Optimal Workflow for Creating Intelligent 3D Models from Laser Scans

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This presentation contains material which is proprietary and confidential to INOVx Solutions Inc.
“Learn from the mistakes of others because you probably won’t have enough time to make ‘em all yourself”

Cap’n Fatty Goodlander
INOVx Overview

- Software and solutions company founded in 1999 – Privately held
- *Asset Virtualization* solutions -- transforming asset intensive industries
- Offices in Irvine, CA, Houston, TX and Al Khobar, Saudi Arabia
- Scanning, modeling and engineering services
- Many satisfied global Fortune 500 process industry clients
- Single software product with an integrated set of functions – RealityLINx
Increasing Demand For Models

- **Asset Documentation**
  - Update existing documents
  - Engineering plant upgrades
  - Process Safety Management (e.g., OSHA NEP)

- **Asset Virtualization**
  - Employ virtual plant model in daily routine
  - Capture and transfer knowledge
  - Improve reliability and safety

*Laser Scanning as best technology to create virtual plant models*
Chevron RAVE Project
Optimal Intelligent Model Creation

1. Individual Laser scan Point clouds
2. Globally Registered Point cloud data
3. Model
4. Intelligized Model
5. Asset Virtualization
6. Asset Documentation

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Intelligent Model Creation – Field Services

1. Individual Laser scan Point clouds
2. Survey Grid of Facility
3. Globally Registered Point cloud data
4. Model
5. Intelligized Model
6. Asset Virtualization

Asset Documentation

3D CAD
Field Services – Laser Scanning

- Reason for the scanning
  - Intelligent model for daily operations and maintenance use
  - Level of detail needed for applications?
  - Geospatial accuracy, coordinate system?

- Considerations:
  - Boundary of volume to be modeled
  - How many scans
  - Position of scanner
  - How much survey
  - Position of targets
  - Elevation
  - ... and many more
Field Services – Laser Scanning

- Alternatives
  - Full survey
  - Partial survey
  - No survey
  - Survey and laser scanning equipment to be used?

- Range of effort
  - Size and density of plant
  - Level of detail to be captured, e.g., small bore

Goal: complete and accurate field data capture
Intelligent Model Creation -- Registration

1. Individual Laser scan Point clouds
2. Survey Grid of Facility
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Asset Documentation

3D CAD
Scan Registration

- **Reason for scan registration**
  - Stitch scans into common data reference
  - Ensure complete data capture

- **Considerations**
  - Absolute or relative positioning
  - May need more than one coordinate reference

- **Alternatives**
  - Choice of software
  - Method (feature based, target based, cloud to cloud, or hybrid)

- **Range of effort**
  - 1 to 15 minutes per scan
  - Effected by onsite data capture practices

**Goal:** complete picture, minimum deviation
Intelligent Model Creation -- Modeling

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Asset Documentation

3D CAD
Modeling

- Reason for modeling
  - Identify and name objects
  - Essential step for creating intelligent models
  - Essential step to *Asset Virtualization*

- Considerations
  - Level of detail, e.g. nuts and bolts
  - Accuracy
  - Objects to include, e.g., small bore piping, conduit, etc.
Modeling

Alternatives
- Model in specialized software
- Model directly in 3D CAD
- Model only surfaces as graphic primitives
- Model as objects with “catalog” properties

Range of effort
- Highly dependent on
  - Level of detail
  - Software and approach
- 30 minutes to 3.5 hours per scan

Goal: convert point cloud data into known objects
Intelligizing

- Reason for intelligizing model
  - Asset Virtualization implementation
    - Connect model to real-time plant systems
  - Synchronize with 3D design system
  - QA/QC of model
    - reaching another level of accuracy

- Considerations
  - Existence and accuracy of existing documentation
  - Field verification
  - Which plant system to integrate
Intelligizing

- Alternatives
  - Export geometry and trace in 3D design system
  - Import data from intelligent plant systems, e.g., P&ID

- Range of effort
  - 15 minutes to 45 minutes per scan

Goal: identify objects by name, QA plant document’n
Intelligent Model Creation– 3D CAD

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CAD Models

➢ Reason for CAD Model
  ♦ Asset documentation
  ♦ Enable future engineering of existing facilities

➢ Considerations
  ♦ Catalogs and specification of existing plant assets
  ♦ Orthogonal versus as-found model
  ♦ Completeness
CAD Models

Alternatives

- Export graphic primitive only
- Export graphic primitives and retrace to CAD objects
- Export intelligent model (matching CAD asset catalog)

Range of effort

- Dependent on form of desired CAD model
- 1 second to 45 minutes per scan

Goal: updated plant documentation for engineering
Intelligent Model Creation—Asset Virtualization

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Asset Virtualization

- Game changing use for virtual plant model
- Generates benefits for plant operators – justifies virtual modeling costs
- Creates demand to scan and model existing facilities
- Creates demand for keeping the model reflective of reality (management of change)

Goal: improve daily work practices
Achieving Results – Benefits of Modeling

- **Asset documentation**
  - Capture current as-built conditions
  - Update documentation for analysis and compliance

- **Asset Virtualization**
  - Broad application within process industries, e.g.,
    - Reliability, maintenance, operations, safety, compliance, etc.
  - Single application justifies model creation
    - Payback measured in days, not years
  - Transforms daily work practices for more effective operations and maintenance of complex plants
Benchmark of Alternative Methods

- Ultimate use determines optimal approach
- More is usually better and justified
  - If point cloud database is sufficient, completeness counts
  - If 3D CAD is ultimate goal, need engineering precision
  - If Asset Virtualization model is goal, even small bore often needed
- Different pathways possible
  - Direct modeling in CAD, with point cloud server
  - INOVx optimal approach uses specialized point cloud modeling software
  - Wide range of effort could result
Benchmark of Alternative Methods

- Observed industry averages

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Average</th>
<th>Range</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point cloud DB</td>
<td>$200 /scan</td>
<td>+/- $100 /scan</td>
<td>Has been main deliverable in support of engineering</td>
</tr>
<tr>
<td>Object model</td>
<td>$200 /scan</td>
<td>+ $1000 /scan - $50 /scan</td>
<td>Needed to update plant documentation</td>
</tr>
<tr>
<td>Intelligized model</td>
<td>$50 /scan</td>
<td>+ $100 /scan - $25 /scan</td>
<td>Quality assurance improved with this effort</td>
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</tbody>
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- Modeling costs have been dramatically reduced
- Intelligizing is a small increment that adds tremendous value
Sharing Best Practices

- As an industry, we must deliver consistently excellent results
  - One poor project reflects poorly on our industry
- Plant owners want to utilize virtual models in daily work practices
  - Creates demand for more accurate models
- INOVx is sharing practices and methodology
  - ASTM E-57 Subcommittee
  - Certified Service Provider Program
Summary and Conclusion

- Intelligent 3D models are more in demand which increases demand for laser scanning services
- Clear understanding of model use important
- Use of specialized modeling software results in optimal work flow and effort
  - Work effort has been dramatically reduced
- Best practices are evolving
  - Industry norms emerging
  - INOVx methodology ensures quality and consistency
  - Expect continued technology improvements
THANK YOU