Committee for Digital Engineering in New Zealand (CoDENZ)

Building the digital capability of New Zealand's infrastructure sector

Vision

New Zealand will become a world leader in the use of digital technologies and data to deliver and manage our physical infrastructure. This will enhance economic performance; international competitiveness; environmental and cultural outcomes and support the well-being of our people.

What is Digital Engineering (DE)?

DE is a collaborative way of working, using digital processes, to enable more productive methods of planning, designing, constructing, operating and maintaining our assets, in respect of horizontal and vertical infrastructure such as housing, buildings, roads, 3 waters, ports, etc.[1]

At its heart DE is how we assemble and manage data effectively to provide the information and insight required to make smart decisions, communicate those decisions to the full range of stakeholders and then carry out and monitor operations to realise those decisions for the benefit of the stakeholders.

Why is DE important?

The world is in the midst of the fourth industrial revolution in which data and digital technologies are transforming the way that our industries operate. Infrastructure is generally falling behind other industries which are fully invested in the Industry 4.0 revolution.

The next 30 years in New Zealand will see an unprecedented investment in our physical infrastructure driven by the needs of: the renewal of ageing infrastructure; the requirements of population growth, climate change, and resilience to natural hazards; and the need for improved economic and environmental performance. To be efficient the planning, investment and construction will require a radical change in how we carry out our infrastructure upgrades. This same need for efficiency should transform the way that we monitor, maintain, operate and dispose of our existing infrastructure. This will require employing the full range of Digital Engineering capabilities from Standards and BIM to Digital Twins and AI.

[1] https://www.deosdigital.com/digital-eng

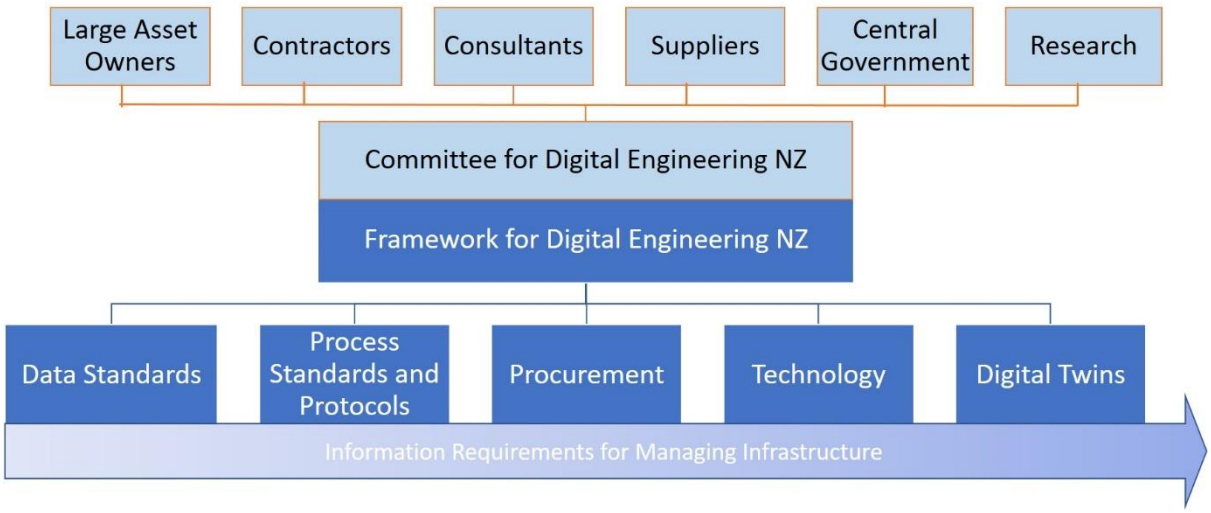
Purpose of CoDENZ

The purpose of the Committee is to:

1. **Lead, develop** and **co-ordinate** a **National Framework for Digital Engineering** (DE) in NZ which will promote the application of DE in the development of New Zealand's built environment.
2. Identify and **champion** initiatives that promote DE including improving productivity, safety and infrastructure quality.
3. Providing **governance** of any initiatives or projects CoDENZ engages in.
4. Providing a **conduit** between Industry, Tertiary Education, Government and Infrastructure Asset Owners in relation to the use of DE.

Structure

CoDENZ is a partnership between Industry and Government and Academia and funded by its members including Central government. It will represent the whole infrastructure supply chain from large asset owner operators through to the material suppliers.



It will act as a coordinating body across a wide range of current and future activities including, but not limited to: BIM Acceleration Committee (BAC), National Technical Standards Committee (NTSC), BIM Education New Zealand (BENZ), Digital Asset Owners Forum (DAOF), etc.

It is envisaged the Committee will employ a Chief Executive to provide a dedicated resource ensuring urgency of delivery of the Digital Strategic Plan and the CE will manage a secretariat service to assist in coordination and support of this delivery.

