

320998

Recap Software: Scanning and Post Processing Workflows for All Manufacturing Plants

Tim Vetter
Fiat Chrysler Automobiles

Learning Objectives

- **Data Collection** - Optimize laser scan settings, target use, and field workflows on your next project to achieve high quality project registrations under .5mm overall RMS.
- **Project Creation** - Range clipping, RCC/RCS files, and other initial workflows
- **Post Processing** - Eliminate field survey costs by creating “virtual” surveyed monuments, rather than physical monuments, to aid registration and alignments.
- **Quality Verification** - Use the limit box for elevation slices and other workflows to verify registration and alignment quality. Export decimated point cloud data files for use in downstream applications and improving the performance of ReCap.

Description

The main goal of this class is to walk attendees through the complete workflow of scanning the pressroom and basement at our FCA Sterling Stamping Plant located in Sterling Heights, Michigan. We'll compare general baseline scanning to more-detailed equipment scanning. Participants will learn how scan data is collected, post processed, aligned, exported, decimated, segmented, and combined over time to create and maintain one virtual model of the largest stamping plant in the world. A key benefit of this class: sharing important ReCap software features and proposed ideas that can improve functionality and save post-processing time.

Speaker

Since 1995, Tim Vetter has been the subject matter expert at FCA US Fiat Chrysler Automotive on the creation of manufacturing process and facility layouts. Tim began his career as a Manufacturing Engineer in the Powertrain Advanced Manufacturing group and then accepted a position in the FCA Stamping Equipment Engineering group as an Equipment Engineer in November of 2017. He was recently appointed co-lead for the World Class Technology-Digital Manufacturing Validation pillar. Tim has a passion and sincere dedication for the practice of virtual manufacturing design in the AEC industry. He is a certified FCA trainer for AutoCAD, Recap, and Navisworks software. Always looking for the next best workflow to improve cost and quality, he led FCA to in-source 3D laser scanning using a Faro Focus 3D laser scanner. This initiative resulted in successful laser scanning projects since January 2016 with proven cost avoidance and reduced installation issues. [YouTube Channel](#) for ReCap training videos.

1) Field Data Collection

All detailed workflows are uploaded to the class materials web page and to [Autodesk Drive](#)

A) FCA Standards

- Point Cloud Standards – [DOC LINK](#)
 - Why FCA uses Recap as our standard software for RCP and RCS deliverables but requires outside suppliers to use manufacturers' software for registration.
 - Recap's compatibility with many different OEM file formats.
 - Internal use of Autodesk's PDC-Product Design Collection.
 - White sphere target use and reporting is a mandatory deliverable to assure quality. FCA plant's typically have low balance. (bold surfaces other than a floor to improve C2C capabilities. Moving robots, vehicle traffic, and people lower balance values.
- Manufacturing CAD Requirement Standards – [DOC LINK](#)
 - Added working with point clouds as a CAD competency requirement for equipment design.
 - Added requirement for OEM 3D space claim model, during the RFQ process, to confirm the equipment will fit in our plants.
 - Added requirement that BIM workflows verify a clash free installation prior to equipment build approval.

B) Scanner Hardware and Recap Software Calibrations - [DOC LINK](#)

- **Goal1:** To get familiar with the capabilities of different scanner hardware systems and understand the use of white sphere targets.
- **Goal2:** To confirm the scanner hardware remains within calibration using target locations of known distances.
- **Goal3:** To confirm Recap software's ability and repeat-ability to find center of targets at known/verified distances and at different scanner resolutions ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{8}$).
- **Field Setup:** Set up the test site area
- **Field Scans:** Confirm the scanner's hardware settings
- **Post Processing:** Hardware Repeatability Test per Scan (Resolution and Quality)
- **Post Processing:** Software Repeatability Test per Scan Resolution
- **AutoCAD workflow:** To measure the distance between targets and verify the altimeter sensor (levelness)

C) Facility and Equipment Scanning Workflows - [DOC LINK](#)

- **Goal1:** Understand what equipment is needed to perform high quality scanning.
- **Goal2:** Understand the difference between facility and equipment scanning.
- **BEST PRACTICE:** Create a field map of scan locations for registration later.
- **BEST PRACTICE:** Field scanning should follow aisles/border of the area of interest first, followed by the internal area if needed (i.e., like solving a puzzle).
- **Required equipment:** 200mm large diameter spheres improve registration / alignment over longer distances (ideal for facility wide scans; not as important for detailed equipment scans).
- **Facility versus equipment scanning recommendations:** Scanner setup and configurations, scan centers, and target placement tips.

