AUTODESK UNIVERSITY

CI123972

Simple Digital Engineering Strategies for Successful Project Delivery

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Learning Objectives

- Learn how to plan successful implementation of digital engineering on infrastructure projects
- Learn how to customize Autodesk Civil 3D and Autodesk Revit with relevant consistency with BIM Execution Plan
- Learn how to educate clients on the benefits of digital engineering on infrastructure projects
- Learn how to increase your organizations BIM capabilities and formalize consistent workflows for increased efficiencies

Description

In Australia, procuring and delivering infrastructure projects digitally is still in its infancy. We need to encourage our clients and not confuse—simplicity is the key. We've all heard the cliché "a picture tells a thousand words," but there's real value in using images to promote engineering content. Images help us learn, grab attention, explain tough concepts, and inspire. Master Information Delivery Plans (MIDP) and levels of detail (LOD), which are usually very detailed wordy descriptions, can be easily represented through diagrams—which can then be used as a basis for developing Task Information Delivery Plans (TIDP). I have used these diagrams successfully on projects with government clients, and can easily explain the required inputs, what will be delivered through the milestones of delivery, and the outputs at each stage of project delivery. This will also let you build content within Building Information Modeling (BIM)-enabled platforms for consistency in delivery.

Speaker

With over 20 years working in the infrastructure engineering industry and 12 years utilising BIM enabled platforms, Steven's experience is extensive and varied in Digital Engineering from bridges, roads, buildings, water and oil and gas. Steven's career has progressed to leading and managing high performing teams using the latest technology to deliver projects. Steven is an Associate Technical Director of Digital Engineering at Arcadis, Sydney, and is currently the Digital Engineering Manager on many Digital Engineering projects within Australia as well as the governance of the implementation of 100% BIM throughout the Australian business.

Introduction

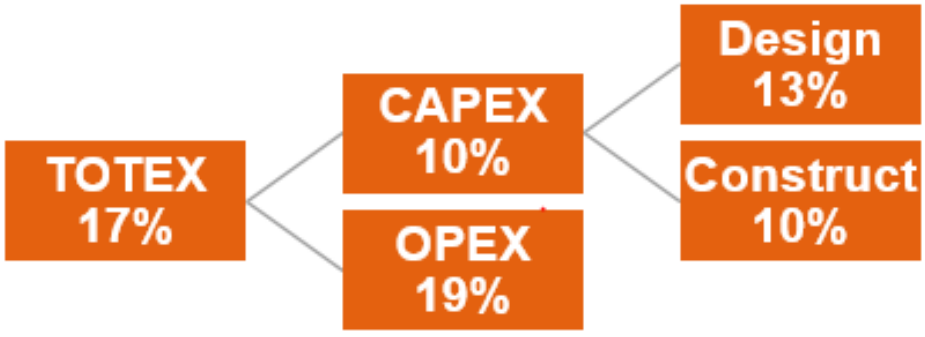
Within Australia, BIM is now a preferred method of project delivery as our clients are beginning to utilise the information to manage their assets. For our infrastructure clients, the term BIM has been confusing, so the term digital engineering is referred to as the process. Simply, Digital Engineering is a collaborative way of working, using digital processes, to enable more productive methods of planning, design, constructing, operating and maintaining of assets. This is achieved by creating a Common Date Environment that aligns information systems including CAD, GIS, 3D BIM, electronic document management, project controls, asset data and other related systems. Digital Engineering provides faster, clearer, and more accurate project and asset information. Enables greater capability, quality and cost effectiveness of:

- Strategic Planning
- Project Outcomes
- Asset Management

When there is not a BIM mandate within regions, why are clients requesting a BIM deliverable and requesting their assets digitally? Our clients, and even within our own business, we are starting to understand the benefits of Digital Engineering. PAS 1192.2 is now being a standard specification that is included within most Requests for Tenders and Scope of works documents.

