ULTIMATE GUIDE

TO

CAD & GIS Integration

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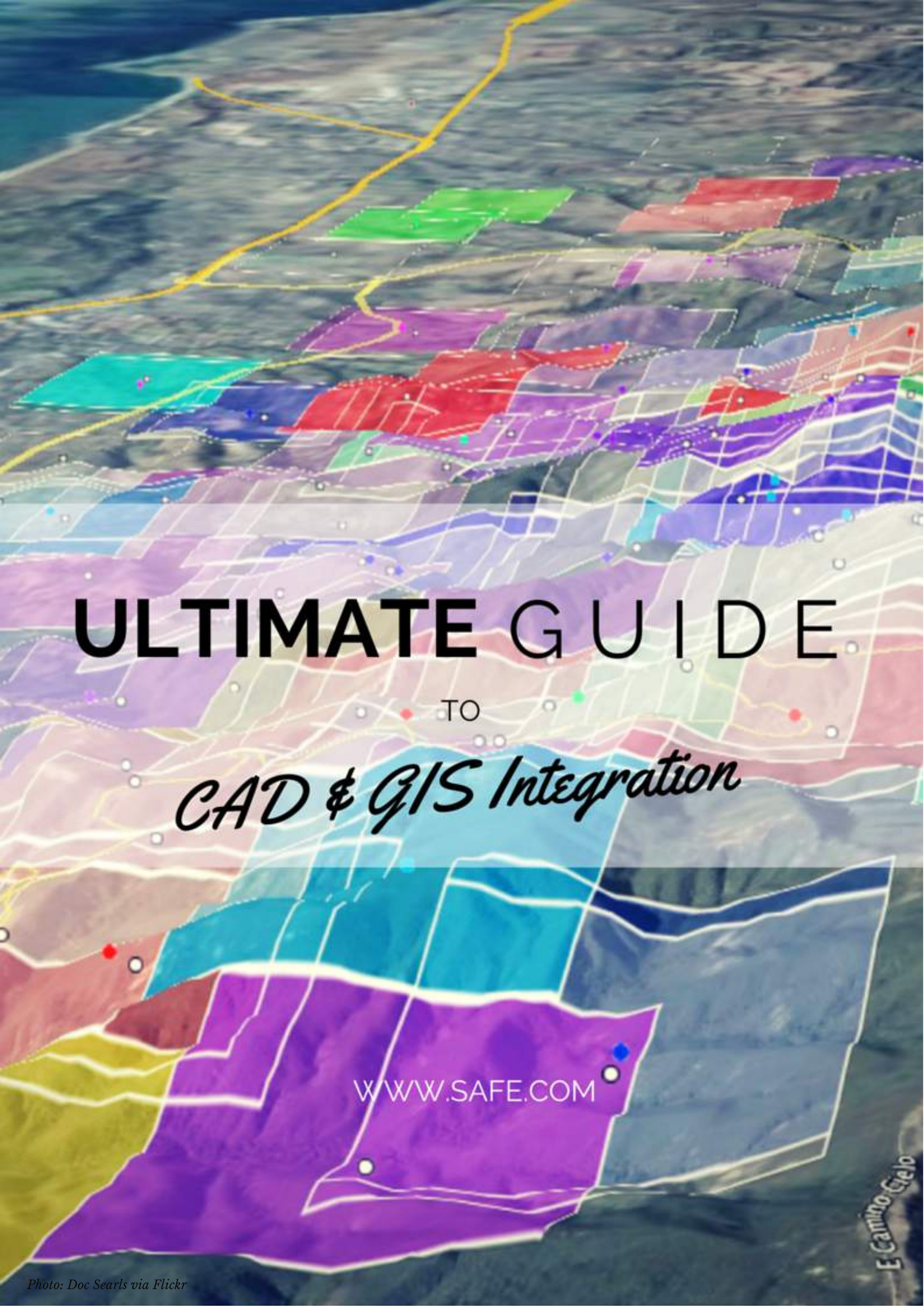

