

NATIONAL
ROADS
& **TRAFFIC** EXPO
INFRASTRUCTURE • TECHNOLOGY • INNOVATION

AUSTRALIA'S BIG TRADE SHOW
FOR THE ENTIRE ROADS
TRANSPORT ECOSYSTEM

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ICC SYDNEY

Christian Pallaria
Digital Engineering Manager
AECOM

Great Western Highway – Central Package
Managing Big Infrastructure Projects and Bigdata for TfNSW
(Transport for NSW)

Agenda

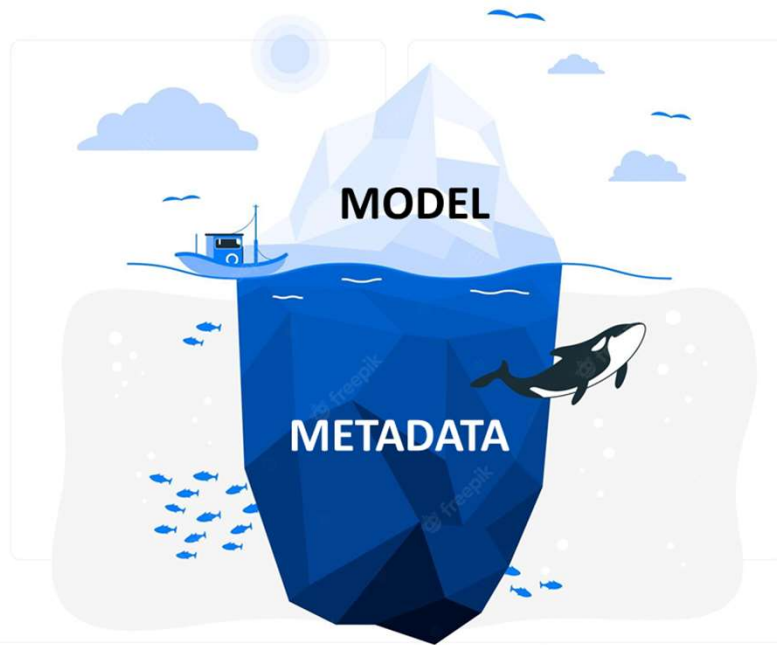
- Quick introduction
- Great Western Highway Central (TfNSW project) – 3 big challenges:
 - High LoD
 - Running clash detections
 - Metadata polulation
 - Metadata validation
- How is the market changing today?
- Why?
- Jump into the “future”: Digital Twin, Metaverse, AR and VR
- Conclusion

Why am I here today?

I will tell you a story...



Yesterday...today...tomorrow???



- **Yesterday:**

- 3D modelling
- Perform the best internal process to get a 3D with the right LOD
- Get it done quickly

- **Today:**

- 3D modelling + Metadata
- Perform the best internal process to get a 3D with the right LOD
- Perform the best internal process to get all the data coming across
- Get it done quickly
- Get metadata correctly populated
- Clash detection, 4D, 5D, Visualization, etc...

1. Thousands of elements (high LOD)

2. Millions of data (high LOI)

3. Clash Detection, 3D Coordination, 4D, 5D, Visualization

The very 1st challenge of every project

Project Managers

Design Managers

Discipline Leads



Digital
Engineering
people

TfNSW requirements:

- Higher and higher LOI
- Higher and higher LOD

Contractor:

