

GIS-T 2014 Burlington, VT

Paths Toward CAD and GIS Interoperability



Bo Guo, PhD, PE
Gistic Research, Inc

Outline

- CAD and GIS Differences
- Interoperability Paths
- UDOT ROW Research Project
- City of Phoenix COLA Project

CAD and GIS: The Difference (I)

Item	CAD	GIS
History	Initiated by academia, driven by private industry	Driven by government projects
Users	Architects, engineers, land surveyors	All
Geometry	Man-made objects Design, presentation through detail geometric specifications	Natural Environment Analysis and presentation through abstraction & attribution
Topology	None	Important
Modeling space	2D/3D orthogonal	Geodetic or various projected spatial reference systems
Geo-references	None or Ground surface	Grid surface
Scale/Extents	Large scale, small extents	Small scale, large extents
Accuracy	Higher	Lower

CAD and GIS: The Difference (II)

Item	CAD	GIS
Attribution	Via symbol (style, color etc), layers, text label, cell, etc	Database
2-D Geometry primitives	Include curve (circle and spline)	Circle has limited support; spline is not supported
Data organization	Layers or levels in single document	Each data layer is unit at the database level
RDMBS support	Limited	Good
Formats	<u>Proprietary:</u> DWG, DGN, etc <u>Intermediate:</u> DXF, IGES <u>Common:</u> Oracle Spatial?	<u>Proprietary:</u> Shapefiles, SDE, etc <u>RDBMS spatial types:</u> Oracle, IBM, ProgreSQL, MSSQL, etc <u>Standards:</u> OGC standards

Why CAD-GIS Integration

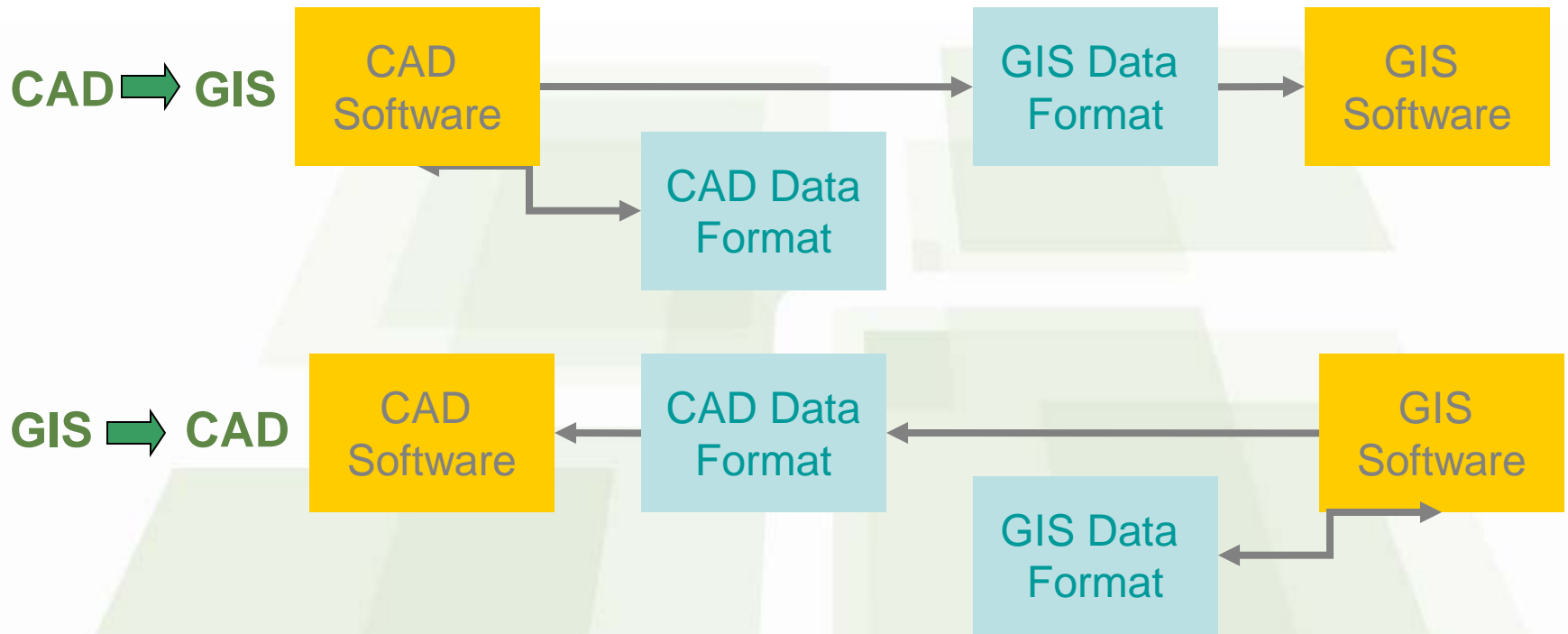
- GIS & CAD have more differences than similarities; they are destined to co-exist
- GIS needs data; there is an abundance of survey and design data developed and maintained in CAD files
- Design engineers need geographic context in which objects are to be designed and built in CAD
- In a project development cycle -

