

Digital Engineering

Tuesday 16 November



Tim Mumford
Beca



Devon Middleditch
Transport for NSW



Carys Evans
DELWP



Stuart Bull
Laing O'Rourke

About Roads Australia

[Roads Australia](#) (RA) is the peak body for roads within an integrated transport system, representing an industry that contributes \$207 billion annually to the economy and supports 1.3 million jobs.

RA brings industry, government and communities together to lead the evolution of Australia's roads, integrated transport and mobility.

The nation's only roads champion, RA's 160+ members include all of Australia's road agencies, major contractors and consultants, motoring clubs, service providers and other relevant industry groups.

RA's current policy focus extends across five activity streams: Safety; Capacity; Transport Reform; Customer Experience; and Sustainability, with Diversity and Inclusion an underlying commitment across each stream.

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Background

With Australia now delivering a record pipeline of transport projects, Digital Engineering (DE) offers a way to enhance productivity and deliver time and cost savings for governments and industry.

Speakers highlighted the importance of accessible platforms and consistent data

standards, not only to facilitate greater DE uptake across the industry, but also to permit the interoperability central to unlocking productivity benefits including transparency across supply chains, management of project risks (including utilities) and automated design and maintenance processes.

There is also an urgent need to focus on enhancing digital skills – not only among those undertaking design and maintenance work, but at the receiving end, so that decision makers can properly understand and interpret information presented via DE platforms.

Event summary

This policy webinar brought into focus the transformational potential of DE. RA President [Michael Bushby](#) hosted a panel of subject matter experts who explained their view and experience of DE.

- [Carys Evans](#), Director Digital Twin Victoria, [Department of Environment, Land, Water and Planning](#)
- [Tim Mumford](#), Business Director – Digital and Innovation, [Beca](#)
- [Stuart Bull](#), Head of Digital Engineering Australia Hub, [Laing O'Rourke](#)
- [Devon Middleditch](#), Director Digital Engineering Services, [Transport for NSW](#)

[Geoff Allan](#), Chief Executive, [Austroads](#) and [David Heins](#), Project Manager, DE Guide, [Transport for NSW](#) also highlighted opportunities for industry input into the [Guide to Digital Engineering](#) currently being developed through Austroads to help with the adoption and standardisation of DE in ways that enhance construction productivity.

The project will assist transport agencies in Australia and New Zealand to deliver and operate their assets more effectively through obtaining better value and consistency in the application of Digital Engineering.

David called on participants to get involved in the consultation and to bring valuable experience in areas of inefficiencies, frustrations, opportunities and suggested solutions.

Policy Insights

RA President, Michael Bushby, opened the Webinar by observing that the Australian transport industry has attracted criticism in recent years for not keeping up to pace with productivity improvements seen in other parts of the economy. He said DE can be used to support better decision making that can reduce costs and improve outcomes overall.



DE – WHAT IS IT?

Practitioners of DE call it a contemporary and collaborative approach to working on assets that allows for faster and more efficient project delivery and management of physical assets. The [Victorian Digital Asset Strategy](#) defines DE as the convergence of emerging technologies such as Building Information Modelling (BIM), Geographic Information Systems (GIS) and other related systems for deriving better

business, project and asset management outcomes.

A deep connection between digital engineering, BIM and digital twins allows models to be created to hydrate a digital twin with real time data, spatial context and connections to asset data, documents and photos. Carys Evans explained that from the viewpoint of Digital Twin Victoria (DTV) this allows a digital representation of reality in three-dimensional space and time. She likened it to virtual Lego, Sim City or Minecraft.

Carys explained that DTV provides an open source platform that is designed to make data sharing easy and drive the development of an ecosystem of digital tools that supports better decisions, faster services and smarter government.

TfNSW's Devon Middleditch spoke about digital delivery through a client's lens. He said the digital engineering framework has evolved to become an instruction book for how to incorporate multi-disciplinary designs and asset handover activities with the greatest efficiency, risk management, standardisation and supply chain transparency.