Photo: Doc Searls via Flickr

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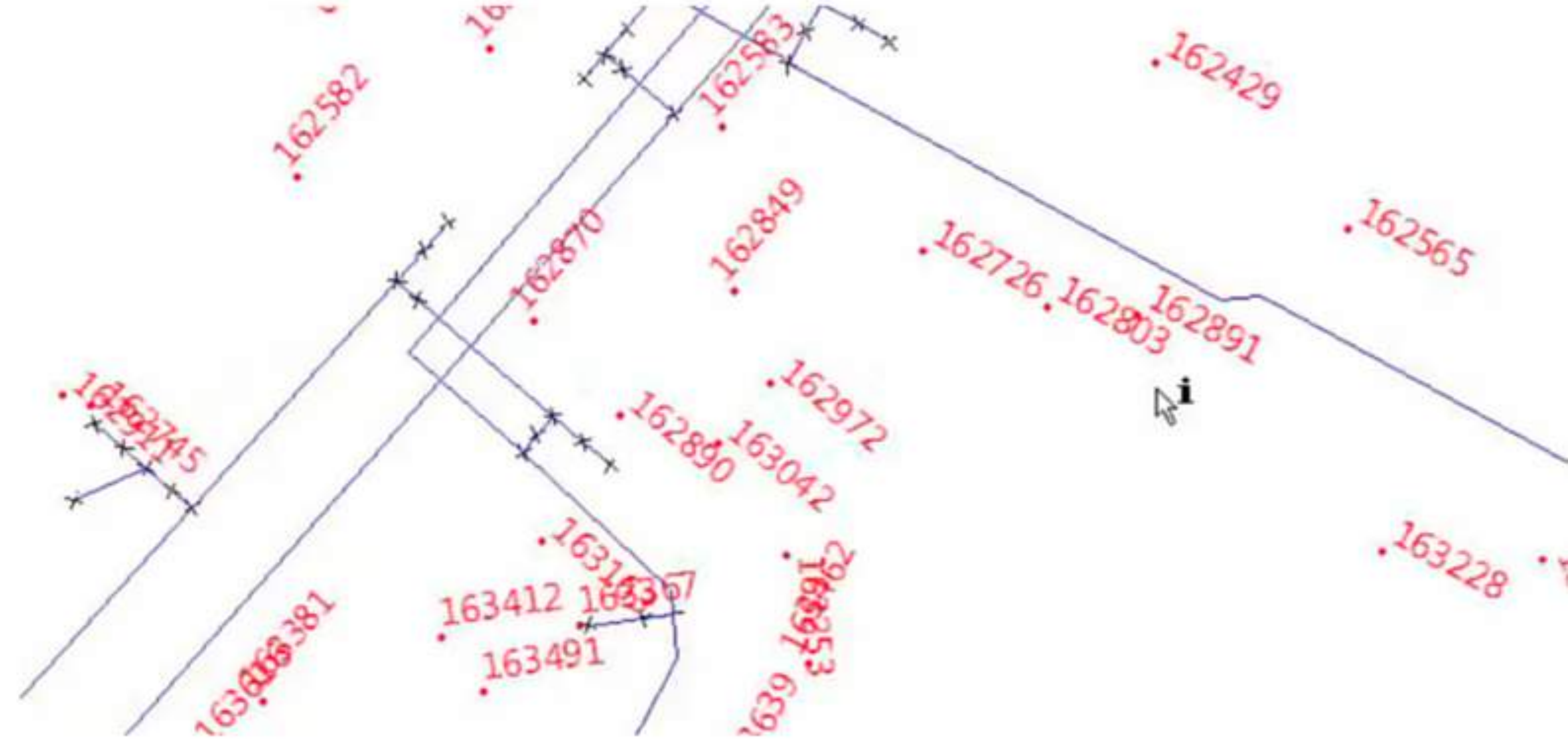


Feeling CADfused and GISorganized?

This Guide can help.

INTRODUCTION

Most organizations are using a combination of GIS and CAD applications for their spatial data management. It's important that we are able to move data smoothly between the two different environments. Although there's a great deal of overlap in functionality between CAD & GIS applications, each has its strengths.

CAD Users

And what they care about

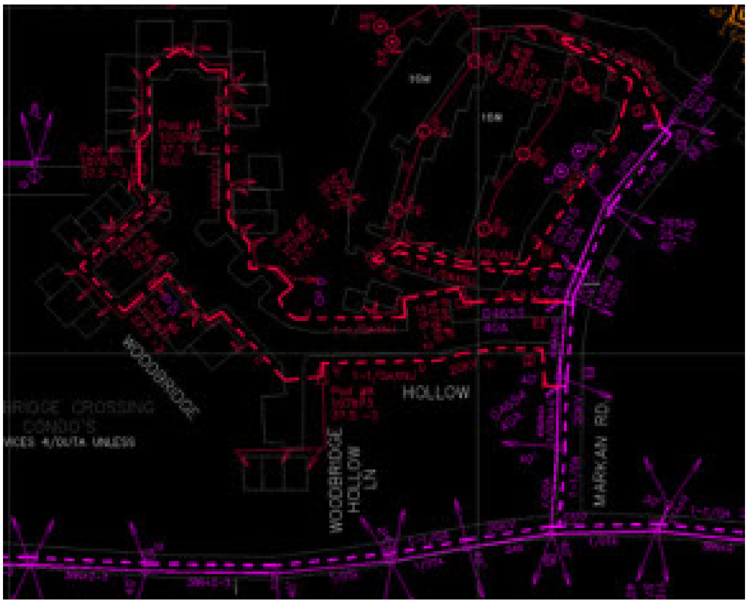
- Productive editing tools
- Visual clarity: labels & white space
- Symbology
- Dimensions