Phase	Main Data Source	Integration direction
Plan	GIS	
Design/Build	CAD	GIS -> CAD
Operate	GIS	CAD -> GIS

Polls

- Which direction of CAD-GIS conversion is more important in your organization?
- List assets in your organization stored in CAD that need to be converted to GIS
- List assets in your organization stored in GIS that need to be converted to CAD

Interoperability via Data Conversion



- Via intermediate formats (such as DXF, IGES) that are supported by both CAD and GIS Software vendors
- Direct convert via 3rd-party tool such as FME by Safe Software

Interoperability via Common Format



CAD and GIS software supports read-and-write to some common formats that should meet the following criteria:

- Open Standards
 - OGC Simple Feature, SQL/MM, Simple Features 2.0
- Support Curves
 - Oracle Spatial
 - SQL Server 2012
- Supports NURBS Curves
 - Oracle 12

UDOT ROW: Project Objectives

- Select the best path for converting DGN files to GIS in Oracle Spatial
- Identify additional CAD standards
- Integrate with existing ROW application

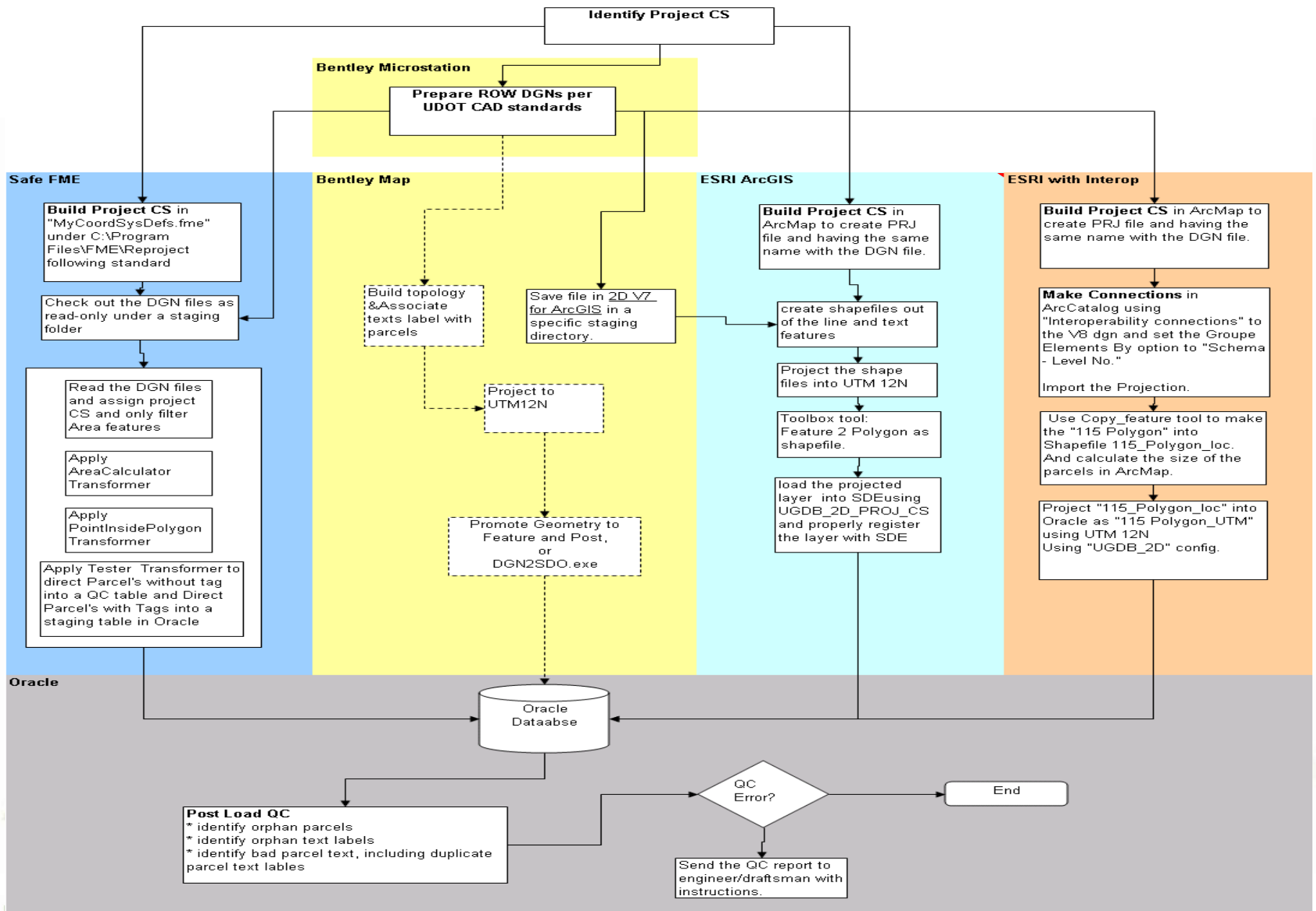
CAD Drawing Evaluation

- Survey data is not fully available for CS projection into UTM
- Lack of conformance to existing CAD standards
- Existing CAD standards need to be extended to support conversion