2) Project Creation Workflows

A) Batch Import Scan Workflows - [DOC LINK](#)

- **Goal1:** Understand important project creation settings and undocumented improved workflows.
- **BEST PRACTICE:** Batch create RCS/RCC files from the native OEM scans by using ReCap software to import and index. (Do not use the Pro version for this batch conversion tip.)
- **BEST PRACTICE:** Filtering tab - Range Clipping: Typically use 35m in the basement and 40m for main aisle facility scans on the manufacturing floor. For equipment scans, stay within 25m. (This tip reduces the scan's file sizes and imports the more accurate point locations by excluding longer range, less accurate point locations.)
- **BEST PRACTICE:** Reuse RCS/RCC files in the support folder when possible to skip the import and index time when creating a new project. Save the cleaned up and range clipped RCC/RCS scan files with people and traffic removed.
- Acknowledge hardware manufacturing software allow more efficient post-processing workflows such as on-the-fly registration, auto target recognition, etc.
- **Idea:** (June, 2017) [Method to batch convert native OEM scans to RCC/RCS.](#)
- For faster project creations and reuse of virtual monument scans.
- Scan range clipping reduces scan sizes and imports the more accurate measurements. Excludes long range distances that are less accurate. My Faro Focus model S70 is accurate within +/-1mm for distances under 25M.
- **Idea:** [Retain target information in RCS/RCC files](#)

B) Merging and Reusing RCP Project Files - [DOC LINK](#)

- **Goal1:** To combine RCP projects beyond C2C registration. **Is this possible?**
- **Issue:** Autodesk support confirmed that combining target enhanced scan groups within a project can create "target metric computation issues". Save often!
- **Issue:** Target creation and then target enhanced registration as a final step for each group in a project will result in a crash. Save often!
- **Idea:** [Existing RCPs, added into a new RCP, should keep the source registration](#)
- **Workaround:** To keep the source registration, export target enhanced registration and aligned ReCap projects as E57 files 'Complete' not '3D-only' then import the E57 files and bypass the registration in a new RCP. It works great but adds time.

3) Post Processing Workflows

A) Registration Best Practices - [DOC LINK](#)

- **Goal1:** To verify the quality of a standard C2C project using targets.
- **Goal2:** To replace and improve the C2C registration using targets.
- **Goal3:** To add virtual monument scans and target coordinates to your project.
- **BEST PRACTICE:** Manually choose bigger white sphere targets first unless medium sizes are needed for backup. ReCap is very good at finding the center of targets.
- **IMPORTANT:** The C2C report does not identify how good the registered scans fit together. Target use is the only method to verify the C2C quality metric.
- **IMPORTANT:** Target enhanced registration [will produce better results than C2C.](#)
- **IMPORTANT:** Targets are the best method to align point cloud projects.
- **Idea:** [Auto-recognize white sphere targets.](#) Similar idea: [WEB LINK2](#)

B) Alignment Best Practices - [DOC LINK](#)

- **Goal1:** To quickly level a ReCap project. Use the plant floor, bottom of crane girders, or bottom of truss. Show the limit box method to confirm a level project.
- **Goal2:** To export the unified, cropped and decimated RCS scan data into the 2D plant grid using AutoCAD.
- **Goal3:** To rotate and move the referenced RCS file using AutoCAD.
- **Goal4:** To insert a 3D virtual monument block using AutoCAD and manually transfer the resulting coordinate locations back into ReCap.
- **IMPORTANT:** Survey point coordinates in METER units only.
- **IMPORTANT:** The “ladder” workflow to overlap aligned virtual monument data for greater field accuracy.
- **Idea:** [Make Survey Points with 1, 2, or all 3 axis values.](#)
- **Idea:** [Survey point coordinates for aligned projects](#)
- **Idea:** [Point Cloud Alignment](#)