GIS Users

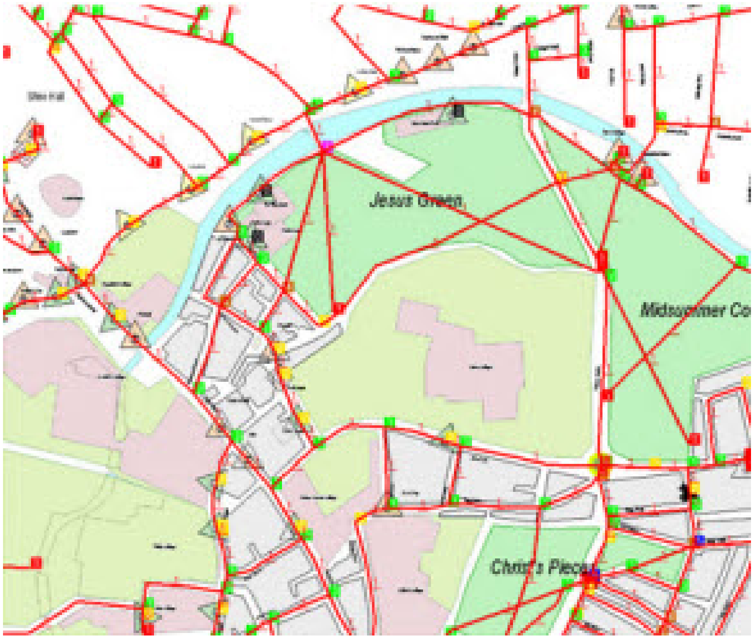
And what they care about

- Data structure and model
- Data consistency
- Attribution and domains
- Location
- Connectivity
- Analysis
- Assets

CAD & GIS BASICS



CAD, or “computer-aided design,” formats involve concepts like styles, symbology, dimensions, labels, and specific geometries like splines and blocks/cells. Example formats include AutoCAD DWG and MicroStation DGN.

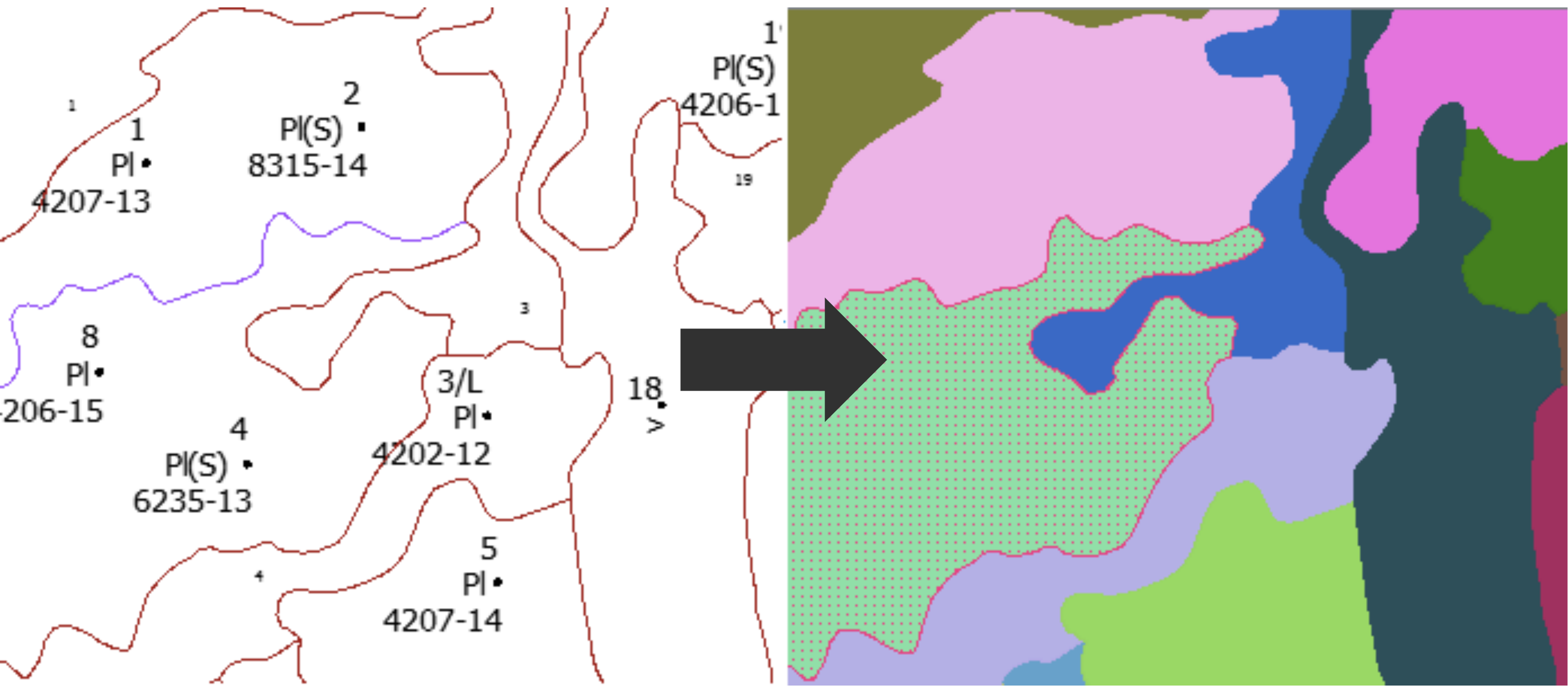


GIS, or “geographic information systems”, was created for mapping and analyzing geographic features. It uses location and imagery and usually conveys data on a large scale. GIS formats involve concepts like data models, attributes, simple geometries, and domains. Example formats include Esri Shapefile, Esri Geodatabase, and GML.