- Historical CAD drawings and survey data may not be available

Selection of Paths

- 4 Approaches
 - Bentley
 - Bentley + ESRI
 - Bentley + ESRI with Interop Kit
 - Bentley + FME
- 5 Major Criteria
 - Coordinate System
 - Oracle Export
 - QA/QC
 - Automation
 - License

UDOT ROW CAD to GIS Conversion Approach Summary Flow



CAD to GIS Conversion Issues

- Spatial Reference System
 - Project CS vs Statewide standard CS: UTM 12N
 - Survey Plane vs. Projection Plane
- Geometry
 - Multiple spatial types
 - Curves
- Topology
 - Build ROW parcels and associate text labels with parcels
- Attribution
 - Organizational CAD standards
 - Extraction of Annotation
 - Attribute and Object association
- QC
 - Orphans, Bad text label, Topology errors, Duplicate labels etc.

UDOT ROW - Phased Implementation

Phase	Description
Phase I	Capture and QC parcel info in ACTIVE projects into Oracle Spatial and tie geometry with ROW application (This phase is critical as it also handles on-going maintenance of parcel fabric once it is built in Phase II.)
Phase II	Spatially-enable entire ROW inventory by building statewide ROW parcel fabric in Oracle Spatial database
Phase III	Build web-based ROW applications for internal or public consumption