So, we do we adopt the use of BIM on projects:

- **Value** – value at every stage of the asset lifecycle with average saving of 17% on total asset expenditure
- **Data** – instrumental for unlocking the value from our architecture, design and engineering data
- **Clients** – able to use BIM in our business as usual is quickly becoming a prerequisite in some regions



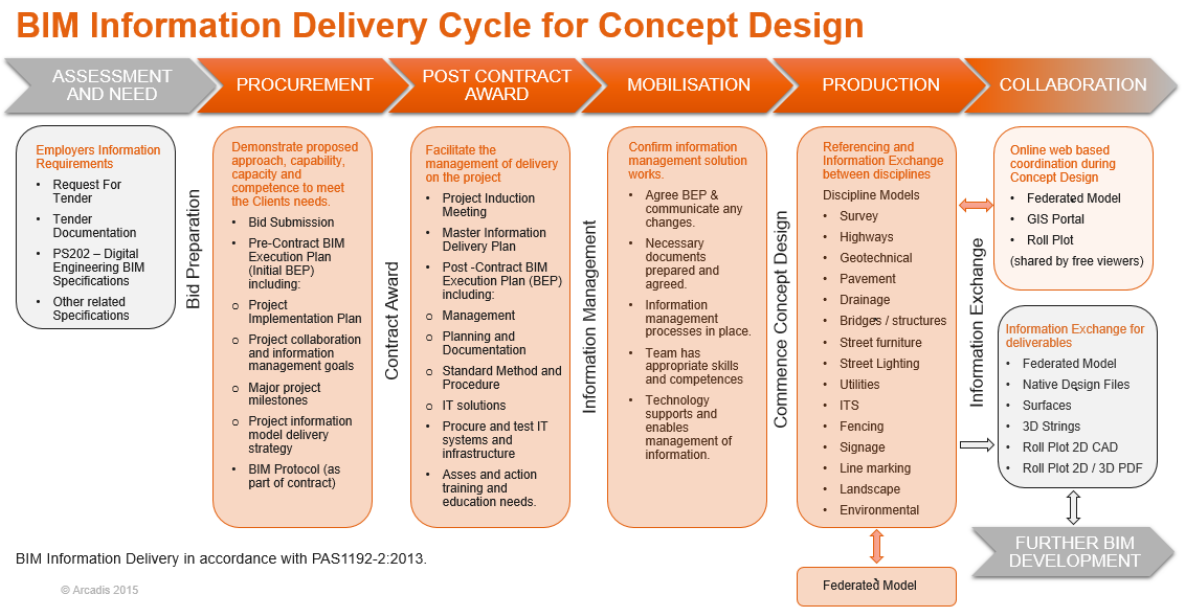
Our clients are becoming more educated through project delivery and the use of BIM Authoring, managing and collaboration tools. But we need to ensure we develop these tools and include these within the planning stages of any Digital Engineering project – even before project award. Taking time to review each project, client, milestone, data, drop, BIM use, and Digital Engineering objectives is critical at the opportunity and tender phase to educate clients but also showcase your organizations capabilities in working in a collaborative way.

Successful planning in the use of BIM on projects

The planning of Digital Engineering delivery does not start on project award. A clear strategy needs to be developed at the opportunity phase and tender phase of any project. The clear and concise strategy is key for client approval and to allow for a collaborative working environment through project delivery. The value of a pre-contract BIM Execution Plan in accordance with CPIx can be a direct response to the clients Employers Information Requirements (EIR) or if there is no EIR.
Items that should be covered are:

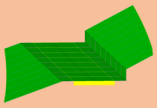
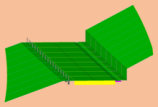
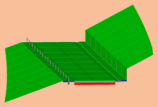
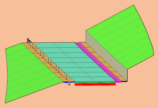
- Project Implementation Plan
- Project goals for collaboration and information modelling
- Major project Milestone's
- Project Information Modelling delivery strategy

Developing a simple project workflow is early in the Pre-Contract BEP will help develop the rest of the process and in turn the document, refer example below of such type workflow that was developed for a Concept Design project

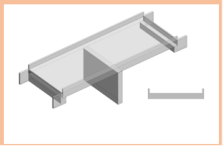
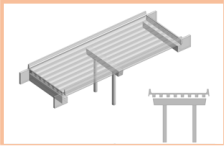
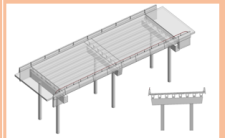


Understanding the content delivery at each milestone, and then informing the client is the next process. Level of Development (LOD) measurement for infrastructure projects is still in development, and working with clients who do not have an appreciation of such measurements needs to be considered. Within the BIM Execution Plan, showing this information is critical to ensure you get the clients early buy-in and needs to be easily consumable. Model production Delivery Diagrams can assist by investigation the information required to be include within the model, the production prototype and the output. An example of a Model Production Deliver Table is shown below for a highways project where Civil 3D was used for the road design, and Revit was used for bridges and structural design.

