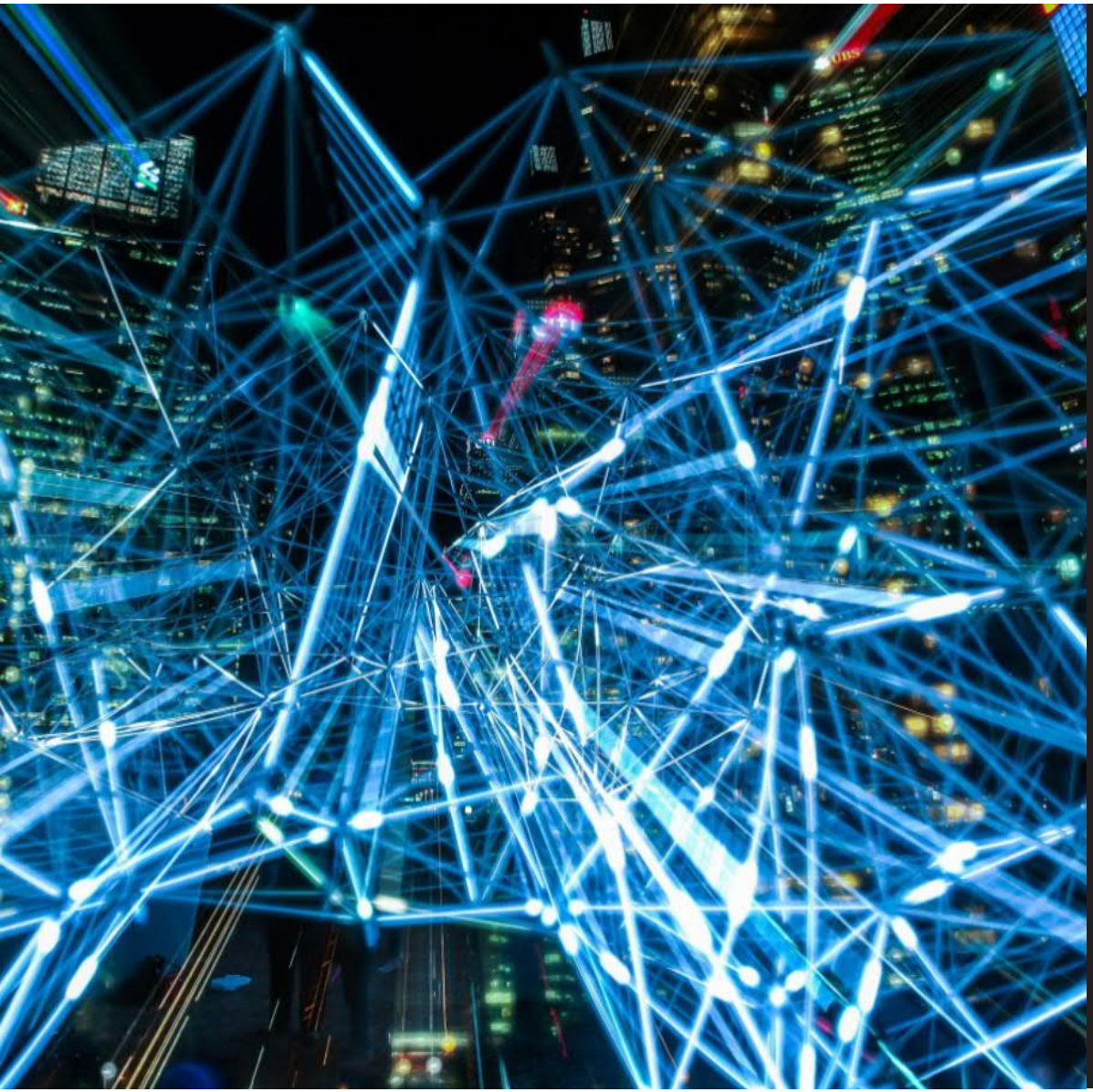


Model-based Design

Presenters:
Greg Goyette, John Barone,
Steven Costa, and Brad Hollister

Stantec

Agenda

1. Industry Overview
2. Introductions
3. Stantec Overview
4. Chicago Transit Authority, Red and Purple Line Modernization
5. BIM Deliverable/Modeling
6. Industry move to Model-Based Design

Industry Overview

Technology is disrupting the transportation infrastructure industry

- Contractors – digital layout and GPS systems, construction job site data
- Designers – BIM, 3D model-based design, visualization
- Owners – asset management applications, data hubs
- Vendors – construction-driven engineering applications and software

