



HEXAGON
PPM

WHITE PAPER

IMPROVING ASSET VALUE THROUGH LASER SCANNING



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1. INTRODUCTION

Many companies use laser scanning to efficiently and accurately, capture brownfield project data. The laser scan, in the form of a point cloud is then used within Intergraph Smart® 3D to:

- Get accurate tie-in locations.
- Avoid clashes with existing items when creating new plant designs.
- Enable the 3D designer to visualise space requirements.
- Build accurate 3D models where none exist.
- Check existing 3D models, for accuracy and completeness.

Hexagon PPM supplies CloudWorx an 'add-on' to Smart 3D which will read a laser scan point cloud and display it to the designer in the 3D environment. CloudWorx also contains tools for point cloud visualisation, automated pipe routing, server-based interference checking and modelling with the point clouds as reference. CloudWorx allows designers to work with large datasets by using either the robust Leica Cyclone or high-performance Leica JetStream point cloud engines.

CloudWorx is developed, supplied, licensed and supported by Hexagon PPM. Released in version 2011, it has been updated through the 2014, 2014R1 and now 2016 versions of Smart 3D. This document describes the latest changes in V2016, the existing and new workflows and the benefits these changes make to your business.

Please note that the new JetStream Technology, as introduced in V2016, has been made available in a hotfix for V2014R1.

Hexagon PPM, in addition to CloudWorx, can now supply two software solutions 'Smart Laser Data Manager' and 'Smart Laser Data Engineer' that include Cyclone and JetStream components – see the section later in this document that describes these offerings. These Solutions play a key role in the digital transformation strategy, 'creating the digital twin.'