Converting CAD to GIS

Why translate from CAD to GIS?

Translating from CAD to GIS means enhancing CAD drawings with spatial information and attributes. It means you can know where objects in the drawing are located as well as all their relevant details. It also means inserting specialized CAD information into a different data structure, one that supports attribute information.



This example CAD-GIS translation has converted the linework of a design file into GIS polygons. Each polygon contains information from the CAD label points. The label can be used to get other attribute information using a database join.

Why is converting CAD to GIS so Messy?

The main problem when converting from CAD to GIS is that we're trying to fit a format with annotation and symbology into a format that does not support annotation and symbology. In a basic translation from CAD to GIS, we lose valuable information like text from the CAD dataset. This can be detrimental to data that relies on annotations to make sense – like blueprints, floor plans, and road design.

10 Ways to Correct CAD/GIS Data

1. Stitch together CAD tiles into a continuous layer and connect segments of features that extend across tile boundaries

2. Convert data to a different mapping coordinate system

3. Create polygons or areas from CAD linework

4. Decipher CAD layer codes and map all CAD layers to the corresponding GIS layers

5. Move and resymbolize map features (or symbols) to give a better cartographic representation of real-world features

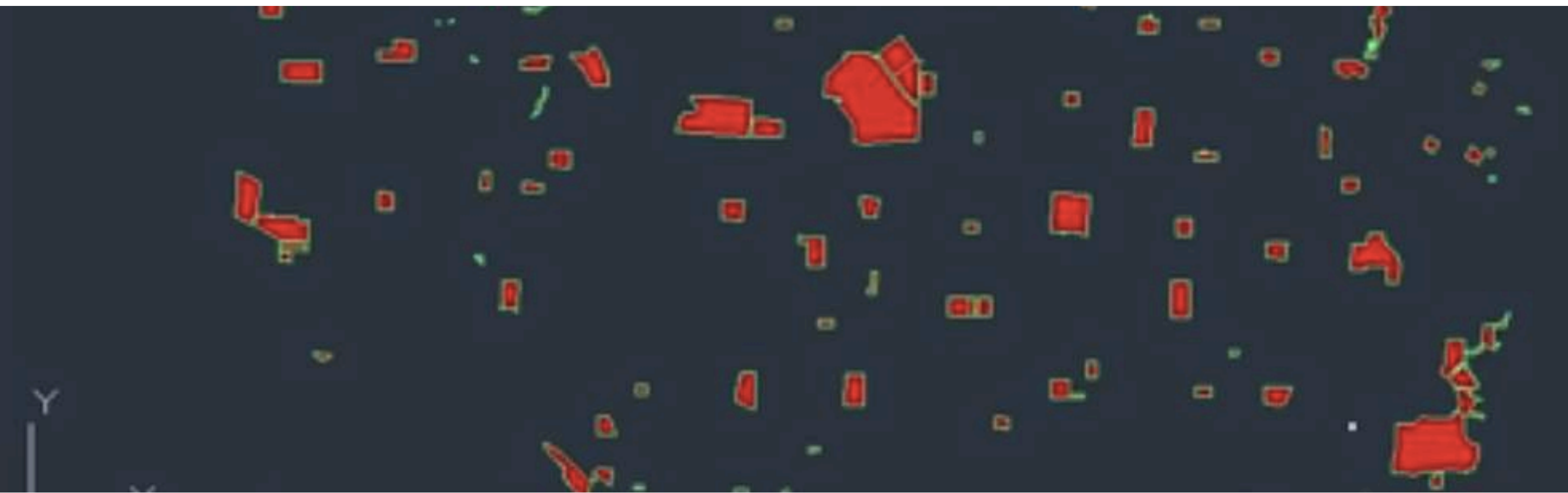
6. Remove slivers and close artificial gaps in map features created by incomplete linework or symbol placement

7. Split lines where the attribute(s) of the feature change

8. Capture attribute information from annotations adjacent to CAD features using proximity analysis or TAG values

9. Retrieve attributes from tables, spreadsheets, or databases and attach these to features

10. Transform feature symbology to match GIS requirements



How to ensure a successful

CAD to GIS translation

in 4 steps

1 Validate your data.

Before trying to translate your CAD data to GIS, identify and solve issues that affect the data's quality. Ensure it meets data model standards, and repair the geometry (for example by snapping lines together).

2 Manipulate the CAD Geometry.

Transform the CAD data to make it fit your desired GIS data model. There are hundreds of transformations you can apply. This might include building areas out of CAD polylines, or splitting the CAD lines into different classes based on an attribute.