Introductions

Greg Goyette, Principal, Transportation Practice

John Barone, Digital Practice Manager

Steven Costa, Digital Practice Specialist

Brad Hollister, Digital Practice Specialist

Stantec Overview

Stantec

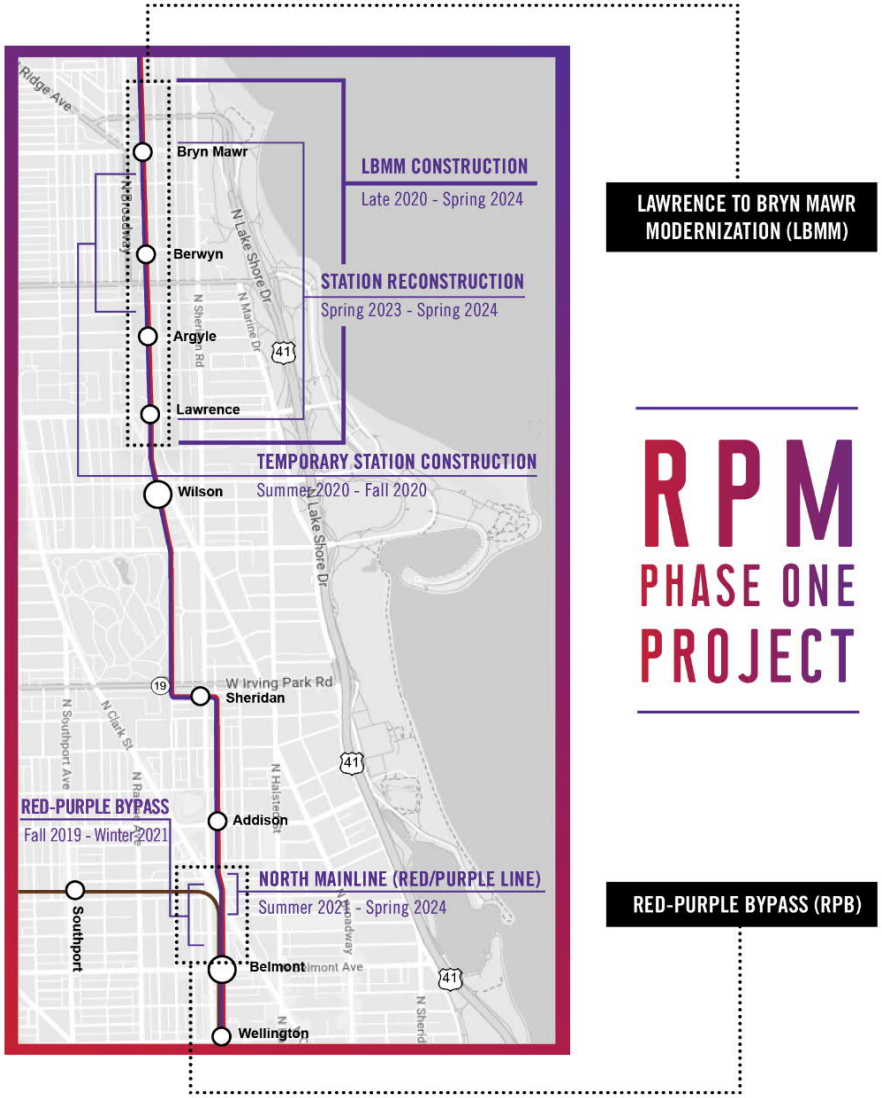
Digital Practice

- CTA CAD Standards
- Deliverables
  - Connect Version of Bentley Products
  - BIM
- Proposal Phase/Design Phase
- Subconsultants

Chicago Transit Authority
Introduction

Project Background

- Reconstruct, modernize and build 1.9 miles of elevated tracks, including bridges and support structures along Chicago's busiest transit corridor
- Demolish and construct four new stations