2. WORKFLOW OVERVIEW

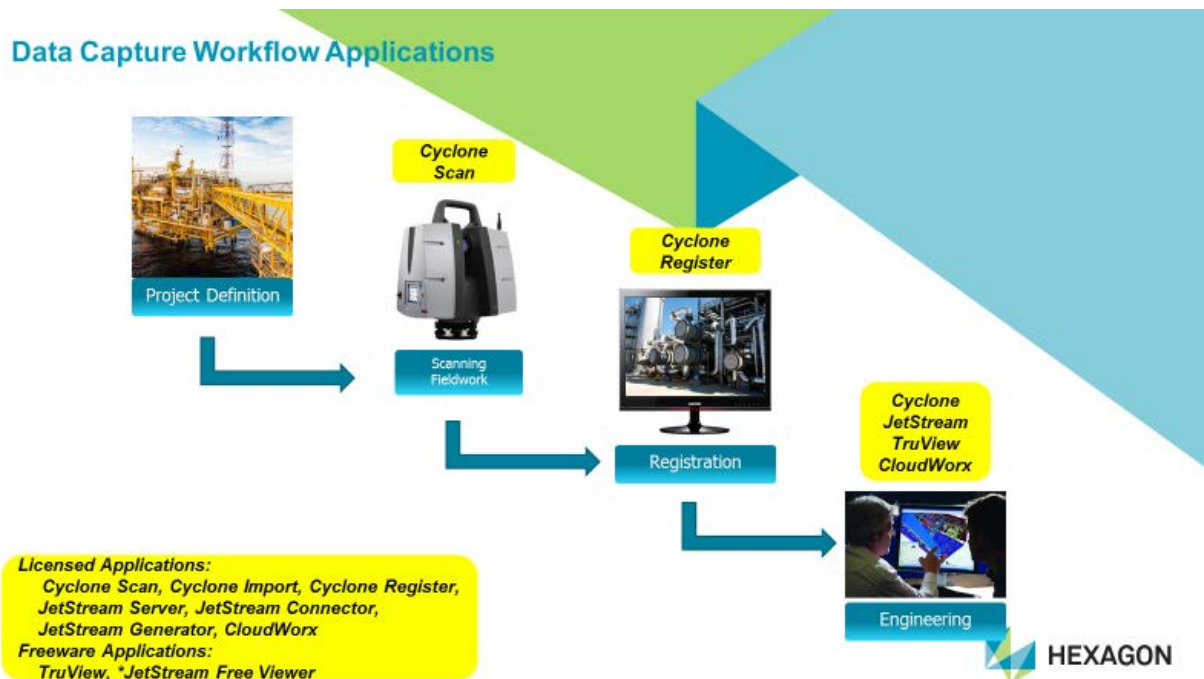


Figure 1: Workflow overview flowchart

2.1. CAPTURING THE DATA ONSITE

The Point Cloud is captured onsite by scanning the site from multiple locations with a high definition laser scanner. It is important that the captured point cloud control points need to be aligned with the plant coordinate system, in order to make sure that the different scan all line up on the plant coordinates correctly. The Point Cloud control points need what they call georeferencing.

This portion of the project is often subcontracted to a specialist survey team, either in-house or an external third party, and the surveyor who captures the scan will determine how many scans, and at what density, are needed for complete coverage of the project area. The scans will produce highly accurate, distinct sets of 3D points and if requested can be supplemented with digital colour photography.

A common misconception is that the site scan should be captured at the highest available resolution on the scanner and then used in the 3D application. However, as the scanners are capable of capturing millions of points at distances of over hundreds of metres, and typically due to site congestion, the scan station is usually only a few, maybe tens of, metres away from the subject, this setting is not required. Scan the site to meet the minimum required level of detail at the distance of interest.

2.2. REGISTERING THE POINT CLOUD

The results from the site survey, in the form of distinct point clouds, are then 'Registered', a procedure in which all the individual scans are tied together to form a single point cloud. This portion of the project is typically an office-based task and is usually performed by the site survey team using specialist software, Leica Cyclone REGISTER. If the resolution settings mentioned in the previous section have been used to

capture the data onsite, then the scan should be imported into Leica Cyclone at 100 percent density; if a higher resolution has been used during capture, then the import density should be reduced.

During this time, additional adjustments in Leica Cyclone can be made to the point cloud, such as:

- Alignment with Plant Coordinate system – The process of aligning the point cloud to plant north and then moving it to the plant coordinate system so that when working in the 3D modelling environment, the point cloud will be correctly positioned
- QA/QC of final registration

Post Registration of the Point Cloud in Leica Cyclone

- Clean point cloud as needed/required using Leica Cyclone cleaning tools
- Creation of a Key Plan – The process of creating a simple key plan which can be used to navigate the point cloud
- If TruViews will be created:
 - TruViews are lightweight, web-ready, user-friendly, spherical panoramic imagery of laser scanner data. TruViews can be made available to a large number of users for red lining, viewing, distance measuring, etc.
- If point clouds will be consumed in CloudWorx as Leica JetStream data:
 - Generation of the new Leica JetStream format – Any point cloud data in Leica Cyclone can be published to the new Leica JetStream format. Leica JetStream is a centralised data server offering user access and controls, while delivering the point cloud to CloudWorx in a high-performance format (all the points, all the time). A Leica JetStream Generator license is required for this.
- If point clouds will be consumed in CloudWorx as Leica Cyclone data: Creating Multiple ModelSpace Views – This is the process of splitting the point cloud into manageable chunks to ensure that they are not too large for the memory of the CAD machine. Optimal size of the ModelSpaces is dependent on user's computer specs. Note that splitting into Model Spaces is not required when the point cloud is to be saved in Leica JetStream format.
- Unification – The process of reducing the point cloud without reducing the clarity of the data. With overlapping scans, there may be redundant data that can be eliminated to improve performance. The unification process will reduce the data based on the user-defined point spacing input. This reduces the size of the point cloud, helping performance without reducing the visual appearance. Note that unification is not required when the point cloud is to be saved in Leica JetStream format.

Please see the work process diagrams later in this document to determine which of these are recommended for your version of CloudWorx.

2.3. ACCESSING THE POINT CLOUD

On completion of registration, the point cloud deliverable is ready to be used in a 3D environment.

2.3.1. Using Leica Cyclone

- Leica Cyclone – Leica Cyclone is used by CloudWorx to load and display the point cloud. The version of Leica Cyclone used on the CAD machine must be equal to, or greater than, the version used during registration as point clouds are not backward version compatible. Leica Cyclone can also be used to set the density of the points loading for the TruSpace views available in Smart 3D. A Leica Cyclone license is not necessary for working in CloudWorx alone.