- All TfNSW requirements
 - Additional specific requirements

The very 1st challenge of every project

Project Managers



We will not do this, it is costing too much

Discipline Leads

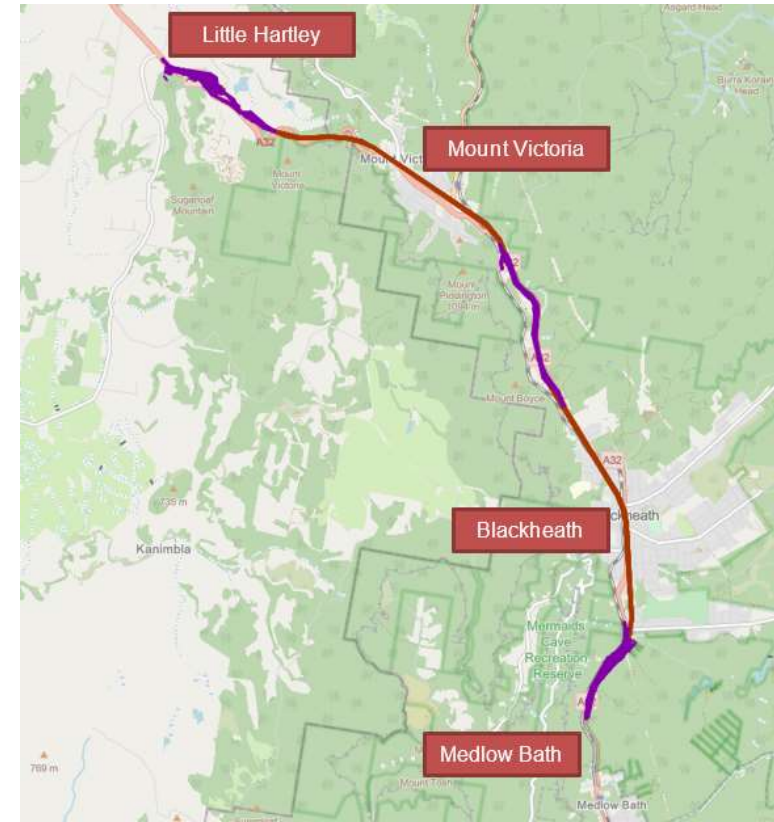


We need to lock off the design, we can't look after digital now

Great Western Highway – Central Package



- The proposed Blackheath to Little Hartley section involved design of a four-lane motorway, which included a Mount Victoria Bypass.
- A central component of this highway upgrade design is a proposed **11-kilometre tunnel** which would run between Blackheath and Little Hartley at the base of Victoria Pass, bypassing Blackheath and Mount Victoria.
- Concept Design Stage



TfNSW Digital Framework

1. It is one of the **most advanced** framework in the market at the moment
2. High level requirements in terms of both **Level of Detail** and **Level of Information** (metadata)
3. **Federated model** with all disciplines combined together to be used as the real source of truth of the project
4. **Clash detection**
5. **4D Simulation**
6. **Visualization**

LoD 100	LoD 200	LoD 300	LoD 350	LoD 400
Elements are not geometric representations. Examples are information attached to other model elements or symbols showing the existence of a component but not its shape, size, or precise location. Any information derived from LoD 100 elements must be considered approximate.	Elements are generic placeholders. They may be recognisable as the components they represent or they may be volumes for space reservation. Any information derived from LoD 200 elements must be considered approximate in terms of quantity, size, shape, location and orientation.	The quantity, size, shape, location and orientation of the element as designed can be measured directly from the model without referring to non-modelled information such as notes or dimension call-outs. The project origin is defined and the element is located accurately with respect to the project origin	Parts necessary for coordination of the element with nearby or attached elements are modelled. These parts will include such items as supports and connections. The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modelled information such as notes or dimension call-outs.	Element is modelled at sufficient detail and accuracy for the fabrication of the represented component. The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modelled information such as notes or dimension call-outs.

