Digital Project Delivery

moving from paper to digital – it’s not that hard, or is it?

John Morrison & Jason Cousino
Parsons Corporation
October 27, 2015
Speaker Background

Combined 19 years in the civil construction industry

- CAD design, Land Survey and GIS knowledge
- Construction project management
- Design-Build and Design Bid Build experience
Takeaway Points

- Digital – not analog
- Technology along with Process
- Benefits of going digital
Analog vs. Digital
Paper to Digital

Paper Standard - why?
• Learning curve is low
• Participation is easy to collect
• Easy to digitize and archive

Why is going digital taking so long?
• Learning curve is high
• Participation requires everyone to be digital
• Too much data to sort through and archive
Current Analog World

- Paper Based Documents (or paper format)
- Plan Sheets
- Contract Documents
- Standards
- Specifications
- Verification Inspection Reports
- Material Testing Reports
Current Digital World

- Electronic is not digital
- 3D CAD Designs
- CIM – Civil Information Model
- Relation database of requirements
- GPS based location
- Barcodes
- RFID tags
Reason for Collecting Field Data

To accurately record existing physical condition

- Land Survey
- Asset Audits
- Compliance Documentation
- Existing Condition Assessment
- Construction Inspection
- Performance Measures
- Job Site Assessment
- Environmental Conditions
- Manpower and Equipment
...Etc.
Traditonal Geospatial Location of Work

- Field markers containing location information
- Location is approximated from a survey stake
- Survey stakes are often damaged, illegible or moved.
Traditional Methods

- Paper inspection reports
- Field staff returns report into office
- Office staff process the information
- Report is scanned into a document repository
- Hard copy is stored in a box
A Typical Field Report...

- Hand written
- Scanned image (loses quality)
- Very hard to retrieve actual data
- Signatures and data often illegible
- No information on whether or not requirements have been verified
- Uncertainties:
  - What alignment were they on?
  - Did they record the right number?
  - Is the calculation correct?
Projects Big and Small

Contractors ahead of the curve

• Full implementation of automatic machine control
  • 3D modeling
  • GPS

• Oversight efforts mainly still based upon old methods...
  • paper plan sheets
  • hand written forms

3D Laser Scanner

Plan Sets & Paper Forms
FHWA e-Construction

• Paperless Construction Admin Delivery Process
• Clear benefits:
  • Improved Communications
  • Reduction of costs and delays
• Electronic review and approval processes
• Resource Collaboration
• Data Accessibility
• GIS Sharing Initiative
Innovative Users

Innovative and advanced owners are moving to GPS enabled data collectors to get better and more consistent geospatial location of points of inspection and testing.

DOT and Contractor Representatives
Field Verification Data Collection

Inspections

Material tests

Better tools, better training...
RESULT: Better data, increased efficiency

Location accuracy
Technology along with Process
Progression of GPS devices

Mobile phones have become an essential part of how people communicate and get their information. Their GPS accuracy is only good enough for basic navigation and turn-by-turn directions.

GPS receivers are becoming more energy efficient, greater accuracy and more compact.

However current market smart devices are unable to address location accuracy not making a viable solution for GPS users.
So many options...

- Numerous applications available for multiple uses:
  - Asset tracking
  - Construction management
  - Photo applications
  - Environmental evaluation
  - Etc.

- Multiple platforms available
  - iOS
  - Android
  - Windows
  - Windows Mobile
  - Etc.
How Can Tablets Collect Performance & Acceptance Data On Projects?

• Software implementation
  • Feature loaded
  • Able to install across multiple platforms and multiple devices
  • Scalable for any type of project

• Training Program
  • User specific for managers and administrators
  • General “bulk” training for multiple users with the similar tasks
Hardware Possibilities

**Plusses**
Ruggedized PC tablet
Internal GPS card and SIM support
Digital Camera
Barcode & RFID reader

**Minuses**
No software included
Accessories are pricey
Hardware Possibilities

Plusses
Initial cost
Camera
Compact size
Available apps
Familiarity

Minuses
Not rugged
Uploading/downloading
GPS accuracy
GPS Tablet Advantages

- Able to capture records and associate many attributes in the form of metadata
- GPS coordinate will always be true to the project while project Station and Offset my change
- GPS tracking provides the field inspector an interface to determine which asset/alignment they are performing their work at
- Minimize the number of “hands” that would traditionally be involved with an inspection record
- Mobile workstation
  - Complete functionality in the office or in the field
Other Benefits of Tablets

- Automated synchronization with current RFC plan sets
  - Updated digitally and synched automatically
  - No paper plans in the field
- Most have a scribe feature available
- Full version of Windows
  - Suitable workstation
  - Recognizable interface
  - Runs popular software applications
Digital Photography

Mobile devices have had built-in optics for quite some time. However, the resolution has been poor in comparison to DSLR cameras.

While mobile devices have made advancements, they still don’t compare with high end cameras as well as their features.
Digital Photography – 360° Cameras

Palm sized cameras have the capability to take 360° panoramas.

