additional mmGPS Machines

• Profilers
• Trimmers
“IC” Intelligent Compaction

Asphalt IC Rollers

- Ammann/Case
- Bomag America
- Caterpillar
- Dynapac
- Sakai America
Rollers/Compactors

Major benefits of Intelligent Compaction

• Improved Density
• Increased Productivity
• Reduction of Highway Repair Costs
• Continuous Record of Material Stiffness Values
• Identification of Non-Compactable Areas
• Improved Depth of Compaction
Grade Management Systems

Applications

- Pre-Bid Topo
- Volume calculations
- Grade checking
- Staking

UTILIZING GPS TO INCREASE PERFORMANCE
Grade Management Systems

Utilizing GPS to Increase Performance
Volume Reports

Thursday, June 12th, 2008, 2:19PM
Surface 1 : A
Surface 2 : B
Common Area : 5417.6ft²
Cut volume : 32.0yd³
Fill volume : 24,065.3yd³
Volume difference : 24,033.3yd³ (fill)
Mark Locations

Locate Manholes, Water valves, Pipe Stubs for future relocation
Re-location

Relocate Manholes & Water Valves to raise to finish grade

Displays cut to top of Manhole or Water Valve
Staking

Locate Control Points, Intersection Stakes & stakes in high traffic areas
Types of Heavy Equipment Users Plan to Install with Machine Control Technology

- Dozers: 75%
- Graders: 56%
- Excavators: 49%
- Scrapers: 25%
- Compactors: 17%
- Other: 11%
Maximizing Production

• New technology increases speed at which grading work can be performed

John Deere 764

Topcon 3D-MC²
3D-MC$^2$ High Speed Steep Slopes
High speed/accuracy with all operators

- Four times more productive than manual dozer
- Twice as productive as a 3D dozer
Machine Control in the Future
Mobile Mapping System

- Laser scanner array
- GNSS Antenna
- 360° Hemispherical Digital Camera
- Vehicle’s CAN Bus Interface
Mobile Mapping Applications

Paved Surface Inspection

- Road surface condition
- Analysis of road profile
- Road radius curvature
- Super-elevation analysis
Mobile Mapping Applications

Paved Surface Maintenance

- Surface crack detection
- Rutting
- Pot-hole detection
- Striping analysis
Mobile Mapping Applications

Asset Management Applications

- Utility structures location
  - Fire hydrants
  - Utility poles
  - Manholes
- Inventory road signs and traffic signals, guardrail
- Tunnel mapping
Telematics
Construction GPS - Telematics

- Machine Telematics
- Vehicle Telematics
- Remote Asset Management
U.S. Telematics Market Size & Segmentation

• Telematics market opportunity Includes:
  – 20 million fleet vehicles
  – 5.1 million trailers
  – 2 million heavy equipment units
  – 60 million+ mobile workers
  – 20+ million containers

• Heavy Equipment sector remains largely untapped. Penetration at just ~5% (97,000/2,000,000)
Marketplace

- **OEM’s**
  - Product Link
  - JD Link
  - Komtrax
  - Care Track

- **3rd Party**
  - Topcon Tierra
  - GlobalTRACS
  - Fleetwatcher
  - Titan
  - Many Others
Components of Complete Solutions

Security
Maintenance
Utilization
Job Costing
Productivity
Reduce Costs

- Collect engine hours automatically, decreasing
  - Human error and inaccuracy
  - Costly reconciliation
- View current equipment location, reducing
  - Equipment “hide-and-hoard”
  - Wasted time searching for equipment needing service
  - Unauthorized use
  - Theft
- Monitor machine health, saving
  - Costly engine or transmission repairs due to operator error and inattention
- Make informed rent-vs.-buy decisions, using
  - Accurate utilization data
Increase Profitability

- Provide competitive bids using accurate equipment utilization history
- Improve daily job cost management by accurately charging each piece of equipment
- Increase overall efficiency with visibility to equipment productivity, location and history
Enhance Productivity

- Reduce downtime through proactive maintenance management based on actual hours
- Receive electronic notification of potential machine health problems
- Distribute equipment between job sites more efficiently based on actual versus reported usage and locations
- Remotely monitor equipment on multiple job sites
- Reduce paperwork and errors through data integration
Value: High Cost of Equip Theft

- Machine and equipment replacement costs
- Machine and equipment rental costs
- Machine content replacement costs
- Lost cargo and onboard equipment
- Premium increases and insurance deductibles
- Crew and equipment/machine downtime
- Lost revenue
- Potential contract penalties
Value: Reduce costs while improving fleet efficiency

- Understand cycle times
- Data available to help improve asset utilization
- Provides data for equipment rental billing and purchase decisions
- Improved employee productivity reduces overtime
UTILIZING GPS TO INCREASE PERFORMANCE
ALARMS AND EVENTS

<table>
<thead>
<tr>
<th>State</th>
<th>ID</th>
<th>Vehicle</th>
<th>Text</th>
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</thead>
<tbody>
<tr>
<td>✅</td>
<td>285</td>
<td>V-001</td>
<td>The unit is out of fence</td>
</tr>
<tr>
<td>✅</td>
<td>284</td>
<td>V-015</td>
<td>Engine speed is equal or greater</td>
</tr>
<tr>
<td>✅</td>
<td>283</td>
<td>V-002</td>
<td>Fuel level is less than 10%</td>
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<tr>
<td>✅</td>
<td>282</td>
<td>V-024</td>
<td>The unit is out of fence</td>
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</table>
GEOFENCING

- Create or import your operation areas.
- Associate machine hours with areas.
- Outside/Inside area alarm
- Notification by email, SMS and RSS
### Maintenance Report

#### Equipment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Fleet</th>
<th>Brand</th>
<th>Model</th>
<th>Equipment Type</th>
<th>Maintenance Status</th>
<th>Next Maintenance Due In</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADL100 - SN12</td>
<td>Italy - Job site Concordia</td>
<td>Caterpillar</td>
<td>D6T</td>
<td>Dozer</td>
<td>Overdue</td>
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<td>Caterpillar</td>
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<td>Australia</td>
<td>John Deere</td>
<td>7530</td>
<td>Tractor</td>
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<td>Italy - Job site Turin</td>
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<td>TOOCON Europe</td>
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ACTIVITY REPORT

FROM: 2008-10-01 07:00:00 - TO: 2008-10-07 17:00:00

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Usage Time</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Caterpillar 140H</td>
<td>08:27:09</td>
<td>20.11%</td>
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<tr>
<td>Low workload</td>
<td>02:41:51</td>
<td>9.69%</td>
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<td>High workload</td>
<td>18:57:38</td>
<td>63.30%</td>
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<tr>
<td>Alarm</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Thank You