3 big challenges for the entire project

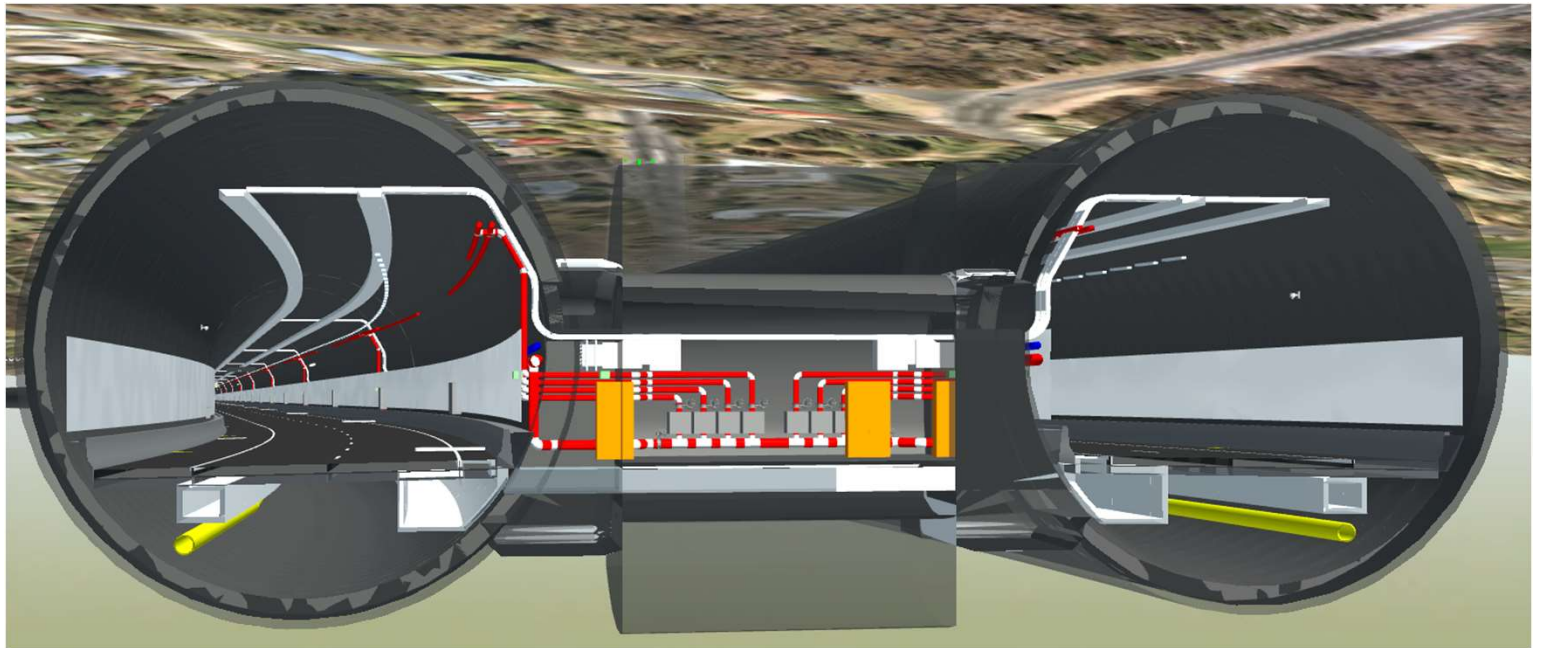
1. **High LoD** for many disciplines (above all MEP in the tunnel)
2. Running **clash detections** for almost **160k** elements
3. **Metadata** population (almost **7 million** of data required in the model)

3 and ½: **educate the Team** to the new full BIM approach workflow

1st challenge: LOD for MEP

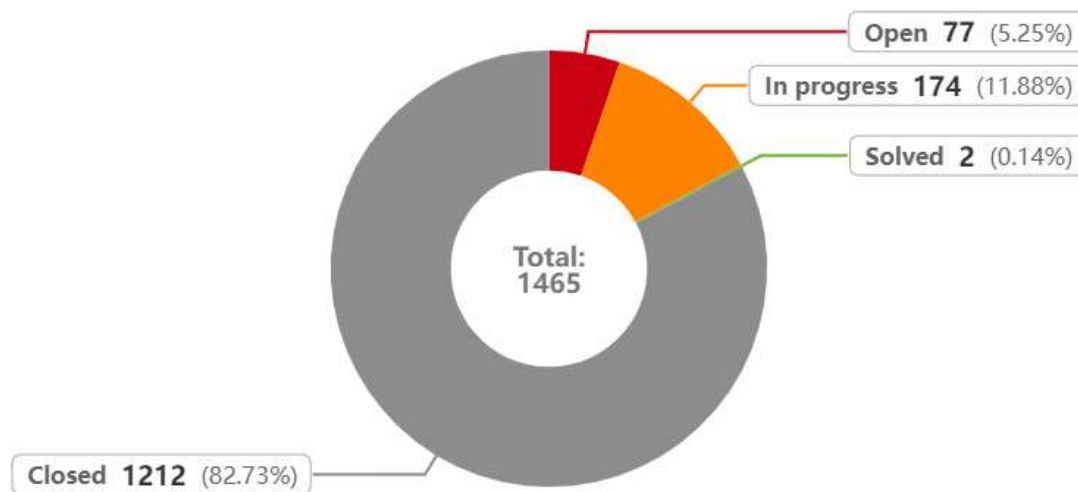
High LoD for many disciplines: MEP tunnel