For further details contact:

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BUILDING
INNOVATION
PARTNERSHIP

The Need for a National Approach to Digital Engineering (DE) for Infrastructure

Purpose

The purpose of this briefing paper is to provide input to the Infrastructure Commission: Te Waihanga's Draft 30-Year Infrastructure Strategy. In particular, the paper addresses the importance of digital engineering (DE) in planning, designing, constructing, operating, maintaining, and assessing the performance of New Zealand's physical infrastructure. It also highlights the need for a National Framework for Digital Engineering to provide strategic direction throughout the entire infrastructure sector. In addition, the need is identified for a long-term partnership between Government, Industry and Academia to coordinate and lead this national strategy. It is noted that a newly conceived Committee for Digital Engineering in New Zealand (CoDENZ) could provide the broad representation needed to successfully implement this critical strategy.

Definition of DE

DE is a collaborative way of working, using digital processes, to enable more productive methods of planning, designing, constructing, operating and maintaining our assets, in respect of horizontal and vertical infrastructure such as housing, buildings, roads, 3 waters, ports, etc.[1]

It should be noted that digital engineering is a very broad discipline and therefore any definition is going to be very wide-ranging. The scope of DE may encompass, but is not limited to:

- Data, Data Standards and Data Interoperability
- Process Standards (such as ISO19650)
- Digital Technologies including: Building Information Management (BIM), Geographic Information Systems (GIS), Asset Management Systems (AMS), and various analytical and modelling systems, etc.
- Procurement of asset information at all stages of an asset's life (including as-built, condition monitoring, etc.)
- Digital Twins, Smart Cities, Internet of Things (IoT), etc.
- Automation, Robotics and Artificial Intelligence (AI)
- Performance monitoring and community benefit assessment (environmental impact, asset health, carbon monitoring, etc.)

[1] https://www.deosdigital.com/digital-eng

Why DE?

At its heart DE is how we assemble and manage data effectively to provide the information and insight required to make smart decisions, communicate those decisions to the full range of stakeholders and then carry out and monitor operations to realise those decisions for the benefit of the stakeholders.

Callaghan Innovation describes the digital revolution currently underway.

We are now experiencing the fourth industrial revolution – dubbed 'Industry 4.0'. This is characterised by a fusion of technologies that is blurring the lines between the physical, digital and cyber-physical.

Just as businesses 150 years ago had to adapt to electricity enabling mass production, today's enterprises face the challenge of embracing smart technologies (such as robotics and artificial intelligence) and data to drive intelligent action in the physical world.[2]

This revolution impacts infrastructure in the same way that it impacts other activities and systems that support our economy and societal well-being. However, progress is not universally smooth. Some sectors are making great strides whist others, such as infrastructure, are much slower to reap the benefits of digital transformation. As a society, we need to ensure that the benefits of *Infrastructure 4.0* are available to our communities; companies, utilities and Local and National Governments. The World Economic Forum (WEF) in its document *Transforming Infrastructure: Frameworks for Bringing the Fourth Industrial Revolution to Infrastructure*[3] identifies the underpinning nature of data, data standards and data interoperability to support decision-making and technological advancement. Infrastructure New Zealand's report: *Unlocking the Value of Data: Managing New Zealand's Interconnected Infrastructure*[4] also describes the benefits to our communities of leveraging high-quality data to maximise the benefits of our past and future investments in infrastructure.

However, DE is also about the processes and technologies that underpin the optimal use of data. The WEF document highlights some of the factors that can enable innovation and uptake in the infrastructure sector. These include the development of frameworks for:

- Using procurement to introduce innovation
- Encouraging the development and transfer of intellectual property
- Leveraging data and advance analytics for decision-making
- Policy and regulation that catalyse change.

2 https://www.callaghaninnovation.govt.nz/industry-4

3 http://www3.weforum.org/docs/WEF_Technology_in_Infrastructure.pdf

4 https://infrastructure.org.nz/resources/Documents/Reports/Infrastructure%20NZ%20Unlocking%20the%20Value%20of%20Data%20Report.pdf

Most importantly, the report reinforces the need for sustained, multi-stakeholder partnership to advance technological transformation of infrastructure to ensure benefits are realised for our people and their communities.

The need for improving DE capability in New Zealand

New Zealand is facing a very large infrastructure deficit which will entail many years of investment to overcome. For example, as part of the 3 Waters reform agenda the Department of Internal Affairs has identified the need to at least double the infrastructure spend in 3 Waters for the next 30-40 years with a total spend in excess of $110 billion. Similarly social infrastructure such as schools and hospitals have been identified as in need of significant upgrades. In addition, it is estimated that there is an urgent need for at least another 100,000 houses to be built to meet societal needs.

This scale of planning, investment, and construction will require a radical change in how we carry out our infrastructure upgrades. At the same time, we need to transform the way that we monitor, maintain, operate and dispose of our existing infrastructure. This will require employing the full range of Digital Engineering capabilities from Standards and BIM to Digital Twins and AI.

But how do we realise the opportunities of DE?