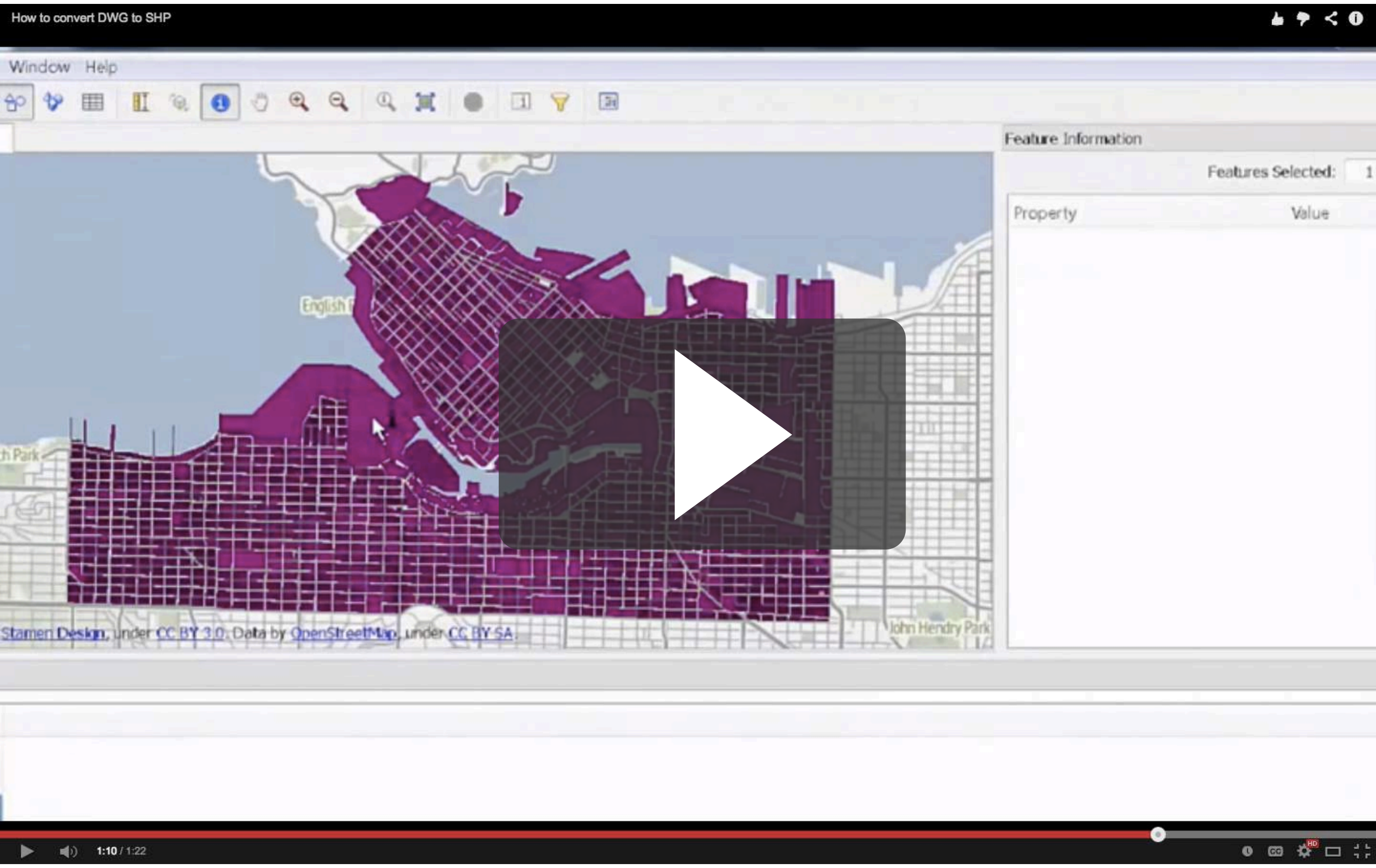
3 Represent CAD info in GIS attributes.

The key to building GIS features from a CAD drawing is to find a way to preserve and represent the CAD information – including labels, text, blocks, dimensions, styles, and symbols. Annotations and symbology should be interpreted as attributes on the target GIS schema. Labels can be preserved by transferring them to the nearest line or polygon.

4 Georeferencing.

CAD generally doesn't have a notion of where it is (i.e., it's not georeferenced). If this is the case, you should explicitly identify the CAD dataset's coordinate system or change (reproject) it from a local grid.

CAD In Action



Demo: Converting CAD to GIS with FME

Converting
GIS to CAD

The top two spatial data formats people are translating are Esri Shape and Bentley MicroStation Design, according to FME usage statistics from 2013. Autodesk AutoCAD DWG/DXF isn't far behind.

What's interesting is that these two formats naturally integrate about as well as oil and water. Esri Shapefiles hold GIS features and MicroStation DGN files hold CAD drawings – and the nature of GIS and CAD data types are so different that attempting to combine them can be difficult.

