

A Digital Twin

OVERVIEW

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Magnae | Great Digital Insights

Magnae exists to help you make decisions on your digital solutions. We do this to build a productive world, and to help create long-term value for clients, people, and society whilst building trust in digital innovation. We are enabled by data and technology designed specifically to help clients grow, transform, and operate. With our services across consulting, strategy, and technical implementation, Magnae teams ask inquisitive questions to help you find new answers for the complex issues facing our world today.

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Introduction

Digital transformation today is complex. It has many layers and levels depending on the industry you are in and what you are trying to achieve.

It seems that every industry is embarking on digital transformation in some form, whether that be the local business, infrastructure asset operators, through to large businesses and State and national governments. Every transformation is looking at the way we see our world so we can interact, connect, and make more informed decisions. But what does this mean when we look at digital transformation using Digital Twins? And how does your digital twin relate to the Digital Twins that your neighbours or peers are building?"

As many businesses who run large facility or asset portfolios know, Digital Twins are certainly not new. They have run their business by connecting the virtual to the physical for years and were using IoT (Internet of Things) devices before the term was even coined.

The portion that is new is the integration of the many systems into a decentralised digital eco-system. An eco-system where you see and therefore better understand your asset, facility, precinct, state, or even country, within an integrated digital platform.

The question is, **how do you reach this level of integration whilst guiding the human experiences, and where should you start?**

But before succumbing to the pressure to 'just implement a Digital Twin *now*' it is important that you consider the role that a Digital Twin will have for your operations and how it will contribute to your big picture goals. You need a sound understanding of the elements that make up a Digital Twin so that you can leverage them for your success. In this paper we give you an insight to the core areas of a Digital Twin and how an individual asset or facility Digital Twin will contribute to the greater eco-system of Digital Twins across the country.

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A Digital Twin is the connection of the physical assets, processes, and systems to the digital replica, to drive better outcomes.



Digital Twin Eco-system © 2021 Magnae Pty Ltd



People

People is the social infrastructure aspects our cities, places, and towns need to service our community.

Place

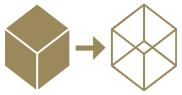


Place is the environmental or natural infrastructure aspects that support a sustainable and healthy environment.

Economy



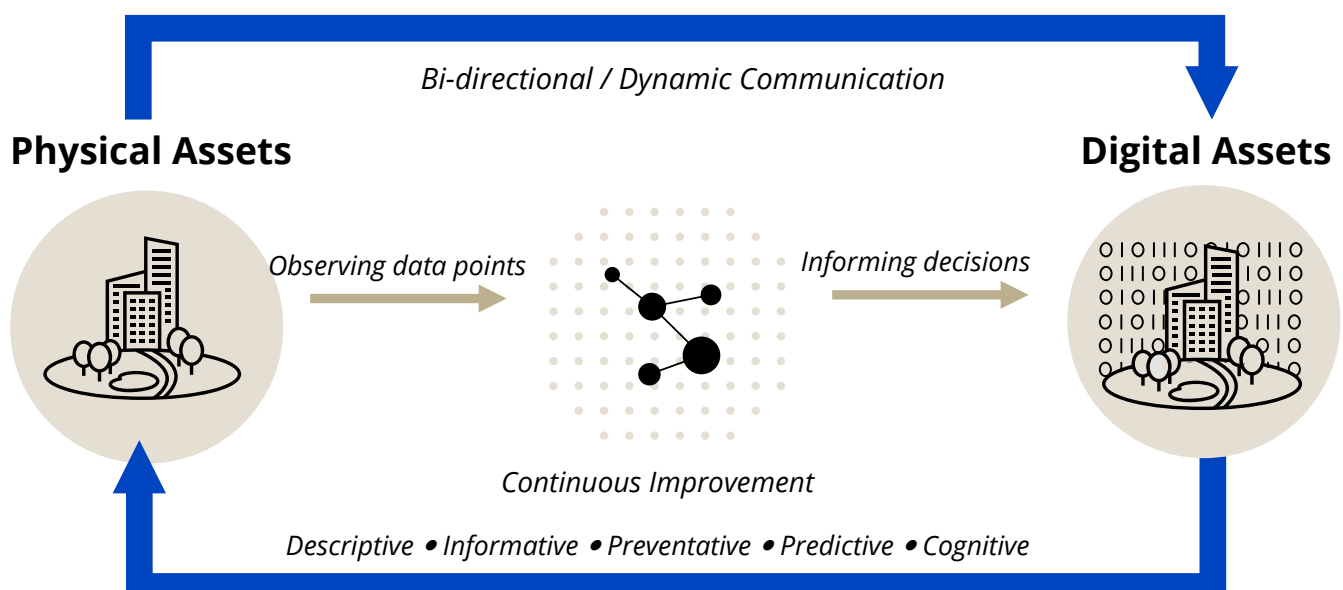
Economy is the hard infrastructure aspects that support the economic growth of our cities, places, and towns.