It is highly recommended to have the same Leica Cyclone version for generating the Point cloud dataset and for referring it on Smart 3D to ensure that there are no compatibility issues.

2.3.2. Using Leica JetStream

- Leica JetStream Enterprise – Leica JetStream is used by CloudWorx V2016 to load and display the point cloud. This software must be installed on an accessible server; licensing is described later in this document.
- Leica JetStream – This is the client software used by CloudWorx to load and display the point cloud; licensing is described later in this document.

It is highly recommended to use Leica JetStream-based point cloud data on CloudWorx for Smart 3D for better productivity and performance.

2.3.3. CloudWorx

- CloudWorx – You will need to install the version of CloudWorx that matches the version of Smart 3D that you are running.
 - CloudWorx is licensed using Hexagon PPM's SPLM software.
 - Once the above software is loaded and licensed, the point cloud can then be registered in Smart 3D using Project Management and opened from the CloudWorx tools available in Smart 3D.

Please see the work process diagrams later in this document to determine which of these are recommended for your version of CloudWorx.

2.3.4. TruView (Optional)

- TruView – This software enables the viewing of the scan data, in Internet Explorer for redlining / measurements, etc. This software is unlicensed and its use is highly recommended for designers, providing high definition views when using CAD systems with point clouds. Note that a Leica Cyclone PUBLISHER license is required for the creation of TruViews.
- TruView Global – This software enables the viewing of TruViews in any web browser with all the same capabilities as the Internet Explorer version of TruView, with a modern user interface compatible with tablets, smart phones, and touch screen input. A separate TruView Global license is required. Simply follow the links below on a device, even your mobile phone, connected to the internet.
 - <https://truviewglobal.leica-geosystems.com/site/572bd25280bf839c260d2409?tab=sitemap> OR, scan the QR Code:



3. SUMMARY OF NEW V2016 FEATURES

The following features are new in CloudWorx for Smart 3D V2016. These features, some of which are optional, will change the existing work processes:

- Ability to transform the point cloud onto a coordinate system in Smart 3D
- Optional use of new Leica JetStream technology; available as a separate license from Leica Geosystems or as part of the 'Smart Laser Data Manager' and 'Smart Laser Data Engineer' products.
- Run Server-Based Interference checking against Point clouds

Please see the work process diagrams later in this document.

3.1. ABILITY TO TRANSFORM THE POINT CLOUD IN SMART 3D

Often, the user of the point cloud in the CAD application would like to move and align the point cloud with the plant coordinate system. In previous versions, this was not possible. The end user would have to specify the plant north and the coordinate system during registration, should later changes be required, and the move and rotate functions would have to be performed in Leica Cyclone and a whole new point cloud reissued, impacting the project schedule.

In Smart 3D V2016, through Project Management, the point cloud can transform without the need for Leica Cyclone.

3.2. OPTIONAL USE OF NEW LEICA JETSTREAM TECHNOLOGY

This is the most exciting development in the technology for some time. Using Leica JetStream, available as a separate license or as part of the Smart Laser Data products as described later in this document, will drastically improve the performance in loading and displaying the point cloud in 3D, while at the same time, reduce aspects in the workflow. Note that this is an optional feature only; CloudWorx for Smart 3D will operate with Cyclone as in previous versions, should this technology not be used.

Using Leica JetStream will bring the following improvements:

- Optimisation of the point cloud - This streamlined process is performed automatically when the point cloud is saved to Leica JetStream format from Leica Cyclone, thus saving time / schedule and reducing cost.
- No need to Create Multiple ModelSpace Views - This process, as described previously, is no longer required, thus saving time / schedule and reducing cost.
- Performance Improvements – Tests have shown that the time taken for loading and displaying the point clouds using Leica JetStream technology is significantly faster than the previous technology.
- Reduced size of the point cloud data when compared to previous technology.
- No installation of Leica Cyclone is required for client machines, saving disk space, install and upgrade time.
- Improved Smart 3D / CloudWorx Workflows
 - Typically, when working in Smart 3D with CloudWorx, it is necessary to make use of the 'limit box' feature to reduce the number of points being held in memory and reduce the area of points

being loaded and so make the view clearer. With Leica JetStream, this workflow would work exactly the same, however, due to the enhanced performance and the better memory management, this feature is often not used, speeding up working with the point cloud and removing the constant need for refreshing of the point cloud.