Whether your GIS data format is Esri Shapefile, Esri Geodatabase, Oracle Spatial, SQL Server, MapInfo, PostGIS, GML, or otherwise, your goal comes down to converting GIS features (i.e., data structures and attributes) into information-rich CAD drawings.

In a poll during our December 2013 webinar, we found that:

39% of users have problems creating CAD symbology when exporting from GIS

Thankfully, with the help of a translation process that understands the properties of GIS features and CAD drawings, converting between these data types is easy.

A successful GIS to CAD translation must read from GIS, style the data, then write it out to CAD. In other words, it needs a robust spatial ETL process.

1. Rich data model

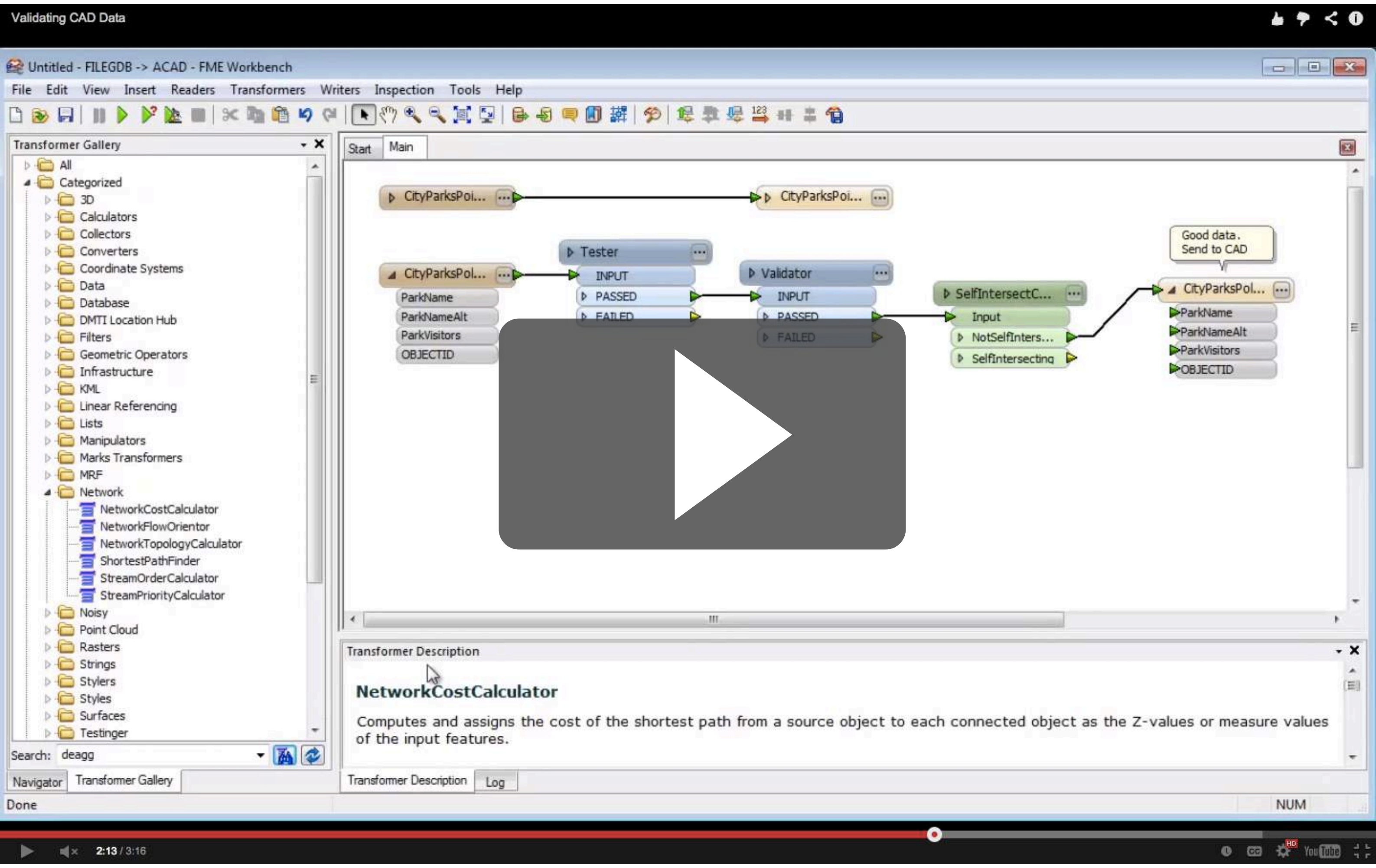
We need to convert GIS data structures into complex geometries used by CAD applications. This means using a rich data model that offers a lossless translation into equivalent structures in the output CAD dataset. For example, we might want to turn GIS point features into MicroStation cells or AutoCAD blocks.

2. Sophisticated data transformation

GIS attributes must be converted to CAD annotations and symbology. The data model should also be able to translate important information like tags, AutoCAD extended entity data, or Map3D object data.