- Fully immersive image environment
- Detailed – HD resolution
- 360° cinematography
- Interact instantly with smartphones

Construction Uses:

- Easily track daily site conditions
- Video evidence of personnel and equipment
Digital Photography – Drones & UAVs

• Imagery can be streamed to a smartphone and in-turn to a web server
• 3D imagery capabilities
• Observe the entire jobsite
• Conditions have to be ideal
• Invasive – privacy issues
• Equipment Costs
Digital Pens

Digital pen technology has been an emerging market for over ten years but has been shadowed by other mobile technologies that can streamline workflows. Yet, their features still offer digital solutions.

- Ink to Digital
- Wireless connectivity
- Built in character recognition software
- Free hand sketch support
- Some pens support GPS positioning
- Affordable
Barcodes

Bar codes are well known for their use in retail but now making an appearance on the construction site.

• Types of barcodes:
  • 1D/Linear
  • 2D
• Barcode Readers
  • Infrared
  • Optical

Fun Fact: The first UPC barcode scanned was in 1974 on a pack of Wrigley’s Juicy Fruit in Troy, OH.
Barcode Application

- Bar code scanning
  - Indexing of material tests and samples
  - Bar code stays adhered to cylinder during cure for later scanning
- Geotagged Images
  - Record photos with verification metadata
Radio-frequency identification (RFID)

The key part of the RFID system is the scanning antenna which sends out short range radio-frequencies to the RFID tag.

- Provides a means of communicating with the RFID tag
- Provides the RFID tag with the energy to communicate
Types of RFID – Passive & Active Tags

Passive Tag
• No battery – power from radio
• Activated conductors send encoded information

Active Tag
• Equipped with a power source
• Can be connected to an external power source
• Tag antenna is always on active standby
Nanotechnology is improving the transportation infrastructure.

- Small embedded sensors
- Safely collect short and long term data
- Control construction materials
- Predictive performance
Recent Innovations in Technologies

• Accessories that provide military grade
• Digital pens that can write any surface
• Indoor Positioning System (IPS)
• 3D photography
• 4K Digital Photography
• Stylus capabilities
• Improved dictation apps

Fun Fact: Tom Sawyer was the first novel written on a typewriter.
Benefits of Going Digital
Requirements Management

• Clearly defines requirements
• Communicates requirements in database format – less paper
• Avoids unnecessary data
• Reduces perceived risk at time of tender – lower bid cost
• Provides platform for Requirement Verification
Requirements Verification

• Risk Assessment of individual requirements
• Focus is on electronic data collection – both good and bad
• Allows for performance analyses
• Allows for data visualization
Final Acceptance

• Final Verification
• Engineer’s Inspection and Punch List
• Final Inspection
• Final Inspector’s Punch List (if warranted)
• Final Documentation
• Final Certification
GIS Data Points From Construction Data

GPS data points can be exhibited at any frequency

- Examples of monthly & quarterly plots
Field Verification Data Collection

- Inspection and Testing Density Plots
GIS Data Points From Construction Data

Maintenance of Traffic GPS data can be tracked through various platforms including GIS and CAD
Exhibit As-Built Data

Tolerances can be visually examined through exhibits

<table>
<thead>
<tr>
<th>Pile Name</th>
<th>Pile Name</th>
<th>Easting</th>
<th>Northing</th>
<th>Easting</th>
<th>Northing</th>
<th>Easting</th>
<th>Bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>308383.70</td>
<td>551796.70</td>
<td>308383.84</td>
<td>551796.91</td>
<td>0.14</td>
<td>0.21</td>
<td>N56°</td>
</tr>
<tr>
<td>1-2</td>
<td>308383.63</td>
<td>551804.92</td>
<td>308383.94</td>
<td>551804.80</td>
<td>0.31</td>
<td>-0.12</td>
<td>N20°</td>
</tr>
<tr>
<td>1-3</td>
<td>308379.38</td>
<td>551796.32</td>
<td>308379.62</td>
<td>551796.36</td>
<td>0.24</td>
<td>0.04</td>
<td>N08°</td>
</tr>
<tr>
<td>1-4</td>
<td>308378.67</td>
<td>551803.14</td>
<td>308379.04</td>
<td>551803.37</td>
<td>0.37</td>
<td>0.23</td>
<td>N32°</td>
</tr>
<tr>
<td>1-5</td>
<td>308373.68</td>
<td>551814.25</td>
<td>308373.69</td>
<td>551814.26</td>
<td>0.30</td>
<td>0.96</td>
<td>N36°</td>
</tr>
</tbody>
</table>
• Performance Data
  • Graphical summaries of trends
  • Standard and customized queries and reports
  • Tracking of detected issues until corrected and verified
In Summary

• Numerous tools out there to go digital
• Digital approach can significantly reduce the volume of paper forms and reports
• Efficient field to office collaboration
• Data can be used to analyze and forecast pointing out trends
• Digital data can be used to track conditions through final project closeout
Questions?

John Morrison
Parsons Corporation
John.Morrison@parsons.com
801.602.4203

Jason Cousino
Parsons Corporation
Jason.Cousino@parsons.com
904.248.0001