- The 'Regenerate Point cloud' command is not required whereas previously, it was in constant use while manipulating (pan, zoom, etc.) the point cloud in Smart 3D.
- Clipping commands operate at a faster pace with Leica JetStream data.
- Loading TruSpace Views is much faster than with the previous technology.
- The Smart 3D display, when using TruSpace to pan and zoom, is instantly updated, rather than the slight delay with the previous technology.
- Unlike Leica Cyclone data, Leica JetStream always comes with optimum point cloud density.

3.3. SERVER-BASED INTERFERENCE CHECKING AGAINST POINT CLOUDS

Now with v2016:

- Run server-based interference checking process to check the model clashes with point cloud data.
- Multiple point cloud sources can be referred by project admin.
- Choose the point cloud source that is intended for clash check.

3.4. LEICA JETSTREAM LICENSING

- Leica JetStream licenses are available with 'Smart Laser Data Manager' and 'Smart Laser Data Engineer' solutions as described later in this document:
 - Leica JetStream Generator – This license enables the creation of the Leica JetStream format from Leica Cyclone. This license is typically used by the scan provider; however, a license may be required to upgrade existing point clouds.
 - Leica JetStream Enterprise – This is the main license for Leica JetStream, enabling the loading of Leica JetStream format point clouds. This license must be installed on the server. Note that this license comes with one 'Connector' license as described below.
 - Leica JetStream Connector - This is a single user license allowing a user to connect to the server and work with the point cloud, so for example 10 concurrent users would require 10 licenses. The licenses are of the 'floating' type.
 - Leica JetStream Viewer – A free viewer for the Leica JetStream cloud points is available in the Smart Laser Data products. This allows the user to view the point cloud model and even make it very portable by loading the viewer and model on a memory stick for others to access and review.

3.5. UPGRADING EXISTING POINT CLOUDS TO LEICA JETSTREAM

To convert an existing point cloud to Leica JetStream, two options exist:

- The service provider can convert the Leica Cyclone Database.
 1. A Leica JetStream 'Generator' License can be purchased, one is supplied as part of the 'Smart Laser Data Manager' solution.

3.5. CLOUDWORX FOR SMART 3D V2016 USER TRAINING

A document named 'CloudWorx for Smart 3D V2016 User Notes' is available upon request to introduce the new technologies, features, and workflows to the users. This document also contains detailed user instruction in the use of the new features.

4. SPECIFIC WORKFLOW DIAGRAMS

The following diagram describes the current workflow with v2014R1 and the two options available in V2016:

- Using CloudWorx V2016 with Leica Cyclone Technology
- Using CloudWorx V2016 with Leica JetStream Technology