Styling the drawing / design might involve a combination of setting colors, picking a template file, configuring blocks, lines, areas, symbols, or text. It might involve transformations like converting lines into polygons, generating text labels, clipping data to a given boundary, or extruding 2D geometries into 3D solids.

GIS In Action



Demo: Converting GIS to CAD with FME

Total **CAD-GIS** Integration

Translating from CAD to GIS and back can feel a little like a game of “telephone”. You know the game: you whisper a message around a circle and the last person says the message aloud—and the final message is always something way off. Likewise, by the time data gets back to its original format, we’ve lost valuable information.

Photo: Kevin Shorter via Flickr

We’ve discussed converting CAD to GIS. We’ve discussed converting GIS to CAD. ***Now how can we take data on a round-trip between CAD and GIS systems without losing anything important?***

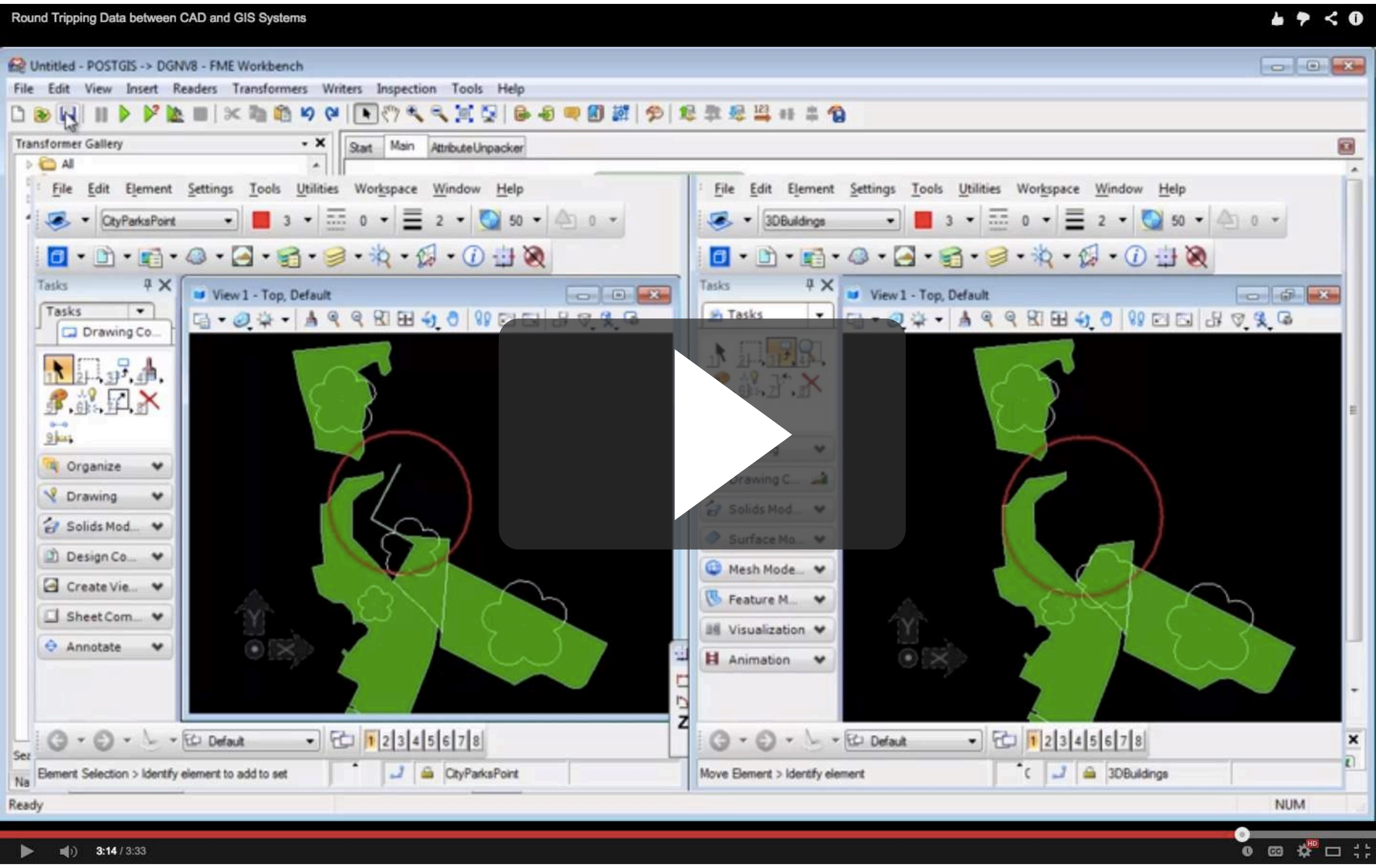
Achieving *interoperability* between CAD, GIS, & more

It's not enough to keep data in a single state: it must be free to move across systems, to integrate with other data, to mold into and exploit the strengths of other formats. It needs to be truly interoperable.

When working with CAD and GIS data, it's often useful to enhance a CAD drawing with GIS information and attributes, then convert it back to the original format.