As an example, the LoD for MEP was so high that we had to model each single cabinet, pipes, cable trays, etc... in each cross passage, even though an automated workflow has been developed for modelling pipes, ducts, cable trays, etc... along the tunnel



2nd challenge: Clash detection

Running clash detections for almost 160k elements



64 models and 160k elements

Number of clashes identified at the 80%: 1465

3rd challenge: Metadata

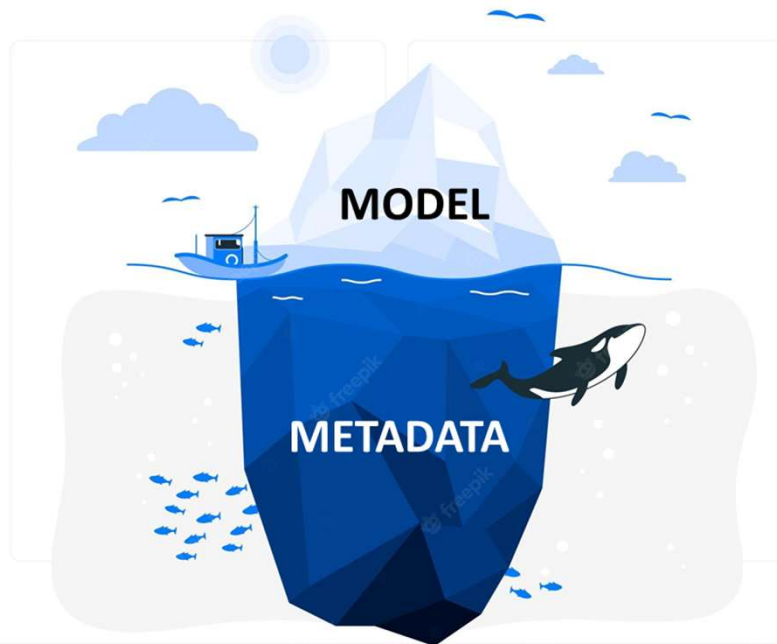
Metadata population for almost 160k elements

- 44 parameters per each element:
 - 11 parameters project specific
 - 12 parameters referring to location
 - 19 element specific (different element by element)
- 2 parameters for 4D simulation

TfNSW_Project	TfNSW_ProjectAndContractName
	tbProjectContractCode
	tbAEOSuppCode
	tbAEOSuppName
	tbDesignCompCode
	tbDesignCompName
	tbCoordSys
	TfNSW_ProjectMilestoneDesc
	TfNSW_StateDesc
	TfNSW_SuitabilityDesc
TfNSW_Location	TfNSW_DocumentNo
	TfNSW_DocumentTitle
	tbAEODisciplineCode
	tbAEOSubDiscCode
	TfNSW_AssetLocationID
	TfNSW_ParentAssetLocationID
	TfNSW_ProjectAssetLocationID
	TfNSW_ParentProjectAssetLocationID
	TfNSW_AssetLocationCode
	TfNSW_ParentAssetLocationCode
TfNSW_Asset	TfNSW_AssetLocationDesc
	TfNSW_UniclassAssetLocationCode
	TfNSW_UniclassAssetLocationTitle
	TfNSW_ProjectAssetID
	TfNSW_ParentProjectAssetID
	TfNSW_AssetDataStandard
	TfNSW_AssetTypeCode
	TfNSW_AssetInstance
	TfNSW_AssetCode
	TfNSW_ParentAssetCode
	TfNSW_AssetDescription
	TfNSW_AssetLabel
	TfNSW_UniclassAssetCode
	TfNSW_UniclassAssetTitle
	TfNSW_DisciplineCode
	TfNSW_SubDisciplineCode
	TfNSW_WPDesignCode
	TfNSW_AssetStatusCode
4D Simulation	TfNSW_AssetOwnerOrgName
	TfNSW_StartKm
	TfNSW_EndKm
	TfNSW_GPSCoordinates
	Activity ID
	Activity name