Devon explained the Transport Data and Information Asset Management Policy which ensures data and information are managed as an asset to enable better planning, delivery and management of a safe, sustainable and integrated transport system. He said providing the right data, and information at the right time, enables more informed decisions.

This empowers the right personas and functional role types to obtain the lens or insight needed to perform an activity more effectively. He explained the key is structured data and data standards. These things turn data into information that benefits customers and the industry.

Tim Mumford from Beca talked about DE as an information management system that works with BIM and Digital Delivery and other enablers to support Smart Cities.

He said the terms were not simply interchangeable, with each having its own nuances. For example, BIM models are digital representations (reminiscent of Minecraft), DE is about data federation enabling changes to flow throughout a model, and Digital Delivery is about the lifecycle-based information that can enable something like a spatial digital twin or, ultimately, a smart city. He said this explains why smart cities are so much more than simply putting widgets on light poles and pointed out that policy enablers and new ways of working are also key to ensuring everyone is “talking the same language”.

Tim described [Beca’s award winning](#) use of automated design for the Bundarbo Bridge that reduced required time by three weeks and said there will be growing opportunities to use “generative design” in future.

He explained Beca’s open source environment aggregates things such as piping and instrumentation diagrams (P&IDs), GIS and BIM environments, enabling key real time insights about projects or a portfolio.

Stuart Bull from Laing O’Rourke talked about DE in the context of Data and Systems Integration and understanding of information management. Collectively he called this a “Project Information Model” and said Laing O’Rourke had more than a hundred digital engineers in Australia and the UK working on what supports such a model. An example are capabilities to develop custom apps, GIS and BIM, analytics, AR/VR, forms and processes around integrated gateways, cloud storage solutions and APIs.

Stuart described custom apps - such as one developed for Wynyard Station - that are based on such an underlying approach to DE. These allow people to navigate a construction site, for example, recognising changes more easily.

But will the Australian DE industry in future be able to find enough of the skilled digital engineers companies such as Laing O’Rourke increasingly rely on?

Stuart said that to achieve the needed digitisation of engineering processes, skills uplift would be needed for engineers, planners,

estimators and hand over teams for using the tools and technology.

Carys agreed, saying Victoria had recognised that capability uplift was crucial in terms of technical capabilities for practitioners, but also capabilities in the parts of government, the community and business that receive the outputs from DE.

Devon said he would like to see courseware developed that can help seasoned project managers and design managers share their “modern delivery” experience.



DE – WHY DO WE NEED IT?

Why has DE caught the industry’s attention and become so central to efficiency and productivity in places such as the UK, US and Singapore? Carys suggested a DE-based digital twin can save up to 20% in construction costs, boost productivity up to 40% and create three times more jobs than more traditional approaches. Essentially these benefits come from being able to better answer questions about the past, present and the future. The benefits also flow from the fact that data which never previously left a consultant’s desk is now being used to its full potential to shrink time needed for processes from weeks to seconds. Such benefits have also coincided with a period of digital transformation opportunity created by Covid along with record construction and infrastructure investment.

Carys pointed to benefits from DE in terms of future workforce building, government decision support, savings through Victoria's Big Build, improved management of the natural environment, better emergency planning and economic acceleration.

She said data made available through DTV addresses use cases such as managing underground utilities in construction projects faster and more safely. But ideally, such data is properly aggregated and that is not always the case. Carys said that in Victoria, diverse data is available from utility service providers but a collated form is not easily accessible. She said “Dial Before You Dig” is an aggregation point but that its 3D digital data was not of the verified quality needed for major projects and needed uplift. DE is gradually solving that through the federation of data pools.

Devon gave a specific example of why DE is so valuable, illustrating Carys’s points by showing why DE’s federated model is so effective at adding value to an area such as sub-surface works. He said it had allowed the Western Sydney Project Office to cut Requests for Information on Design by 56% and cut the cost of variations by 59% through an 18% overall reduction in variations.