4.1. USING CLOUDWORX V2016 WITH LEICA CYCLONE TECHNOLOGY

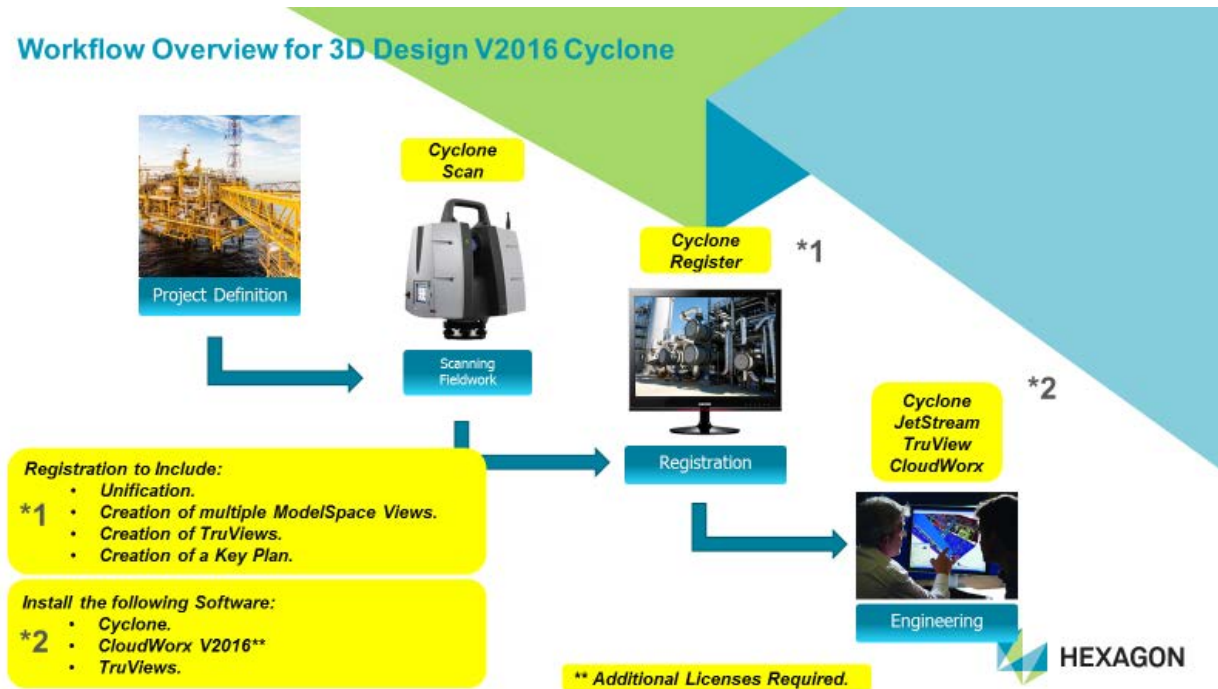


Figure 2: CloudWorx V2016 with Leica Cyclone Technology

4.2. USING CLOUDWORX V2016 WITH LEICA JETSTREAM TECHNOLOGY

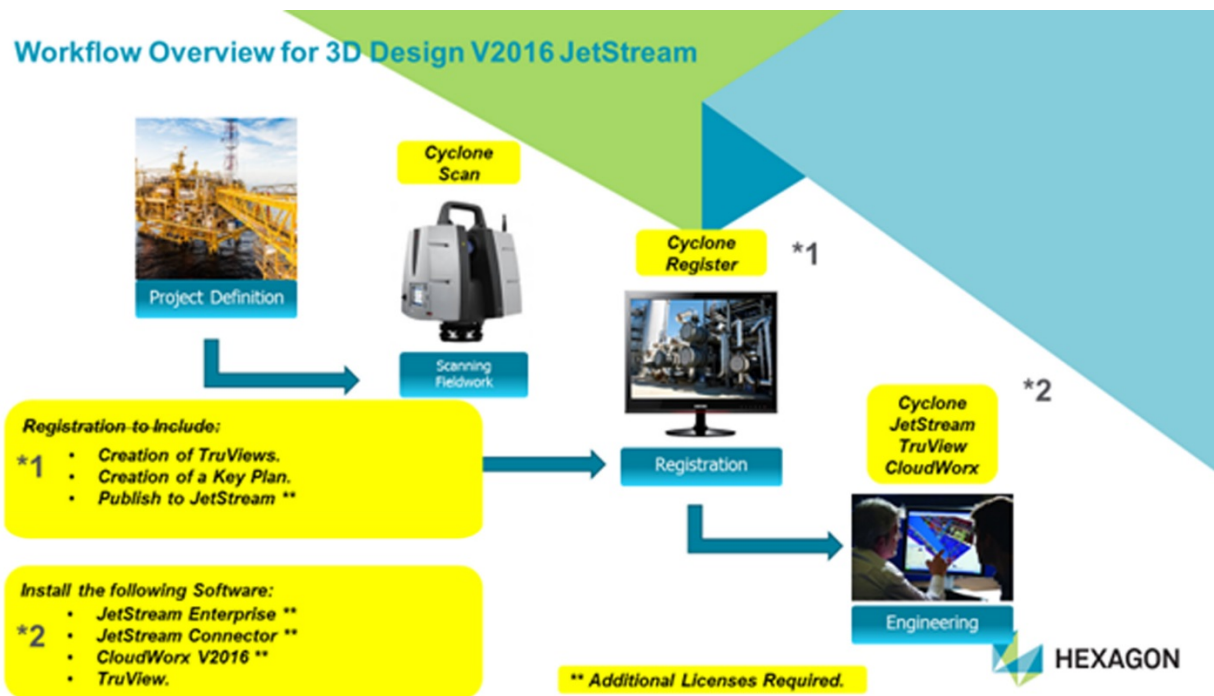


Figure 3: CloudWorx V2016 with Leica JetStream Technology

5. SUMMARY OF THE BENEFITS OF USING SMART 3D V2016 WITH THE NEW LEICA JETSTREAM TECHNOLOGY

In summary, using Smart 3D V2016 with the Leica JetStream technology will reduce risk and save valuable time and cost as listed below:

- By reducing the reliance on the laser scanning service provider, project cost, schedule, and risk can be reduced. This is accomplished by the following:
 - Unification step is removed and replaced by simpler, faster publishing to Leica JetStream.
 - The need for the creation of multiple model space views is removed, shortening the process.
 - The need to have the service provider rotate and align the point cloud to plant north is removed.
- By benefiting from the improved performance and adopting the new workflows, project schedule can be reduced. This is accomplished by:
 - Reduced need to use the limit box and other clipping tools.

- Improved times to load and refresh the point cloud.
- Improved times to load TruSpace.
- Improved performance when working between TruSpace and Smart 3D.
- The removal of the need to swap between different ModelSpace views.
- Having a single source of data held on a server reduces the need for copying data to individual machines, saving time and hardware. A change made to a single data set is seen by all without having to redistribute the entire data set. Performance is identical whether the point cloud is located locally or across the network on a server.
- Using CloudWorx V2016 with Leica JetStream Technology

Furthermore, the above benefits can be realised with current scan datasets by publishing to Leica JetStream.

6. SOFTWARE SOLUTIONS AVAILABLE FROM HEXAGON PPM

From June 1, 2017, Hexagon PPM is offering two additional laser scanning software product options, 'Smart Laser Data Engineer' and 'Smart laser Data Manager' as described below:

6.1 SMART LASER DATA ENGINEER (SLDE)

This product is aimed at the point cloud consumer, it consists of the following elements:

- Leica JetStream Generator
- Leica JetStream Enterprise
- 20 x Leica JetStream Connector Licenses
- Leica JetStream Viewer

CloudWorx is the connection between SLDE and the design and review applications to enable access to the Point Cloud model. There are different CloudWorx versions for the different solutions such as CloudWorx for Smart 3D and CloudWorx for SmartPlant Review.

6.2 SMART LASER DATA MANAGER (SLDM)

This product is aimed at the point cloud producers and consumers, it consists of the following elements:

- Leica Cyclone Import (needed to import scans from non-Leica scanners)
- Leica Cyclone Register (needed for point cloud registration)
- Leica Cyclone Publisher (needed to publish the point cloud to Leica JetStream)
- Leica JetStream Freeviewer (needed to create the stand alone Freeviewer datasets)

7. EXECUTIVE SUMMARY

Laser scanning technology is a well-accepted, proven method to capture the existing assets in a quick and cost-effective way. With the new JetStream technology, we have made the user experience and cost of ownership significantly better. The registration process is faster and the end result point cloud file is much smaller in size. Keeping it in a single location helps significantly with the consistency, quality, accessibility, and finally, security.

CloudWorx for Smart 3D connects to the point cloud and enables you to make the hybrid between the existing plant and the newly modeled parts giving benefits such as clash detection, creating deliverables and ability to do walk-throughs with SmartPlant® Review for design validations and training sessions.

In addition, the point clouds can be overlaid with high definition photos to create a TruView on the plant and add tags to increase the value of the assets by not only capturing the locational and special data but also tie that in with the engineering data.



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