Meeting New Zealand's DE needs

DE's broad reach means that we need to take a national approach to improving both capability and capacity within the infrastructure sector. Without a coordinated approach, we will repeat the mistakes of the past which have led to a poor integration; differing and contradictory standards; capture by proprietary interests, a confused supply chain and wasteful investment. As stated earlier, we need a **sustained**, multi-stakeholder partnership including Government, Industry and Academia. A group to this effect has come together under the banner of the Committee for Digital Engineering for New Zealand (CoDENZ). This nascent committee can provide the leadership and coordination needed. However, the role of this committee will predominantly be a steering and governance group. Support and funding will be needed for CoDENZ as well as across a range of other existing and yet to be formed groups and activities for which CoDENZ will provide a coordinating umbrella. Existing bodies include:

- BIM Acceleration Committee (BAC) – expanding and updating the BIM handbook.
- BIMinNZ – sharing lessons and conference opportunities for practitioners
- BIM Education Group – coordinating Tertiary Education activities
- National Technical Standards Committee (NTSC) – coordinating and providing governance for data standards development.
- Digital Asset Owners Forum (DAOF) – creating links between large asset owner/operators.

- Building Innovation Partnership (BIP) – developing and implementing research outcomes to support the digitalization of the infrastructure sector.
- Smart Cities Council – informing, educating, convening and advocating for smart cities.
- Digital Council of New Zealand

There is a need for a rationalisation of some of these groups and also an expansion of scope to ensure the full benefits of DE are realised. Activities that could happen within existing groups provided addition resources are available include:

- Creation of a Framework for Digital Engineering in NZ and the creation of a roadmap. This would be a primary role of CoDENZ
- Development of national procurement guidance and documents for digital information (BAC, DAOF and NZ Government Property and Procurement)
- A curriculum for tertiary level BIM (BIM Education Group)

Activities that require new or much expanded capability include:

- Development of a National Digital Infrastructure Model (NDIM)
- Industry training and certification to raise the level of capability within the sector
- Support for innovation and digital transformation of existing organisations. Some of these are very large and will require the digital champions to be employed and supported in their roles.

Implications for NZ's 30-Year Infrastructure Strategy

By its very nature, DE is fast-moving. It is almost certain that internationally, within 10 years, DE will be the primary methodology for delivering and managing key infrastructure. If NZ is not to be left behind we need a strategy that will deliver the long-term capacity and capability needed. The following should be the key components of this strategy.

Vision statement

Change requires vision. A draft vision statement for Digital Engineering for Infrastructure 4.0 could be:

New Zealand will become a world leader in the use of data and digital technologies to deliver and manage our physical infrastructure. This will enhance economic performance; international competitiveness; environmental and cultural outcomes and support the well-being of our people.

Development of a DE Framework and Roadmap

This is essential and urgent. There are several useful international examples that we can adapt to meet New Zealand's needs. This framework needs to be endorsed by Central Government and become central to the strategies of all government asset owners and operators. Adherence to the framework should be a key attribute in assessing tenders for new infrastructure development.

Investment in partnership and coordination

Long-term and consistent investment is needed to establish an enduring organisation to oversee the range of digitalisation activity across the infrastructure sector. This can be guided by CoDENZ. However, long-term commitments from government, industry and academia are needed to support both CoDENZ and the partnerships it fosters.

Development of procurement strategies

Industry and Government need to co-develop procurement strategies, contracts and procurement documentation that set a common methodology for procurement of digital information for infrastructure in NZ.

Targets, metrics and a risk-based approach to procurement

The Government needs to set targets for the uptake of DE. Performance against these targets need to be measured and benchmarked. A risk-based framework should be introduced to give guidance on the appropriate scale of DE for programmes and individual projects.

Education, training and certification

Pathways and training opportunities for those currently in work need to be provided. This needs to be supported by appropriate certification and quality assurance processes. In addition, curricula for Tertiary providers needs to be developed.

Standards

Standards need to be mandated by Central Government. The approach should be to employ international standards wherever possible. Government needs to endorse the appropriate international Standards for use in NZ and, where appropriate, adapt or develop NZ standards that might meet NZ specific needs. These standards should apply to data and the processes needed to create, manipulate, use and transmit those data through the entire sector.

Research

Research will be an essential element if NZ is to remain current with the international development of DE. The opportunity provided by an infrastructure specific research body, as is currently being jointly proposed by the Universities of Canterbury and Auckland, would be a natural home for the development of skills, processes and technologies to support Industry in advancing DE. The Centre would also be a home for the development of the National Digital Infrastructure Model.

Conclusion and Recommendations

This paper recommends that the Infrastructure Commission: Te Waihanga's 30-Year Strategy includes the following in respect to Digital Engineering for Infrastructure 4.0:

1. A vision statement in regards to the role of digital engineering in improving the well-being of New Zealand.
2. The need for sustained, multi-stakeholder partnership of Government, Industry and Academia to advance technological transformation of infrastructure through DE.
3. The development of a Framework and Roadmap for DE in NZ
4. The need for investment in:
    a. A central organisation to lead and coordinate DE for infrastructure
    b. A National Digital Infrastructure Model
    c. Standards governance, endorsement and development
    d. Procurement strategies, contracts and documents for DE
    e. Education and training
    f. A research centre to drive innovation and assist industry with the DE transformation.
    g. Targets and benchmarking of performance.

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