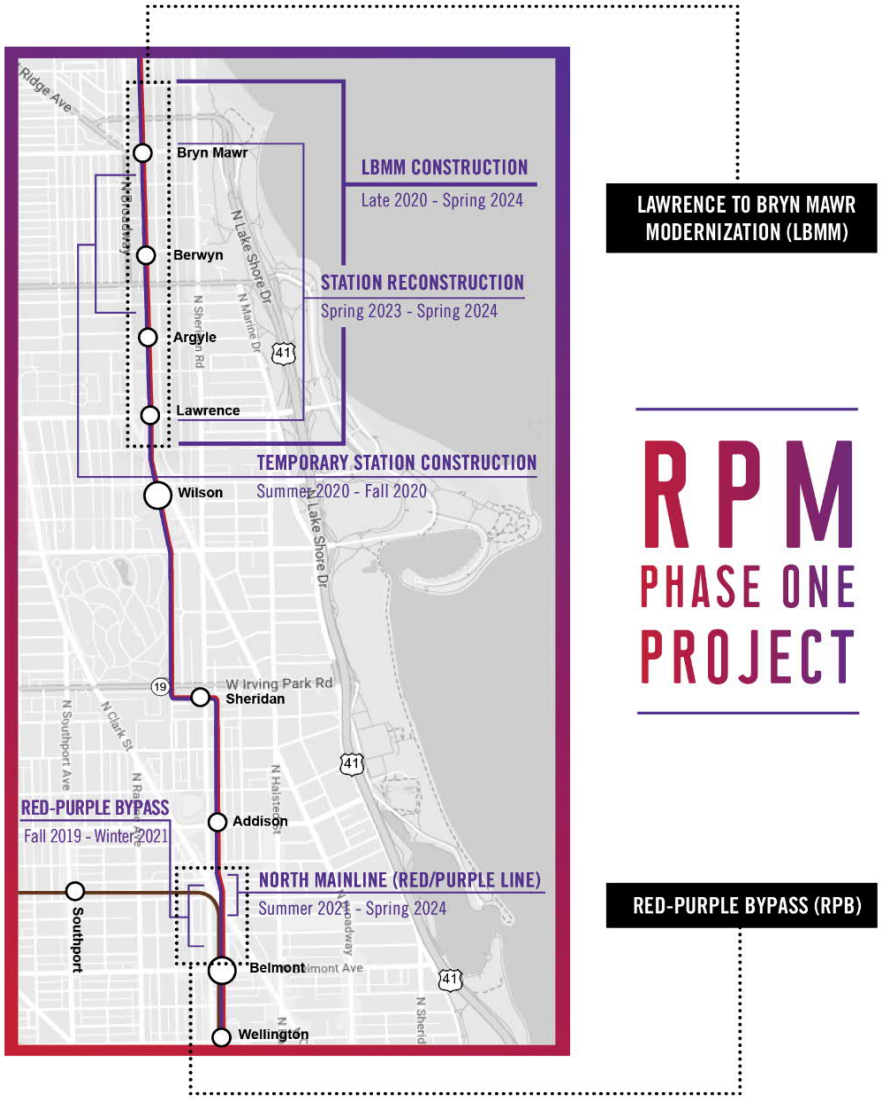


Project Background

- A new rail bypass / flyover north of Belmont Station

Project Background

- 150 design packages within 22 months; 48 months of construction
- $2.1B in construction cost



Chicago Transit Authority
Challenges

Challenge #1

First project using Bentley Open Suite within Stantec.

SOLUTION:

Engage vendors at start of project and listen to user issues.

Challenge #2

Daily file conversion/replication between Revit files hosted on BIM 360 and Bentley Open Suite files hosted on ProjectWise.

SOLUTION:

Leveraged scripting to automate the conversion process for hundreds of drawings.

Challenge #3

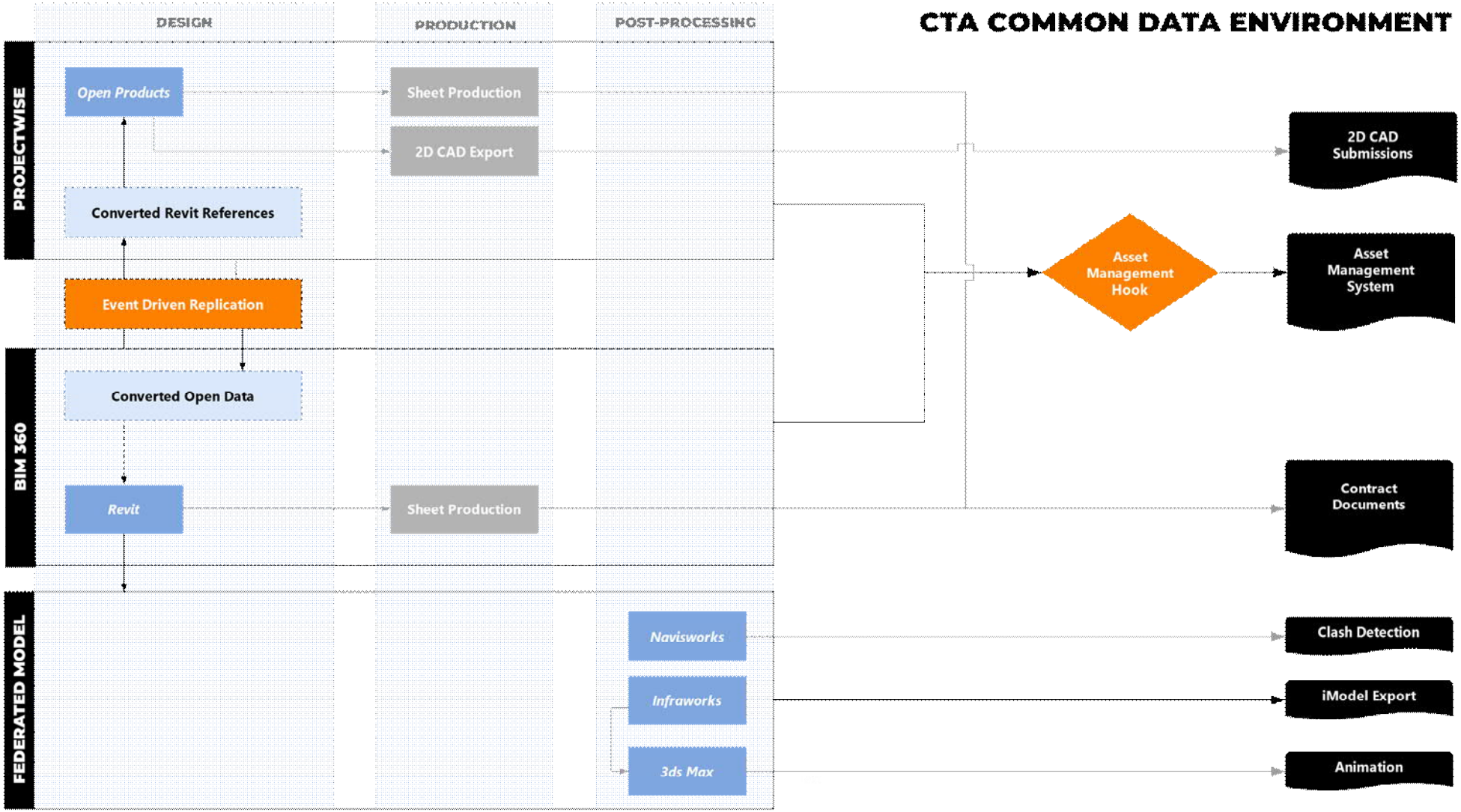
Coordination on project of this complexity and density cannot effectively be done with 2D plans