Tim brought another powerful argument for why DE was proving so valuable: the cost of construction has outpaced average inflation by 24% over the last 30 years in Australia, meaning we can afford less and less infrastructure over time unless we realise the benefits of data to compensate for that.

He said the societal benefit of infrastructure - which is the base reason for building infrastructure in the first place - underscores the importance of addressing that lag.

Tim couched the importance of DE in terms of its contribution to ensure the infrastructure we build serves a purpose, with DE’s information being able to drive decisions to create the infrastructure which has the most value and where the benefits are most likely to occur in perpetuity. He said industry meanwhile gets benefits such as an 80% reduction in time to generate a cost estimate and a 10% saving of the contract value through clash detections.

Tim explored why DE can make such a valuable contribution to each phase of infrastructure development, through planning, procurement, engineering and construction, addressing challenges in areas such as speed, cost, complexity and capability. He said this was

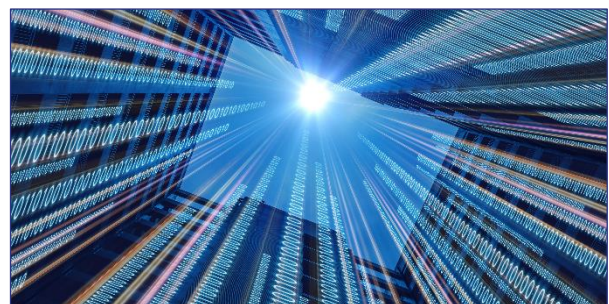
why it was so important to ensure information was retained and standardised, even if it meant some sacrifice to a project’s speed.

Whilst 80% of asset information is currently unstructured and 20% structured, Tim argued this ratio should be flipped. Asset and facilities managers value the non-geometrical information that’s attributed to the information sets because of the help it provides in areas such as combustible cladding. Here it is vital to know where that combustible cladding has come from, what it is made of and who the manufacturer is. Tim said retaining such information in a structured format can benefit asset managers in their tasks, helping to create an essential source of truth to rely on. He said that doing so was more important than creating things such as flythroughs.

Rapid optioneering in the planning phase plays another key role in validating assets. Tim said this can serve to increase project buy-in and social licence.

Beca has also developed DE-related tools such as “[Frankly AI](#)”. This applies a conversational AI algorithm to foster conversation with stakeholders, both building and reaching back into conversational databases.

Beca also uses BIM in the engineering phase to detect clashes and reduce waste. Tim argued that in future such innovations will bring greater confluence between DE, sustainability, automated design, project collaboration and IoT sensors.



He said that the use of digital twins in the construct phase is also helping to track material origins. This means that the source of something like combustible cladding or asbestos can be verified at handover, which helps ensure quality is delivered as expected.

Tim said such benefits are less about digital than about a bigger picture of “information management”. He said everyone in the industry needed to recognise that - including clients, regulators and policy authors - and that the cost of inaction would be high.

Stuart warned of a disconnected digital Australia where what he said are a series of great, state-based outcomes are unaccompanied by enough national leadership. He called for national agreement on areas such as how the digital transformational approach can stop being shoehorned into a traditional contractual outcome. This accords with RA’s encouragement of the Australian Government to take a strong leadership role in a comprehensive and nationally consistent approach to digital engineering in the procurement, operation and management of infrastructure.

Stuart said “whole-of-life” digital collaboration platforms (such as Revizto), when used throughout a project could help to achieve this, improving design, collaboration and community engagement with much faster tracking and reviews.

Stuart also explained why DE makes such a difference to safety with more interactive safety and design reviews.



DE – HOW CAN IT BEST BE USED?

The speakers explained how DE federated information unlocks efficiencies at every point of an infrastructure project.

Stuart said Laing O’Rourke is using DE to develop projects that are connected, flexible, demonstrable and scalable, with evidence-based outcomes.