3rd challenge: Metadata

3rd challenge: Metadata population



- 64 models
- Almost 160.000 elements
- More than 40 metadata per element

7M metadata in total

3rd challenge: Metadata – modeler's reaction

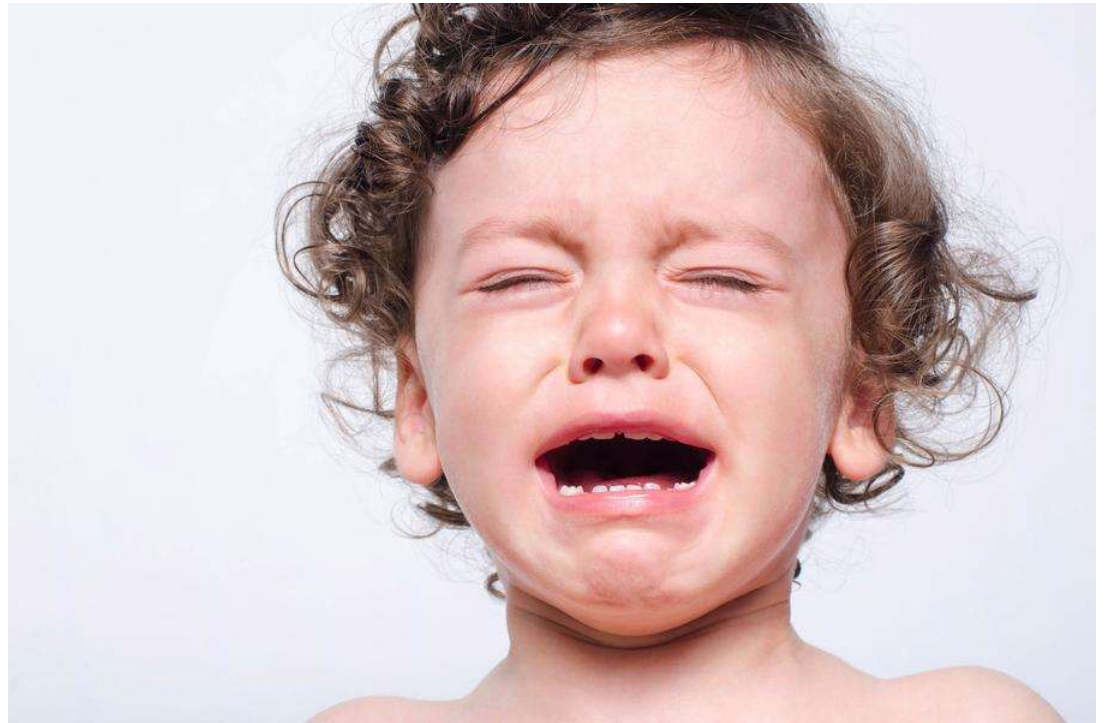
Modeler's reaction after our meeting regarding metadata...



3rd challenge: Metadata – DE Lead reaction

During the meeting they told me:

“we will populate the metadata **manually** before the delivery, once the models have been locked off”