SOLUTION:

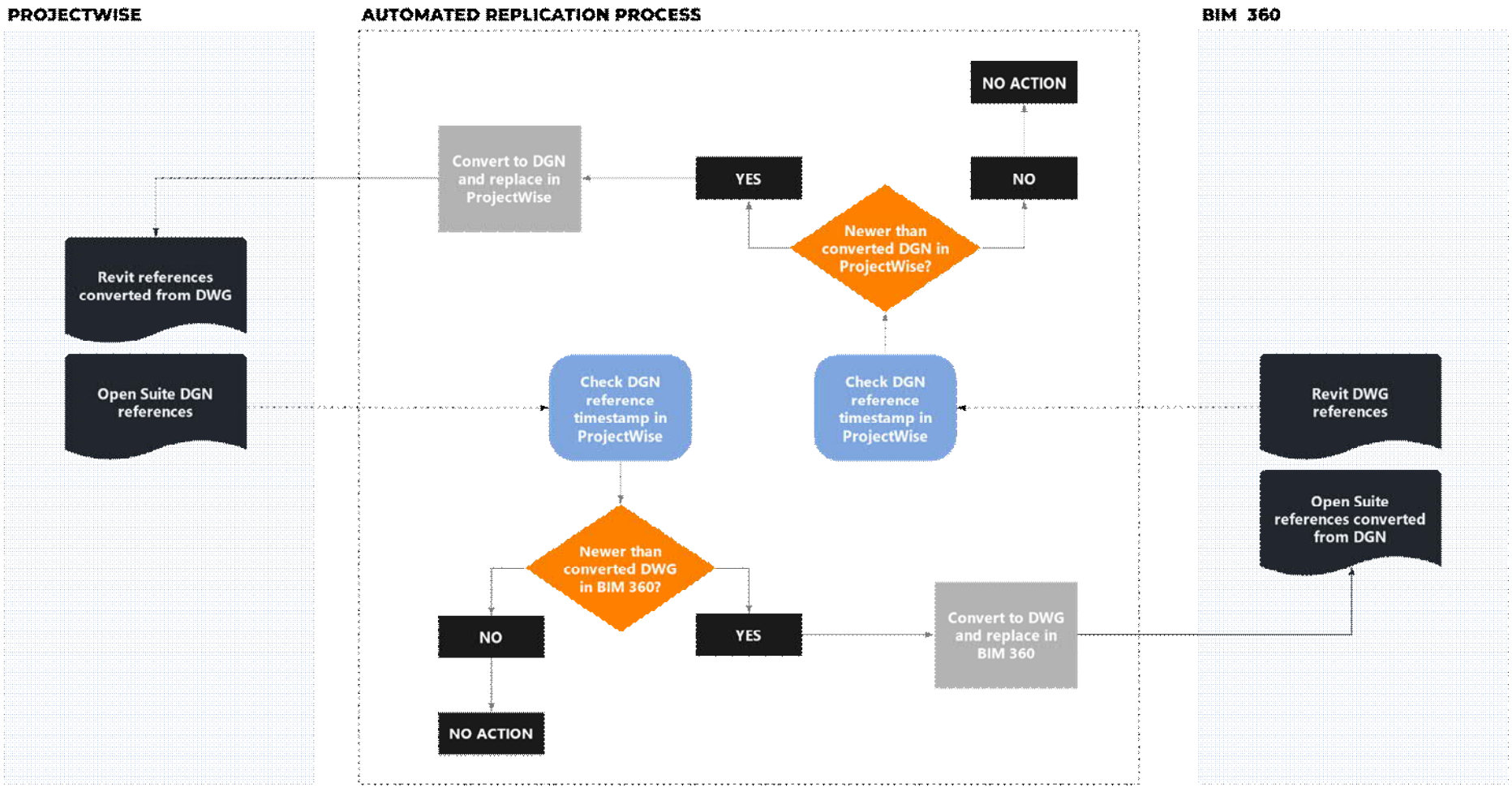
Federate model using data from Bentley and Autodesk platforms to properly coordinate data and clash resolution for all project disciplines