ALIGNMENT - MODEL PRODUCTION DELIVERY DIAGRAM

Milestone		20% Design	50% Design	80% Design	100% Design
Design Input	Design Team	GENIO from RMS, survey, GIS, Cadastral, engineering input, review Aurecon design	GENIO from RMS, survey, GIS, Cadastral, engineering input, geotechnical, hydrology, utilities	Survey, GIS, Cadastral, engineering input, geotechnical, hydrology, utilities, drainage	Survey, GIS, Cadastral, engineering input, geotechnical, hydrology, utilities, drainage
	Client	Approval of BIM Execution Plan	Preferred Alignment Option	Frozen alignment	Final comments
Production	Details	Basic 3D model in Civil 3D including road alignment, a basic road formation with an indicative pavement box, verges and indicative batters and/or retaining wall faces, indicative line marking and road furniture. Typical Cross Sections determined. Models at the correct location	Basic 3D model in Civil 3D including road alignment, a road formation with an indicative pavement box, verges and basic batters and/or retaining wall faces, basic line marking and road furniture. Models at the correct location.	Full 3D model in Civil 3D including road alignment, road formation including pavement layers, verges, batters, retaining wall faces, line marking and road furniture.	Complete 3D model in Civil 3D including different pavement types, batters, retaining wall faces, line marking and road furniture.
		← Model to modify →		← Minimal alignment or design changes →	
	Sample				
Design Output	BIM	NWD, Federated Model	NWD, Federated Model	NWD, Federated Model	NWD, Federated Model, IFC, GENIO
	2D	1:1000 Roll Plot	1:1000 Roll Plot	1:1000 Roll Plot	1:1000 Roll Plot

BRIDGES – MODEL PRODUCTION DELIVERY DIAGRAM

Milestone		20% Design	50% Design	80% Design	100% Design
Design Input	Design Team	3D control line, 3D surface level, hydrology, structural engineering input	3D control line, 3D surface level, hydrology, structural engineering input, geotechnical parameters	3D control line, 3D surface level, hydrology, structural engineering input, geotechnical parameters, pavement, drainage	3D control line, 3D surface level, hydrology, structural engineering input, geotechnical parameters, pavement, drainage
	Client	Approval of BIM Execution Plan	Preferred Bridge Option	Frozen alignment, standard details for bridge components	Final comments
Production	Details	Basic 3D model in Revit. Basic model of: • Abutment • Pier • Superstructure excluding road geometry and carriageway crossfall	Basic 3D Revit model with preferred bridge type modelled i.e. detailed cross section.	Full bridge geometry modelled in Revit. Individual properties included for superstructure and true geometry of substructure.	Complete full Revit model, with full review. Review visualisation
		← Model to modify →		← Minimal alignment or design changes →	
	Sample				
Design Output	BIM	NWD, Federated Model	NWD, Federated Model	NWD, Federated Model	NWD, Federated Model, IFC
	2D	n/a	n/a	GA drawing including to 80%	Completed 2D drawing

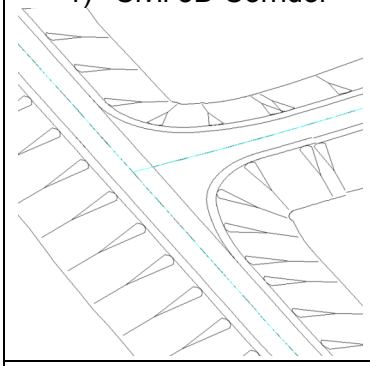
These diagrams provide a starting point to then assist in further development of BIM authoring tools, as well as further innovations by collaboration with the design team and the client.

Customising BIM tools in relation to Strategy

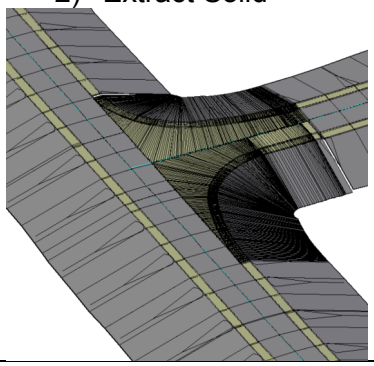
Buildings have been using Revit out of the box for years, and delivering information rich models for design development, procurement, construction and asset management. For infrastructure projects, where we have string based elements, and complex geometry issues, as well as client specific asset management requirements, early investment needs to be identified and be included within the BIM strategy for the project. Additionally, how we share and collaborate with the model and its information needs to be considered, especially how the client proposes to us the information. The creation of subassemblies with asset classification information to global or

client standards needs to be included so when the asset is being design, this information is included from out outset. And then ensuring this information can be viewed within the collaboration tools, such as Navisworks. The diagram below shows the workflow within Civil 3D from creation of the intersection, then by using the customized sub-assemblies as well as the asset information and ensuing the properties of this information is transferrable from Civil 3D to Navisworks.