C) Data Cleanup and Project Preparation - [DOC LINK](#)

- Acknowledge OEMs have hardware and software workflows for auto-data cleanup.
 - Hardware Solution-Leica RTC360 double pass scans to remove data not present in second pass (e.g., people, aisle traffic, etc.).
 - Software Solution-Faro Scene software removes this data.
- **Auto-data cleanup:** Recap (2020) has removed this feature, so manual cleanup of aisles and data outside the area of interest is quick and easy.
- **Mini-map:** Elevation sections to separate mezzanine, main floor, and basement.
- **Scan Regions** (aka layers): Can dramatically slow down performance.
 - [2016 AU Screencast:](#) “Reducing Waste Through Reality Capture-Utilizing Scan Data Not Scan to BIM” - Mark Labell & Tony Paupert – SSOE Group

D) Decimation Workflows - [DOC LINK](#)

- **Goal1:** To export decimated and unified RCS files for use in downstream applications. Point cloud exports are typically created from standard plant specific elevation slices.
- **Goal2:** To reduce overall project size and improve performance.
- **Floor:** With marking details = **8mm**. Floors with no marking details = **20mm**. (+/- 25mm elevation slice). Basement floors, with slope, require +/- 100mm elevation.
- **Equipment:** **2mm** (above the floor and below the truss or girders).
- **Truss or girder beams in the pressroom:** (bottom of beams to the roof = **5mm**)
- [AU2017 Screencast:](#) “ReCap to the Max! How to Edit, Document, and Coordinate” Mark Labell, SSOE Group. ReCap Hack (at 38 minutes) shows a great workflow to reduce project size and improve performance.

E) Virtual Monuments - [DOC LINK](#)

- **Goal1:** To add virtual monument scans into a ReCap project (C2C workflow).
- **Goal2:** To create and locate virtual monuments in AutoCAD.
- **Goal3:** To data-extract virtual monument coordinate locations in AutoCAD.
- **Goal4:** To batch import virtual monument coordinate locations into ReCap.
- **IMPORTANT:** Before starting this workflow, the ReCap project has a target enhanced registration, with an overall RMS under 1mm. Under .5mm should be an

easy goal. The project has been accurately registered and aligned using the workflows explained in sections 3A and 3B.

4) Quality Verification Workflows

How to verify the finished project is of good quality?

A) Registration and Alignment Reporting - [DOC LINK](#)

- **Goal1:** To read the registration reports and determine quality work.
- Reporting is not user friendly, does not sort columns, lacks important detail to determine registration quality, lacks a graphics interface, lacks exporting formats.
- **Bottom line:** The reporting function needs a lot of work here...
- **Idea:** [Graphic interface, based on scan locations, for registration reporting](#)
- **Idea:** [Display scan location reporting data after C2C registration is complete](#)
- [Scan Accuracy and Point Density](#) by Autodesk Support

B) Elevation Slices and Using the Limit Box. - [DOC LINK](#)

- **Goal1:** To master the limit box to confirm project quality.
- **Workflow:** By [Autodesk Support](#)
- **IMPORTANT:** Difference between flatness and level: A cloud project floor can be flat but not level.
- **IMPORTANT:** Refrain from ReCap's plane feature which determines a flat plane but not level or vertical. The flatness tolerances are not specified or known. Use the limit box for this purpose to confirm if your project is level or vertical within specified limits.

C) Import CAD geometry into Recap. - [DOC LINK](#)

- **Goal1:** To learn how to add CAD geometry to ReCap.
- **Workflow:** By Autodesk Support: This CAD import feature will display NWD files (Navisworks). Can be a quick check to make sure your point cloud project is aligned to project data: [CAD Import](#) (Short 1 minute video)
- **Workflow:** by Buddy Legnon (Autodesk): [ReCap to Plant to Navis and Back](#)
- Attach projects using the method outlined in the above video or use this Autodesk Support link: [Attach a Navisworks Project](#)
- **Idea:** [Point Cloud Alignment](#)