What you need to know about Digital Twins



Digital Twins help us run physical-world environments virtually. They enable us to model, monitor, and manage by enabling improved insights that lead to more informed decision making and greater outcomes. Those outcomes can range from running a component in an asset assembly such as a valve, through to informing the national infrastructure strategy. To understand this level of complexity it is best to think about the Digital Twin as independent assets or facilities that have two core areas of focus: the digital environment and the physical environment.





Digital Environment

The digital aspect of the Digital Twin eco-system is the aggregate of information from the physical and connecting that aggregation to the virtual system/s to visualise, query, and make informed decisions for operation.

To achieve this digital environment, you have three areas to consider. This is the data you are connecting/collecting from the physical devices, how the data is queried and made available, and how people or systems will consume that data to make more informed decisions.

Below is a brief explanation for each area.

Data Collection - This is based on the characteristics of the data or information you need. You are deciding what information you are collecting from the physical, how that information is collected, and how the Digital Twin eco-system will connect, consume, and use that information.

Data Virtualisation - This is how the data is aggregated to enable the Digital Twin eco-system to run analysis queries on the data. For example: how does the data from the device temperature sensor compare to the operation speed, the outside temperature, and the amount rainfall, in order to decide on the maintenance requirements. This layer is vital to protect the integrity of your data collection and to not rely on custom applications that go out of date quickly.

Data Consumption - This is how staff can consume the data efficiently and effectively. The objective is to use a virtual 3D model of the asset, connect that virtual model to the data virtualisation and data collection areas and help make better informed decisions. This could be dashboards, graphs, interactive maps, environments etc.

Data Collection

Information from disparate data sources.



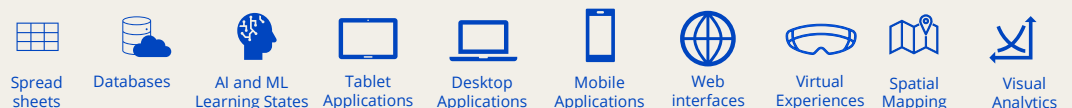
Data Virtualisation

Aggregate the data sources together and run queries.



Data Consumption

Interact with virtual environment to control physical environment.



Digital Environment considerations for a Digital Twin - © 2021 Magnae Pty Ltd

Physical Environment

The physical aspect of the Digital Twin eco-system is how to observe, connect, and collect information that is linked to the virtual environment.

To achieve this connected physical environment, you have three areas to consider. The physical areas you are observing, the devices, systems, and networks needed to conduct the observation, and the physical systems you need to connect directly to, in order to manage the physical environment.

Below is a brief example of each area.

Data Observation – This is deciding on what needs to be observed in the physical environment. The frequency in which the observation needs to take place. The level of accuracy that data or information is collected for observation, along with how and where the data or information needs to be computed to make a decision.

Data Connection – This is the types and layers of connection to the virtual environment. Some assets will be automated and managed through the physical devices' computing. Others will be connected through devices such as the PLC to the SCADA system. Whilst some may be connected directly to the virtual environment.

Data Systems and Networks – This is how the physical connects to the virtual. You are deciding how the data or information travels and what stops it needs to make along the way. That connection may be made through low frequency networks, high frequency networks, across a variety of security layers etc.

Data Observation

The physical assets, processes, or systems you are observing.



Vision



Acceleration /
Tilt



RFID /
NFC



Force / Load /
Pressure



Chemical /
Gas



Vibration



Usage



Temperature



Humidity /
Moisture



Lighting



Motion

Data Connection

The types and layers of connection to the digital environment.



Data Points



Exchange
Protocols



Edge
Computing /
Processing



Process
Mapping



Automatic
Generation
Control



SCADA
Database



Business
Intelligence



Data
Archive



Market
Trading

Data Systems and Networks

The way the data travels to the digital environment.



Coaxial Cable
e.g. Broadband /
Baseband



Twisted Cable
e.g. Unshielded
/ Shielded



Optical
Fibre
e.g. NBN



Radio
Frequency



Microwave
Frequency



Satellite /
Infrared

Physical Environment considerations for a Digital Twin - © 2021 Magnae Pty Ltd

This overview is the high-level fundamentals to help you think about what your Digital Twin might need. The other aspect to consider is what information are you are collecting within your Digital Twin that will be shared with the greater eco-system. This is information that could be used at a national, state, region, district, or precinct level to make better planning, public-funding, or resource allocation decisions. It is at this point where you will start to consider how important your Digital Twin is in being the primary host of a decentralised Digital Twin eco-system.





The future Digital Twin eco-system

A decentralised Digital Twin eco-system is multiple levels and types of environments that connect together with a variety of owners and specialisms. Why do we need this? To improve our **economy**, to improve the planning and execution of our **places**, and to enhance the lives of our **people**.

