



DIGITAL TWINS

What role do they play for the environment & climate resilience?

Rose Challies, with contributions from Julia Hamilton (Digital Innovation at Wellington City Council), Maurice Wills (Geospatial Technical Lead, Environment Canterbury) and insights from participants of the Digital Twin Summit – Environment and Climate Resilience Workshop.

Digital twins can be best described as a virtual model designed to accurately reflect a physical object. It can be a powerful tool for efficiencies and effectiveness in industry but how can it help address current and future challenges in our environment? At the Aotearoa NZ Digital Twin Summit 2022 attendees got to the critical issues on opportunities and challenges in reality.

Digital twins are becoming widely known for their array of benefits across industries, including construction, manufacturing, aerospace engineering, transport systems and city planning. The list is increasing as technology enables more efficient models to be built and connected to increasing amounts of data. But the world is facing unprecedented decline in ecosystems, major disruptions in biospheres and human disconnect from their very source of survival, the earth – how can digital twins contribute to this in a genuinely positive way?

Digital twins are led by the need or request. There are huge environmental losses happening now and this will only worsen so need is high. But how are we looking at this? Are we looking at it from a perspective of mitigation or adaptation – there is no hope so ‘let’s build to survive’ point of view. Or from a position of driving change – seeking out catalysts for change and implementing to reinvigorate our earth. Or from a

holistic viewpoint – we are the earth, the earth is us, so how can we nurture our connectedness and restore us and our planet. Or perhaps a combination of all of these?

It was noted throughout the summit by those who have already carried out digital twins that context is critical and a big-picture view is necessary for the value of digital twins to be fully realised. Amber Craig from [Tumu Labs](#) emphasised the need to get to the root cause, to look holistically, and the role of te ao Māori to ensure there is genuine kaitiakitanga of approaches, stories and data. She profoundly reminded everyone – when you’re taking insights from data, whose insights are they? Her deep dive into the real role of technology and not assuming that it will be the solution to social and environmental issues was enlightening and help set the scene for the discussion to come.

Getting people on the same page was a key theme throughout the summit. Big-picture thinkers and leaders, both environmental and

digital, coming together to ensure the most effective, progressive (future of our earth progressive) and efficient plans are put in place quickly were deemed essential. However, this is not a popular place for funding and investment, which can drive people to skip this crucial step. This in turn can easily kick off vast amounts of money being invested in 'innovative' digital 'solutions' that don't really know the problems they're trying to solve (currently seen worldwide with climate interventions that are only dealing with the symptom of carbon, not the root cause of it, i.e. our insatiable greed and consumption).

We heard in the summit from [case studies in Victoria, Australia](#), where government investment, central and regional, helped to drive aligned and integrated digital twin planning. With rapid environmental degradation combined with fast-growing urban developments happening in Aotearoa, there was a resounding 'yes' by attendees that it is absolutely the right time for significant investment here as well.

At the summit there was no shortage of expert insight and experience on key priorities and learnings required for the full realisation of digital twins' value to the environment. No one was assuming digital twins on their own were the answer but there was big support for digital twins to play an important and critical role to both mitigating and creating change for our urban and rural landscapes.

Digital twins as a tool for environmental change

Given that the majority of environmental degradation and rapid biodiversity decline is due to human behaviour, namely, the vast [over-consumption](#) of earth's natural resources, there is considerable opportunity for digital twins to play

a key role in identifying and showing change in our behaviour. Digital twins as a tool for storytelling, enabling joined up leadership and cross-sector implementation, and environmentally sound tech (how they're built and operated) were just a few of the suggested ways that this value could be realised.

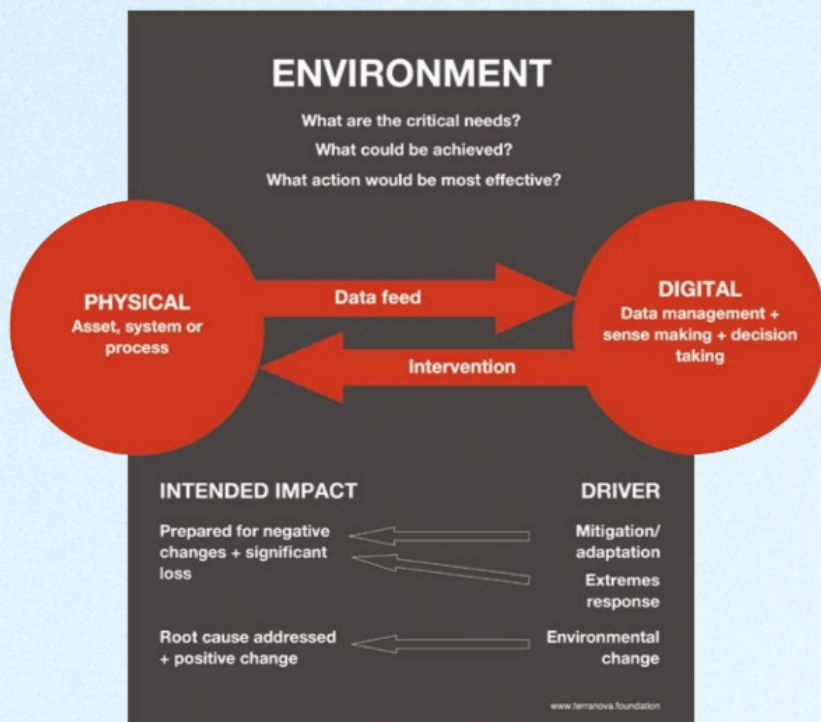
Digital twins can:

- Enable storytelling of the past, present and future – critical to informed decision-making and inspired action
- Bring together and analyse methods/behaviours that are effective
- Enable open source access and rigour to information (let's kick greenwashing and eco-propaganda in the bin!)
- Provide visual representations to enable insightful debate into what is effective
- Enable collective analysis that shows the effectiveness of change interventions
- Enable opportunities for the

independent critique of data, e.g. answering:

- Is the data relevant to the overall intended impact?
 - Is data disproportionately influencing the big picture?
 - Is the data showing symptoms or the root cause?
 - Who is influencing the analysis and for what ends?
- Put scientific data into human and environmental context
 - Show regional and national commitments to change
 - Generate income and funds from data for social and environmental change
 - Provide a competitive edge for business through shared data sharing and analysis
 - Enable and encourage citizen science and community participation in the contribution of data.