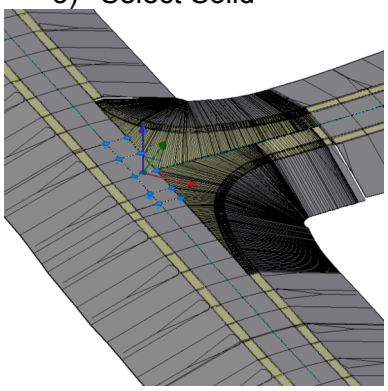
1) Civil 3D Corridor



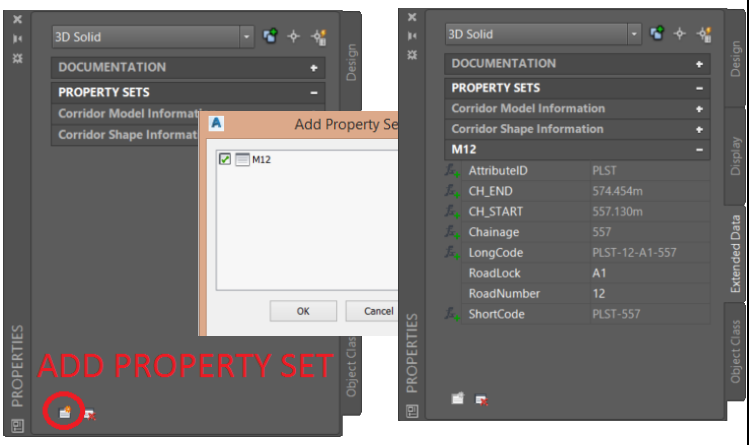
2) Extract Solid



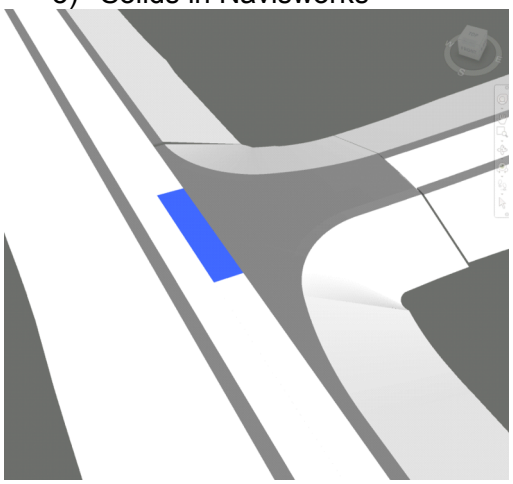
3) Select Solid



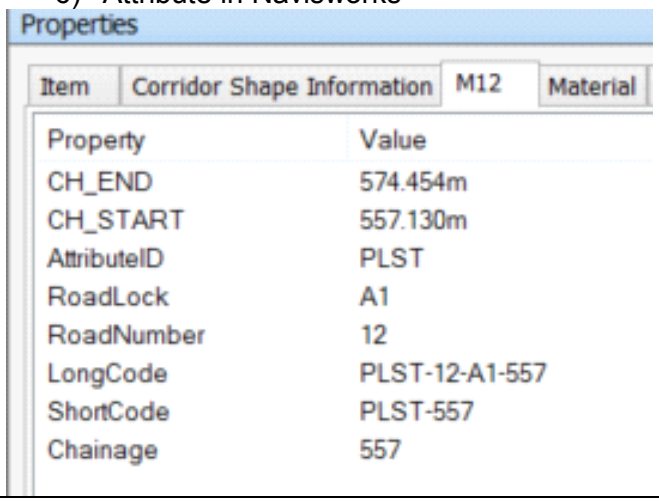
4) Add Property Set



5) Solids in Navisworks

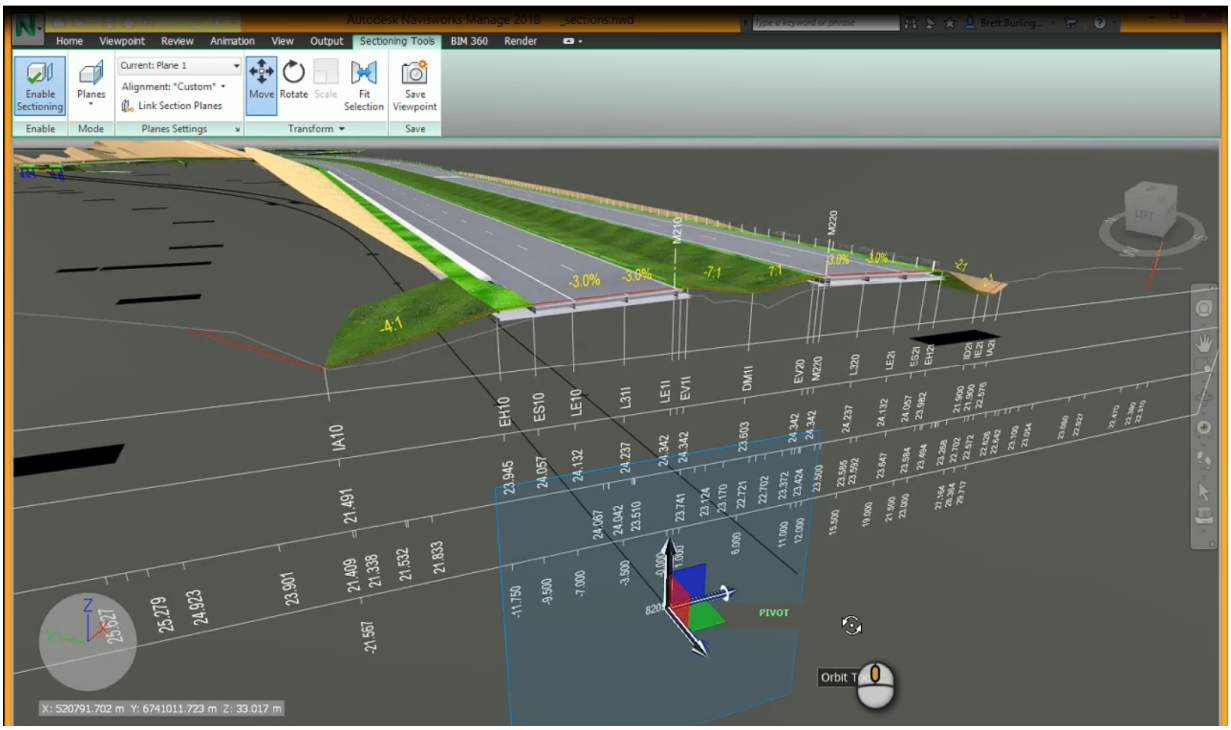


6) Attribute in Navisworks



How our clients can benefit from BIM

As business and industry develop their Digital Engineering strategy and capabilities, these need to be mirrored with our client's benefits. To collaborate with clients, it's important not to confuse with terminology, standards and processes. Ensuring delivery of projects will be consistent with previous procurement methods, clients will start to see the benefits of a Digital Engineering process and will start their journey by understanding value adds the process can have. For a recent highways project, we strategized how the client will be able to review the design, based upon their current skill sets. By reviewing the 3D BIM information within Navisworks, the client would not be able to review information as they would previously. We developed workflows of Civil 3D, where the cross section and long section data, which contains all the road geometry information would appear in Navisworks to use as a review and checking process for levels and geometry. An example of this is shown below.



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Increase BIM capabilities in your organisation

According to McKinsey, “In a digital transformation, leaders should focus on three building blocks:”

Strategic direction and control	Project Enablement	Enterprise Transformation
Develop overall strategy innovations	Define digital-project section criteria and scope	Develop implementation plan
Set clear objectives	Identify suitable projects (fully digital and/or digital applications)	Install digital-project unit
Develop transformation road map	Run projects in waves	Assess IT Infrastructure
Shape story and communicate	Adapt based on learnings	
Install transformation management		

Digital Engineering is the first step towards a digital future in the engineering, architecture and construction industry. How business is structured needs to suit that of your clients to ensure you stay on par with the BIM maturity of your business as well as the industry. This can be achieved by following two key initiative:

1. Bridge the Gap in Each region
    a. Regional BIM leadership and implementation roadmap
    b. Local implementation teams
    c. Capability upgrade (people, process, technology)
2. Sustain Market Leadership with Continuous improvement
    a. Technology and business model innovation
    b. Benefits articulation and price realization
    c. Standardization and continuous process improvement