UDOT ROW - Phase I Diagram

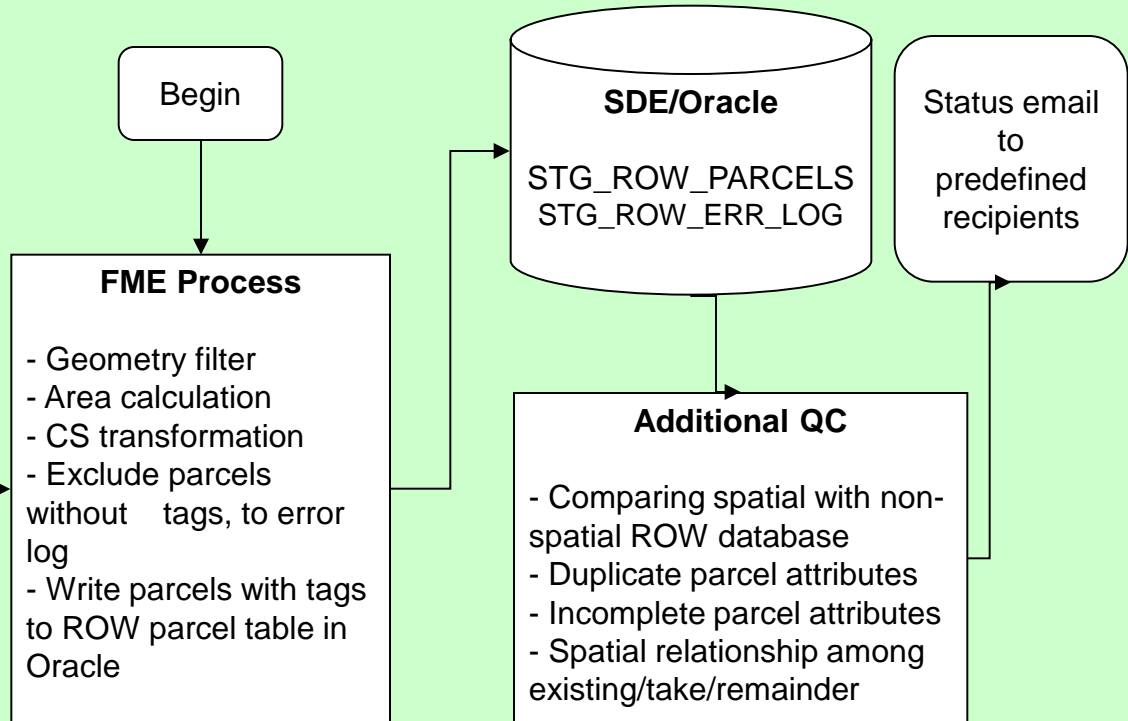
UGear Phase I System Flow Overview UDOT GIS-Enabled Application for ROW

UGear Admin

Web Application to setup the project for GIS loading:

- define the DGN files to be loaded
- define the project coordinate systems
- define recipient's of QC messages
- browse processing log and error log
- schedule script execution time