Basically, for the betterment of our society. The item to think about when planning your individual strategy is what can this contribute to the greater needs of the Built Environment?

Technically what this becomes is the Digital Twin economy. A circular lifecycle with varied levels of a Digital Twin contributing to the next. The reason for this is to refine the level of information waste across our industries and improve decision making based on a clear line of responsibility and Digital Twin purpose.

The image following: Digital Twin Eco-System, is an example of how the Digital Twin economy would be broken up across the Built Environment to achieve Australia's desired outcome in being digital leaders on the global stage by 2030 (Australian Government 2019).

All assets from buildings to infrastructure are divided up across each Digital Twin. As an example, Transport for NSW or Sydney Water would own aspects of the transport and water infrastructure Digital Twins. They will then share certain graphical elements and data with the public Digital Twins to ensure more informed decisions are made across precincts through to national planning.

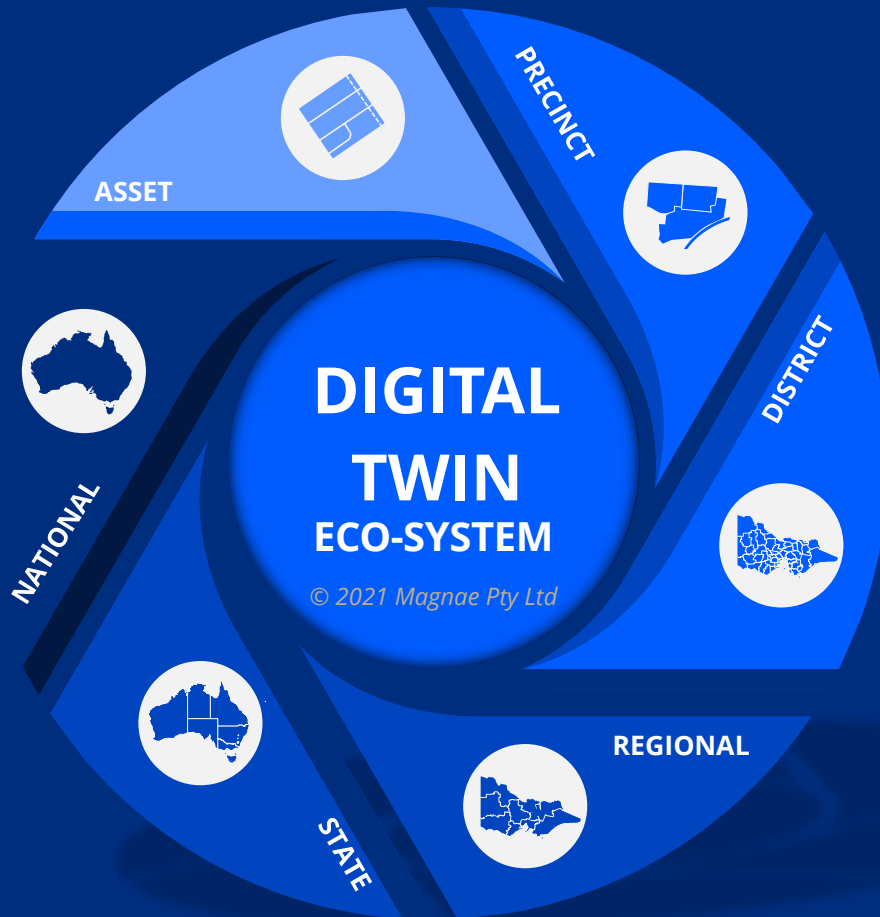
These Digital Twins are secured and decentralised to protect everything from our critical infrastructure through to managing the diversification of responsibility and expertise.

The most impressive piece of this puzzle is how this strategy produces positive effects on a national scale. Those effects span across our people, our places, and our economy depending on the level of commitment we place into rolling out this national strategy. There is nothing that could possibly improve productivity, lift skills and competencies, and drive new markets more definitively than a Digital Twin eco-system.

Technically what this becomes is the Digital Twin economy. A circular lifecycle with varied levels of a Digital Twin contributing to the next.



Digital Twin eco-system



ASSET

Public and private funded projects to operate and maintain independent assets.

PRECINCT & DISTRICT

LGA public-funded projects to service communities.

REGIONAL & STATE

State public-funded projects to position and differentiate each State.

NATIONAL

Nationally public-funded projects to manage impacts to sustainable growth and competitiveness on a global scale.

Digital Twins for your asset, facility, or portfolio contribute to the way you run your business, through to how the nation might plan its infrastructure. Spending time on analysing your needs and discovering how useful that information is to the different tiers of Digital Twins within the eco-system will help secure your Digital Twin performance whilst building your spot in the greater Digital Twin economy.

Need help? Magnae is here to be your guiding partner.



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