3rd challenge: Metadata – solution

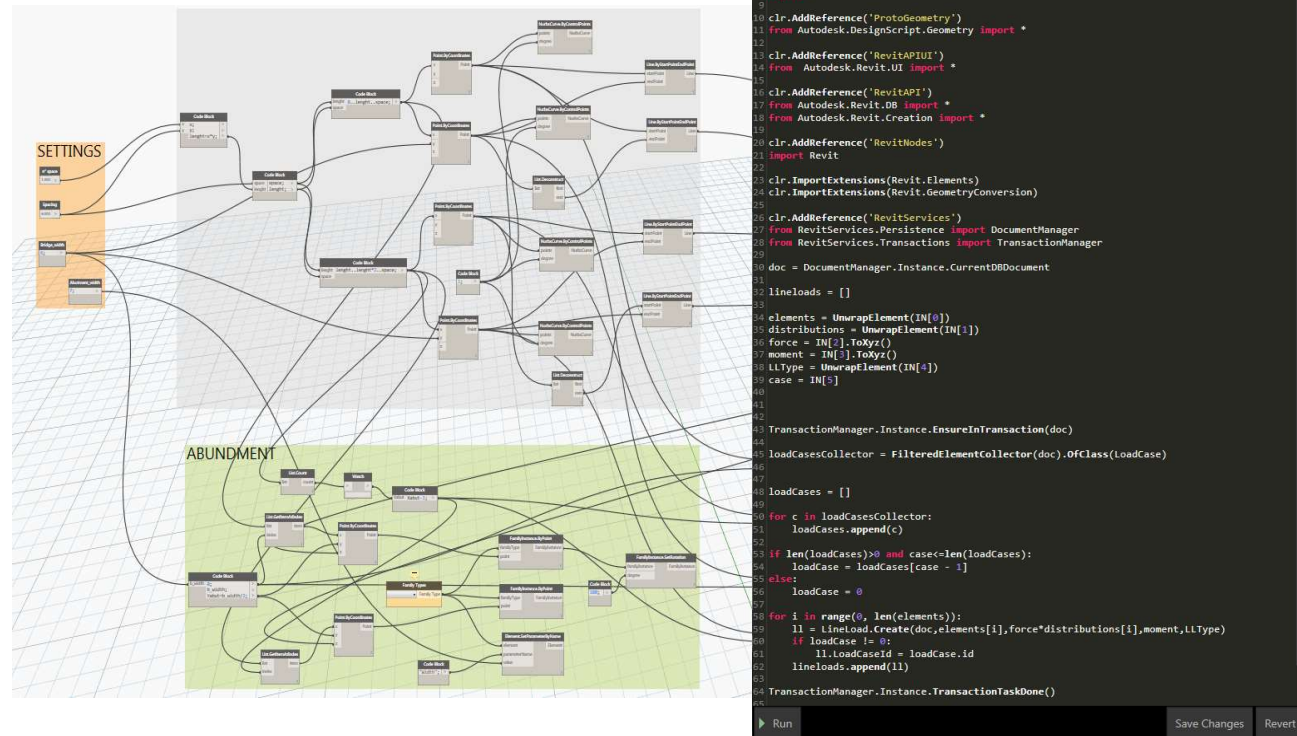
Find the right workflow to place metadata and model linear element regardless the software we are using