By Administrator



Automated Process

Resource Impact

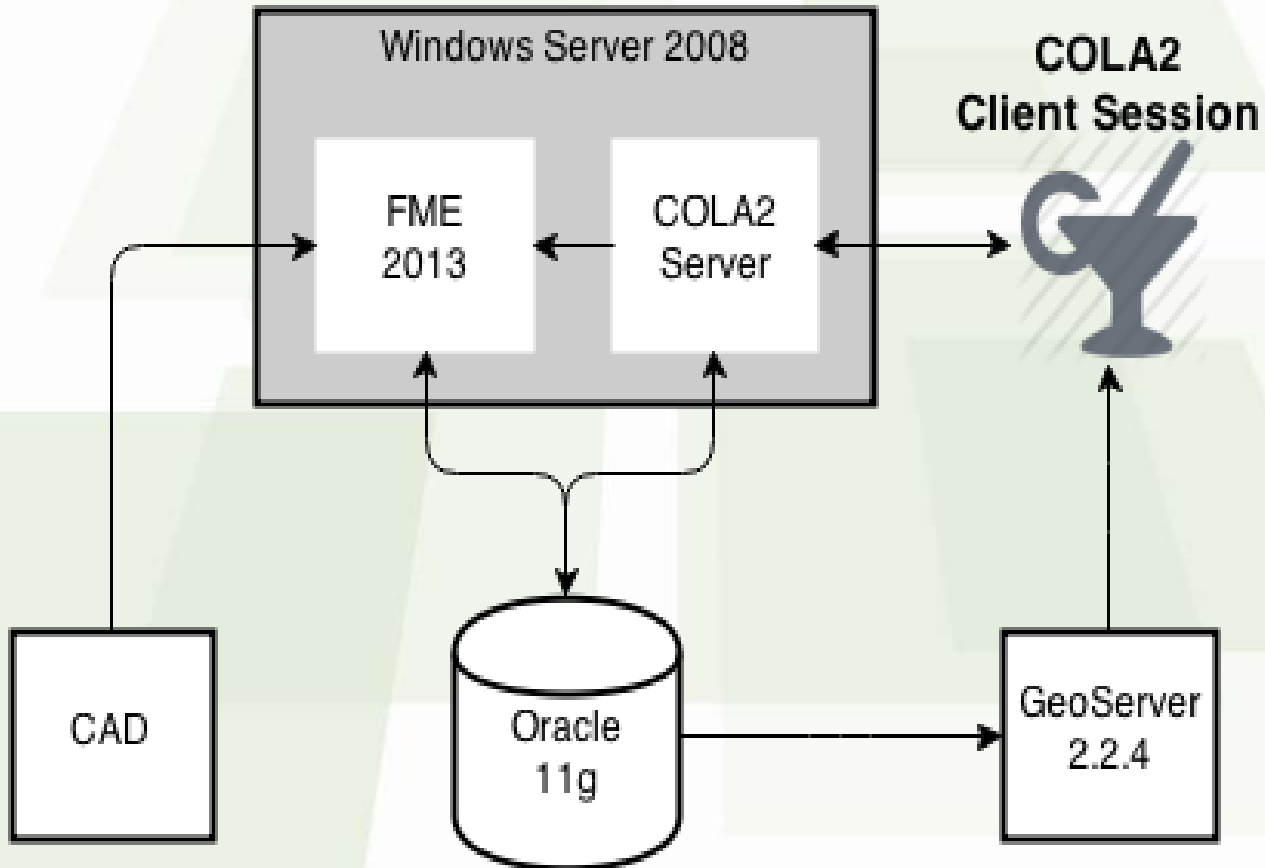
Task	Description	UDOT Staff			Consultant Staff		
		Staff	Essential Skills	Time	Title	Essential Skills	Time
Projection System	<p><u>Admin</u> - Ensure the Proj CS parameters are available and correct. Enter into the Admin application.</p> <p><u>Consultant</u> - Provide the info on a timely manner</p>	Admin	ROW Business, Survey	2-5 hours per Project	Engineer / Surveyor	Survey and/or GIS	2 hours
QC	<p><u>Admin</u> - Advice consultants on fixing the errors.</p> <p><u>Consultant</u> - Fix the QC issues</p>	Admin	ROW Business, CAD	2 hours per Project	Engineer / Draftsman	CAD and / or ROW Design	2 hours per project
CAD File Prep	<u>Consultant</u> - Preparing the DGN files per new standards	None	None	None	Engineer / Draftsman	CAD and / or ROW Design	2 minutes per parcel shape

City of Phoenix

COLA2 Requirements

- Business requirements
 - CAD files containing parcel lines/labels.
 - Quality-control CAD data.
 - Move the geometry to Oracle.
 - Intranet web app with modern UI.
- Existing Infrastructure
 - AutoCAD
 - Oracle with Oracle Spatial
 - FME Desktop
 - GeoServer
 - Windows OS

City of Phoenix COLA2 Design



City of Phoenix COLA2 Application UI

COLA2! s:\Projects\City of Phoenix\COLA2\CADFiles\working_Anno_miss.dwg

Pick CAD file to process

Drive Path

- ..
- 2012
- working.dwg
- working_Anno_miss.dwg
- working_bad_layer_names.dwg
- working_not_closed.dwg
- working_not_closed2.dwg
- working_no_error.dwg
- working_with_errors.dwg

Project NO.

Lot Type

Subdivision Name

ERR_CODE	AREA_HANDLE	DATASET	LINE_HANDLE
SL		WORKING_ANNO_MISS.DWG	569995659596A99C20929451...
SL		WORKING_ANNO_MISS.DWG	5A5596596566A55C20929451...
OP	566656695565665C20929451...	WORKING_ANNO_MISS.DWG	
MA	4B4277F4A7E4659B20929451...	WORKING_ANNO_MISS.DWG	
MA	4B41D2487213566720929451...	WORKING_ANNO_MISS.DWG	



Q U E S T I O N S
A N S W E R S