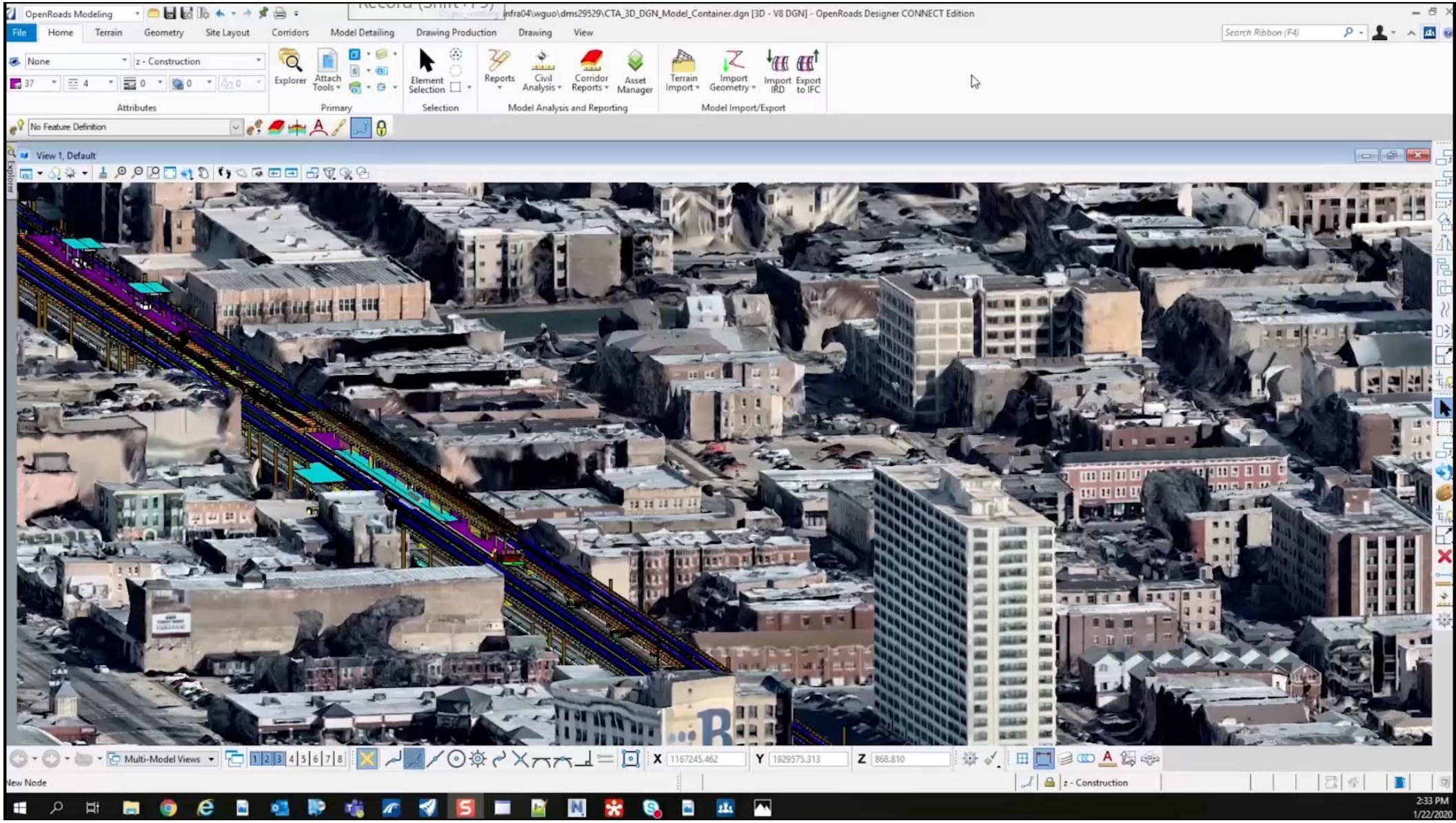
Chicago Transit Authority

Solutions


CTA COMMON DATA ENVIRONMENT
DESIGN
PRODUCTION
POST-PROCESSING
PROJECTWISE
Open Products
Converted Revit References
Event Driven Replication
Sheet Production
2D CAD Export
BIM 360
Converted Open Data
Revit
Sheet Production
FEDERATED MODEL
Navisworks
Infraworks
3ds Max
Asset Management Hook
2D CAD Submissions
Asset Management System
Contract Documents
Clash Detection
iModel Export
Animation

CTA AUTOMATED REPLICATION




OpenRoads Modeling
infra04\wguo\dms29529\CTA_3D_DGN_Model_Container.dgn [3D - V8 DGN] - OpenRoads Designer CONNECT Edition
File
Home
Terrain
Geometry
Site Layout
Corridors
Model Detailing
Drawing Production
Drawing
View
Search Ribbon (F4)
None
z - Construction
Attributes
Explorer
Attach Tools
Primary
Element Selection
Selection
Reports
Civil Analysis
Corridor Reports
Asset Manager
Model Analysis and Reporting
Terrain Import
Import Geometry
Import IRD
Export to IFC
Model Import/Export
No Feature Definition
View 1, Default
Multi-Model Views
X 1167245.462
Y 1929575.313
Z 868.810
New Node
z - Construction
2:33 PM
1/22/2020