He showed how DE adds value to the whole delivery of a project through improvements to collaboration sufficient to meet the massive upcoming construction and design pipeline.

Carys described that the \$37m funding for Digital Twin Victoria (DTV) had enabled what she said was arguably one of the most exciting and ambitious digital programs in government to be created. She said this harnessed digital innovation, emerging technologies and geospatial data to create a platform for government, business and the community to collaborate on, share and visualise spatial data.

How DE delivers value is shown in areas such as flood prediction and traffic optimisation. Carys gave examples of how historic weather data and infrastructure models enable analysts to predict localised flooding impacts. Traffic condition and road closure decisions can inform emergency vehicle routing in real time. She explained how building scenarios to visualize how projects will interact with built form in the future, helps coordinate transport and present planning, enabling enriched engagement with Victorian businesses and community.

She explained how new data products will include sources such as a statewide digital elevation model and 3D building models, enabling easier access to the mammoth amount of reliable imagery generated through the state’s construction and infrastructure projects.

She said capturing data from the Level Crossing Removal Authority, for example, could in future save costs, reduce effort, cut approval times and more accurately verify locations and events.

In a different workstream DTV developed a process that reduces an approval process that can take weeks down to 15 seconds.

The general principle is that uplift of asset management approaches by defining standards and workflows with BIM helps ensure digital assets have a useful life long beyond the initial project they are completed for, supporting asset planning, operations and maintenance, not just design and construction.

Devon said DE's new kit of tools had created the expectation that projects would be essentially built twice, both virtually and physically.

He described how the industry's digital maturity has grown, improving the design phase, constructability and the operational management of assets with clearer and more consistent information handover. He described how a future state was emerging where the smart collection and analysis of data leads to better decisions and improved flow of projects between the planning, design, construction and operation phases.

He explained how TfNSW is actively working to avoid a digital "gauge break situation" between borders through national consistencies that avoid barriers in areas such as worker and industry skill sets. He said TfNSW's multimodal digital standards integration between roads and rail, and alignment with Australian and international standards, would be key to that.

Tim explained how such developments had allowed Beca to reduce the delivery time for a NZ water treatment facility to just one year, rather than the usual two to three.

Stuart described how such benefits of DE might be further magnified if more groups participated in the national discussion around digital and data, suggesting examples such as international universities working with the Australian industry, collaborating on digital bridge and road solutions.

He described how Laing O'Rourke takes advantage of DE's support for data driven optioneering producing a rapid 10-15 options per day for its clients, with better ability through DE's methodology to show what changes looks like and spot cost savings.

He described how Laing O'Rourke uses DE to usefully link data at lower cost, better understanding project status and avoiding failures. Alerts generated in live dashboards are capable of recognising whether tasks have been done and met requirements or local authority standards.

And he explained how DE data can support AR and VR to map the complex systems needed for something like a submarine facility in more easily understandable ways, using tools such as [vGIS](https://www.vgis.io/) (<https://www.vgis.io/>) for de-risking jobs such as level crossing projects.

He also said Laing O'Rourke is supporting STEM to help ensure the needed experience and training are available.

Parting Thoughts

In his concluding remarks, Geoff Allen, Chief Executive of Austroads, said Austroads wanted to help provide some of the national leadership necessary for DE and that this could come from a collective of Australian Governments and road transport authorities working together. He said Austroads aims to produce a guide to digital engineering, to support organisations to develop consistent and effective DE implementation and to progress opportunities for national consistency and adoption.

Event outputs and next steps

David Heins, the Project Manager for the Austroads DE Guide expected the project's engagement with industry will progress the goal of assisting transport agencies in Australia and New Zealand to deliver and operate their assets more effectively through obtaining better value and consistency in the application of Digital Engineering (DE).

An overview of the event and the broad themes addressed during the webinar was circulated via [RA's LinkedIn channel](#).