The key is to translate between CAD and GIS systems without losing any structure, geometry, or overall quality of the dataset.

Watch a Demo



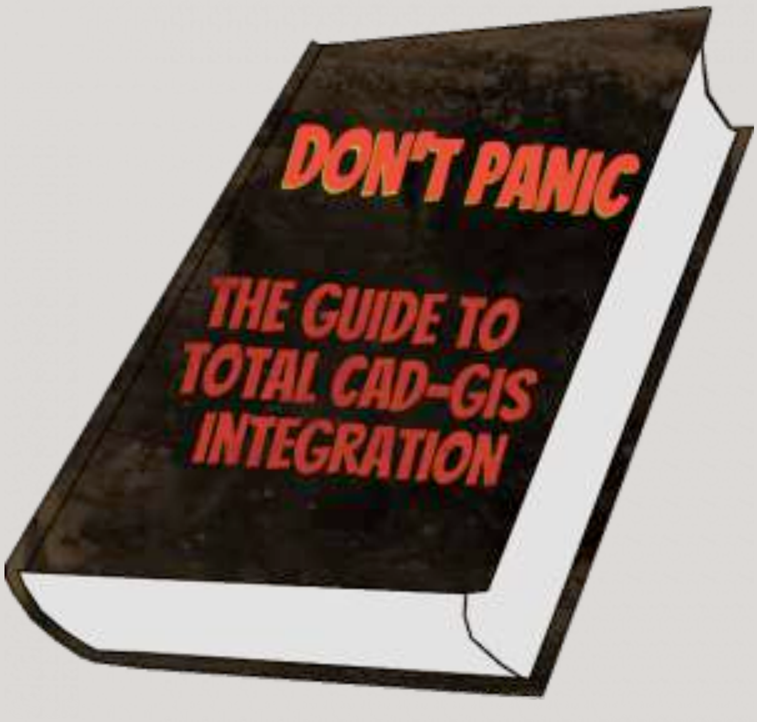
Round Tripping Data between CAD and GIS Systems

3 Strategies for a CAD-to-GIS Roundtrip

The basic idea of a CAD-to-GIS-to-CAD translation is to:

1. Record individual CAD components in the GIS dataset (e.g., block / cell names, basic symbology like line style and color).
2. Use this stored information to recreate the geometries and structures when writing the data back to CAD.

Following are some strategies for ensuring your translation is robust.

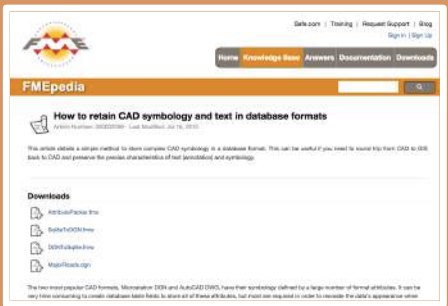


1. Use an attribute blob for CAD symbology

Often, CAD data includes a lot of complex symbology, making it complicated to translate to GIS and back. However, this multitude of information needs to stay intact in order to recreate the data's appearance when converting back to CAD.

A convenient way to do this is to **pack the CAD symbology into a single blob field and store it that way in the GIS dataset** (e.g. Esri Geodatabase).

Then when converting back to CAD, you can unpack the blob into its original attributes without losing information. Bonus: packing the attributes into a blob is also accommodating for an evolving schema.



Try it yourself in this interactive article:
How to retain CAD symbology and text in database formats

2. Convert unsupported geometries

If a geometry isn't supported by the GIS format, the data integrity will be lost in a conversion.

These line segments (green line) have been smoothed into arcs (black line).

For example, a true mathematical arc might get stroked and stored as line segments in an Esri Shapefile.

We might get a nice conversion between GIS point features and MicroStation cells or AutoCAD blocks, but other pieces don't map so nicely. It's therefore important to **convert data back into its intended geometry**—like smoothing line segments into a curve—when translating back to CAD.

3. Validate the CAD, GIS, and in-between data

Validation is always an important step in data transformations. In a CAD-to-GIS-to-CAD situation, it’s especially important to validate the data along the way.

One technique is **to write a set of metadata records** to document whatever changes are taking place. Another is to perform **feature-by-feature quality checks** to ensure the GIS-to-CAD translation is writing valid output. If an error is found, the features can be passed back to the GIS application to be cleaned up.

“FME makes it easy to handle attribute and geometry differences between CAD and GIS formats. It helps us reliably stitch together over 1500 CAD drawings into a seamless enterprise Geodatabase.”

- *Steve Grise,*

Solution Architectat Vertex 3 Inc.

University of Washington Case Study

Conclusion

Integrating data types gives us the potential to create datasets with a huge level of detail. Every data type – CAD, GIS, and otherwise – has its strengths. By implementing the strategies in this ebook, we can design well-structured spatial ETL translations that leverage these strengths. That is the key to harmonizing CAD and GIS data, and achieving true interoperability.

To learn more about how FME can make this data combination easier, go to:

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