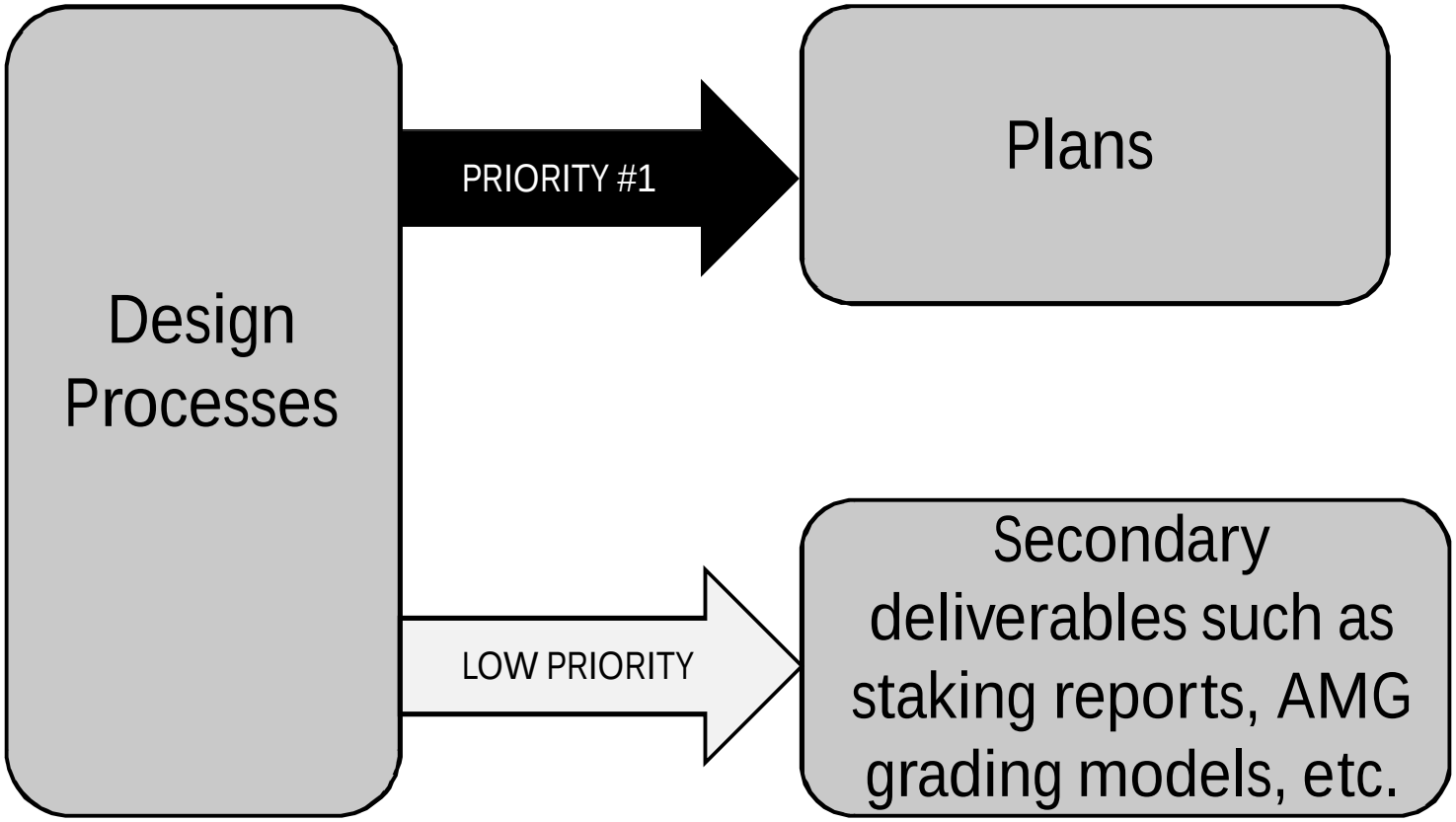
The Industry Move to Model Based Design

ACEC/VTRANS
Transportation Technical
Workshop

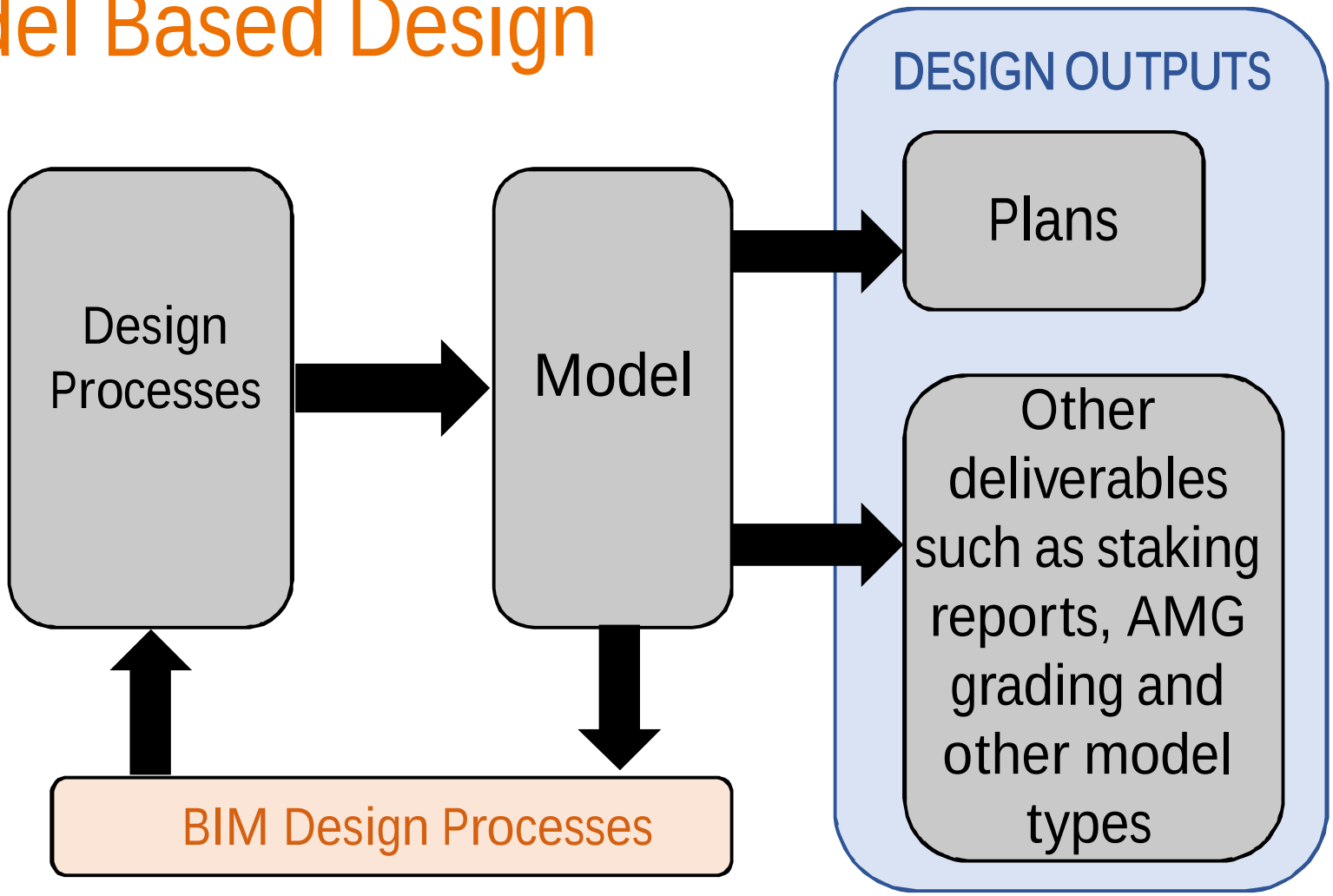
Stantec

Digital Practice - Infrastructure

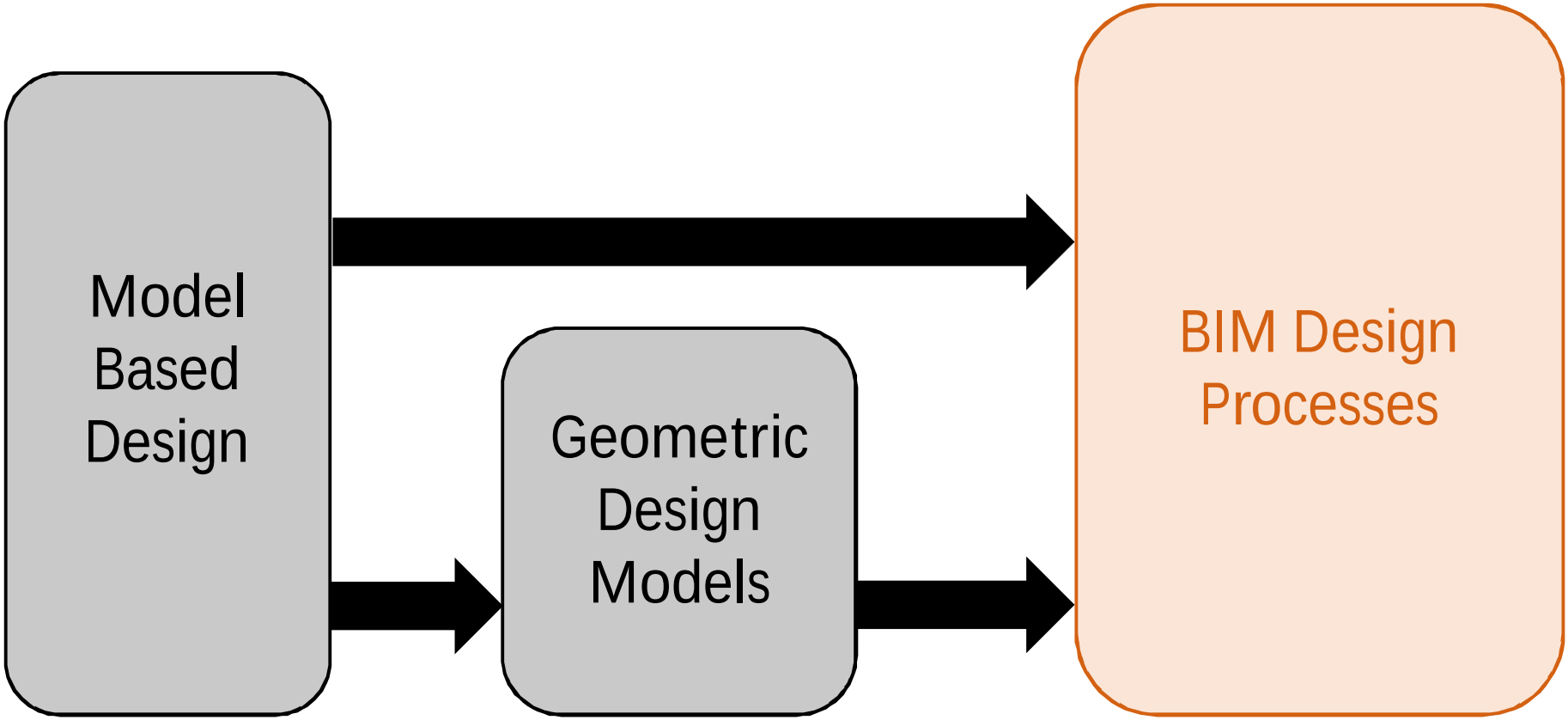
Old-School Design



Model Based Design



Model Based Design



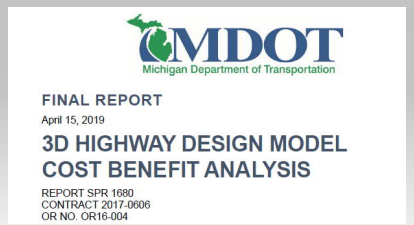
Michigan DOT 3D Highway Design Model Cost Benefit Analysis*

- Studied projects from 2012 – 2016
- 65 projects with traditional 2D + 3D deliverables
- 192 projects with traditional 2D delivery only

*https://www.michigan.gov/documents/mdot/2019-SPR-1680_652496_7.pdf

Executive Summary, Page 1:

"The historical data statistical analysis revealed that project sizes of $5 million to $20 million benefit the most from the use of 3D models. However, 3D models (indiscriminate of project size) consistently produced bids that were lower than the engineer's estimate. When bids came in higher than the engineer's estimate, 3D models produced fewer change orders than 2D plans."