The insight provided at the summit also included challenges into joined-up work and implementation,



Digital Twins as a Tool for the Environment. Infographic by Terra Nova Foundation www.terranovalfoundation

balancing ownership and commercial interest with open source, kotahitanga or collective benefit, and kaitiakitanga or concepts of guardianship. Here are some fundamental challenges raised:

Key challenges for effective digital twins for the environment


- Knowing what is needed for change – what are the catalysts for major environmental change?
- Knowing what data we need (for the above), where we can get it and how we can get it?
- Knowing the audience – who is the digital twin for? Communities, the environment, companies, politicians? And who is likely to have the most influence over its design and implementation?
- Understanding the context is complex and dynamic but also filled with pockets of inertia (local, regional, international contexts)
- Resourcing big-picture planning that is cross sector, environmental and digital, geographic, cultural, holistic, future focused and informed by past and present
- How the digital twins themselves are funded, particularly when there are few funding options available
- Bringing together aligned organisations to drive the digital twin/s
- Knowing the resource cost of a digital twin – how does it compare to the overall benefit to the environment.

Given the lucrative nature of environmental data, how does one protect the data assets, yet make it open and accessible? And we had an impassioned call from one participant – “it all starts with the

data” i.e. if we can't use it, share it, integrate it, analyse it effectively then all impacts are compromised. Other **data challenges** raised at the summit included:

- Ensuring data is shareable and can mesh, including decentralising to enable integration
- Finding and bringing together data that is already there
- Metadata and the reality of data lineage – it is not always straight-forward
- Clarity on ownership and custodianship as it exists currently
- How to do holistic data models that are meaningful
- Being upfront and honest about ‘rubbish’ data e.g. data amnesty
- Ensuring small but critical changes e.g. data clauses in contracts to enable data sharing
- Watching for accumulations of data assets and controlling influences, and managing these before they get out of hand
- Addressing significant gaps in environmental data, including accurate spatial environmental datasets e.g. coastal erosion, flood protection, land use, wetlands, agriculture and forestry, soil quality, water quantity and quality.

Digital twins have been around for a while and in recent years their potential to drive innovation and action for change has become much more widely known. However, the infrastructure to support digital twins (and its governance) is still catching up. It's all well and good saying we need open source everything but how is this managed, who is responsible for it and how can it be protected? Summit participants raised a number of **infrastructure and governance issues**, including:

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- Building enough infrastructure, including upskilling and teaching a new generation of enviro-digital minds
 - Determining the geographic boundaries or areas of focus – regional, national? Something else?
 - Empowering engineers to collaborate and scale their IP to communities
 - Bigger impacts require digital twins linking together, which is unlikely to be neat and tidy
 - Building trusted places for data
 - Deciding who the governors of the trusted data are
 - Being aware and knowing the commercial benefits and competitive advantage data can have when building and implementing
 - The need for, and critical role of, regulation of data and data standards in digital twins
 - Awareness of data control by individuals within organisations.

So what do we need to do? What are the critical areas for digital twins and the environment?

Here is a starter for 10 inspired by the summit participants:

- Establish a big-picture view – how the digital twin contributes to environmental change
- Ensure you have change-led vision and planning and transparent, expert, independent governance of it
- Know what you need to know – be clear on what the main needs are (root cause). Agree to only develop digital twins and related tools that are effective to addressing those needs and be accountable to this
- Ensure there is infrastructure and clear guardianship of open

source data, with protected use and assets

- Start with small, catalyst digital twins but with a plan to join up and align multiple twins for large scale environmental change
- For fund/resource holders – commit significant resource to strategic digital twins from an early stage, to avoid commercial or other interests driving development – or big inefficiencies from unnecessary data collection and analysis
- Do everything you can to ensure data integration can happen seamlessly, driving initiatives that enable efficient and effective use of data for wide ranging application
- Engage and leverage support from multiple stakeholders – dig-

ital twins are a combined effort from start to finish

- Fully evaluate the overall value of the technology used and contrast to its costs on the environment
- Understand the connectivity of humans in their own ecosystem – ‘Ko au te awa, ko te awa ko au’ I am the river, the river is me – honour the power and spirit of our earth in who we are and what we’re trying to achieve.

Finally, with mother earth being the context for everything that happens, the need for environmental action is utterly critical. Economic, social and cultural needs are all affected by the change happening in our environments. It is our survival as a species and millions of other species on this planet that are at stake. If digital twins are dismissive of this, they will

likely contribute to the rapid decline in ecosystems; however, if they are grounded and led by environmental change, they could have profound effects for our future.

Never has it been so urgent for action to be taken to change the way we interact with this planet. And digital twins can be a key contributor to showing us the way if led by environmental change and are resourced, planned and implemented well. ●

If you are interested in driving forward environmental change through digital twins and/or related tools and technology in Aotearoa New Zealand, please get in touch with Rose Challies rose@terranovalfoundation.org or Jannat Maqbool jannat.maqbool@anz.smartcitiescouncil.com.

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