Adoption of
**Computational Design
(Automation)**



3rd challenge: Metadata – solution

Visual programming
codes to perform
custom workflow based
on design requirements



3rd challenge: Metadata – solution

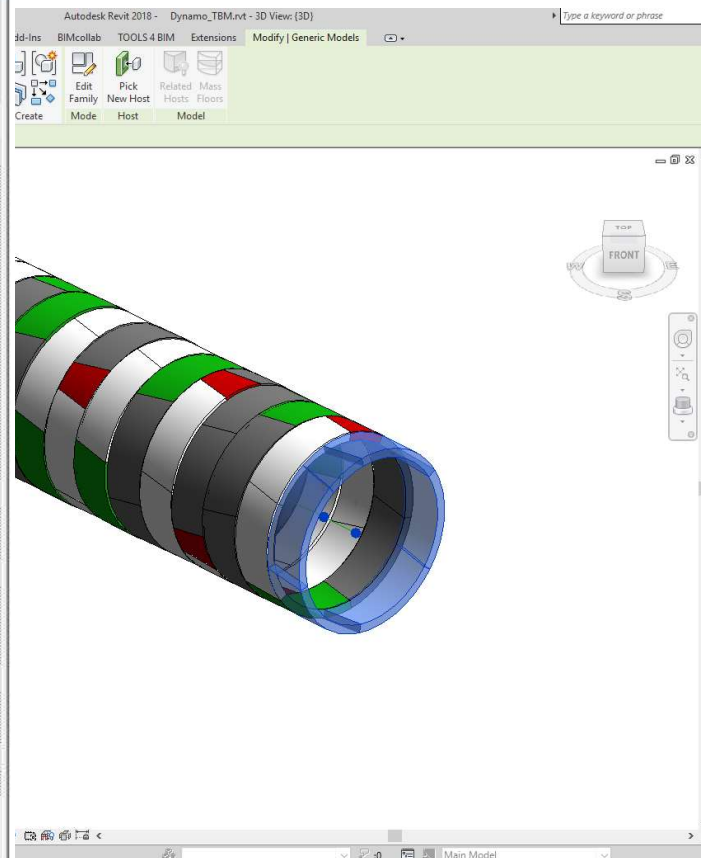
Properties

GD_3339TBM_Ring

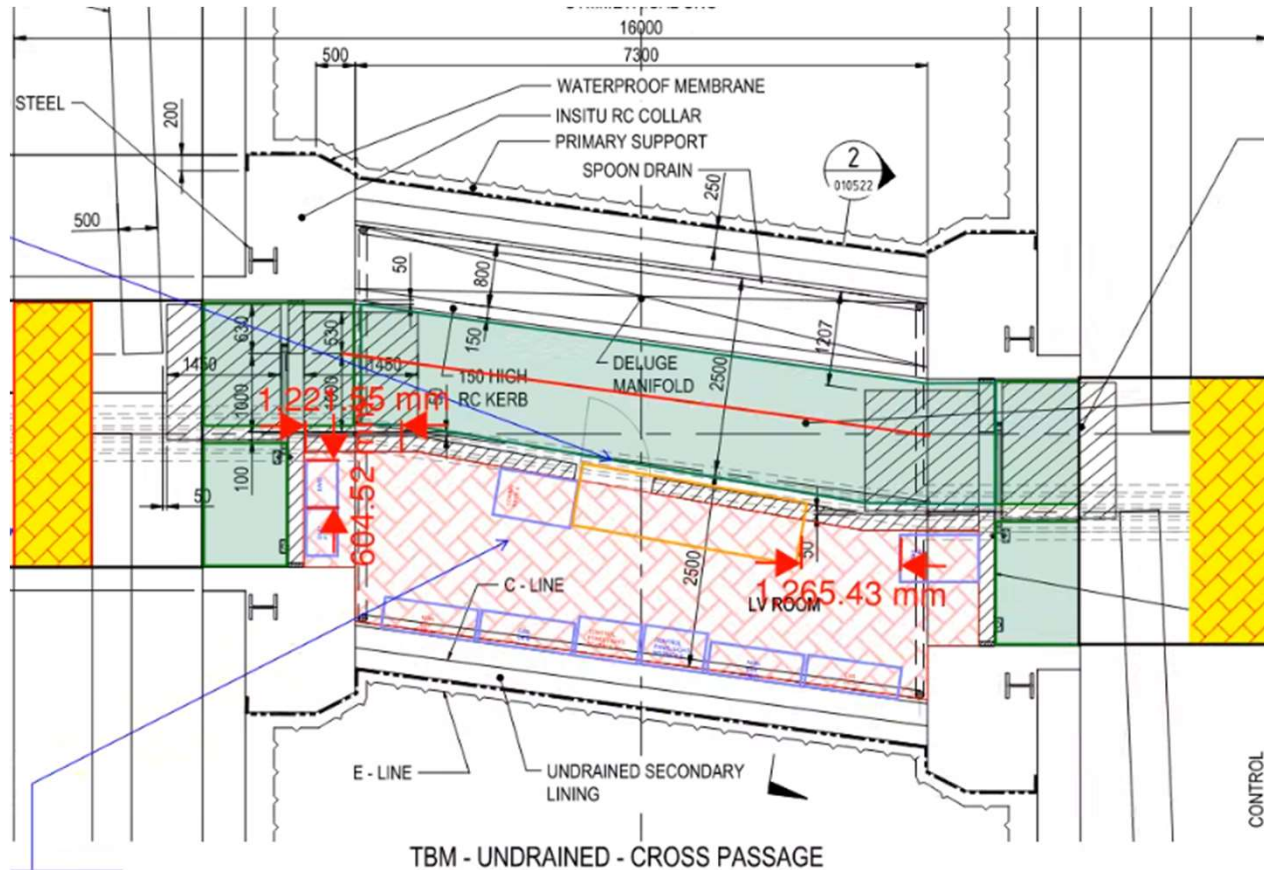
Generic Models (1) Edit Type

Construction	
InstallationDate	23/05/2018 18:27:10
RingNumber	178
SegmentPosition	U16
Stationing (m)	27941
Damage_SegmentA	RE+RE
Damage_SegmentB	
Damage_SegmentC	
Damage_SegmentD	RB
Damage_SegmentE	
NumberOfDamagesPerRing	3
HorizontalDeviation (mm)	14
VerticalDeviation (mm)	-43
Dimensions	
PositionAngle	247.50°
Volume	
Identity Data	
Image	
Comments	
Mark	
Phasing	
Phase Created	New Construction
Phase Demolished	None
Adaptive Component	
Flip	☐