https://www.michigan.gov/documents/mdot/2019-SPR-1680_652496_7.pdf

Bid Amount Effects

MDOT
Michigan Department of Transportation

FINAL REPORT
April 15, 2019

3D HIGHWAY DESIGN MODEL COST BENEFIT ANALYSIS

REPORT SPR-1680
CONTRACT 2017-0606
OR NO. OR16-004

$$\text{Award Growth} = \frac{\text{Awarded Contract Value} - \text{Engineer's Estimate}}{\text{Engineer's Estimate}} \; x\,100$$

Equation 1. Formula for calculating award growth parameter.

Table 8. Historical data award growth analysis summary (for all regions).

Award growth – All Regions	2D Plans	3D Models
Count	192	65
Average	+3.0%	-1.4%
Standard Deviation	15%	15%

Net 4.4% Change

https://www.michigan.gov/documents/mdot/2019-SPR-1680_652496_7.pdf

ROI

Table 21. Summary of calculations for the 5-year ROI of MDOT's implementation of RID 3D models.

Value	Output ($)
Average Construction Program ($)	$ 1,249,400,000
Timeframe	5 Years
Cost Over Timeframe ($)	$ 56,752,963
Benefits Over Timeframe ($)	$ 74,964,000
Net Benefits	$ 18,211,037
5-Year ROI (%)	32.03%
Breakeven Year	Year 1

MDOT
Michigan Department of Transportation

FINAL REPORT
April 15, 2019

3D HIGHWAY DESIGN MODEL COST BENEFIT ANALYSIS

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2D (TRADITIONAL)	2D + 3D
Estimated Construction Cost	
$1,000,000.00	$1,000,000.00
Design Cost	
9% of Estimated Cost	+ 10% to the Design Cost
$90,000.00	$99,000.00
Bid Results	
Estimated Cost +3%	Estimated Cost -1.4%
$1,030,000.00	$986,000.00
Final As-Let Cost	
$1,120,000.00	$1,085,000.00
As-Let Cost Savings	
$1,120,000 - $1,085,0000 = $35,000.00	

Project Level Benefit on Bid Cost

$35,000

Project Delivery Cost Savings equals
39% of Design Effort

($35,000/$90,000)

Wisconsin Lessons Learned

Deliver Design Model Pre-Bid

Wisconsin Lessons Learned

3D Design Workflow is Different From Traditional Approaches

Wisconsin Lessons Learned

Match Model Content to Project Needs

- Type of Content
- Level of Detail, Level of Development

Wisconsin Lessons Learned

Moving the Entire Industry – Leave No One Behind

Stantec and BIM for Infrastructure

Internal and External

How can we help?

Questions