Properties help Apply



Automation



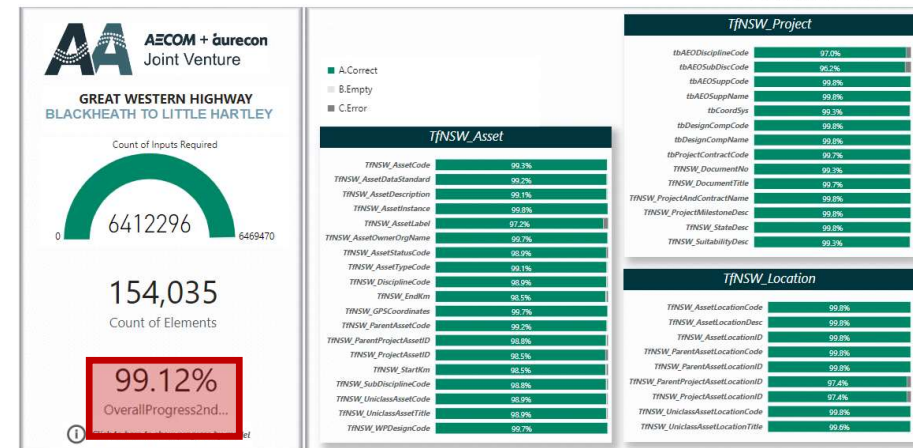
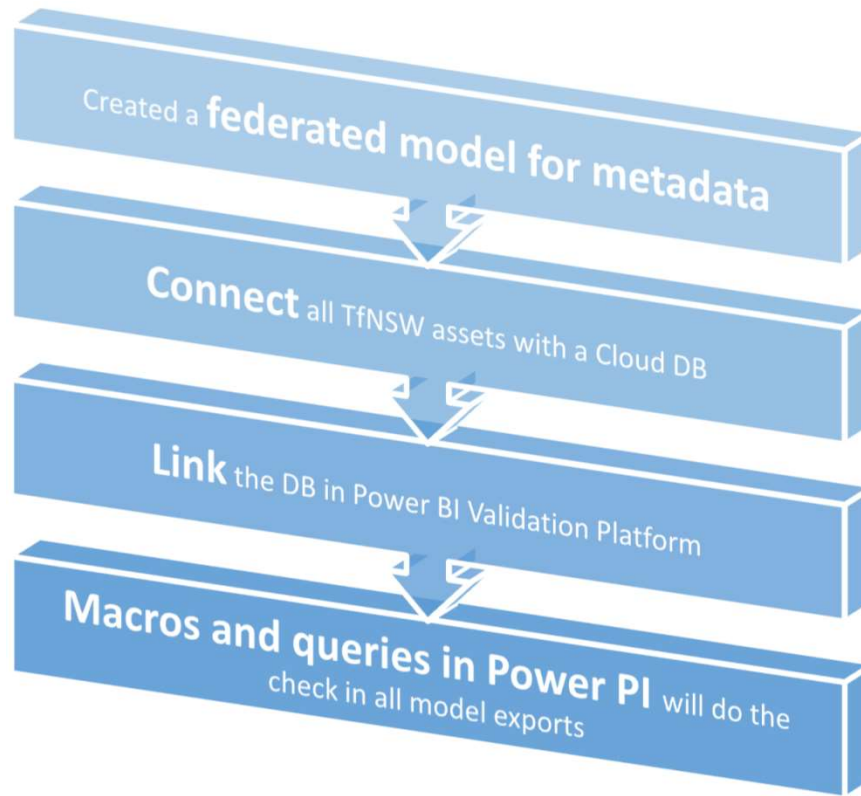
Automation is not only for metadata population

It is extremely useful in the **design phase** too: as an example we placed almost 100 cross passages, calculating the skew angle and the slope automatically in order to optimize rings demolitions:

Minutes of calculations and modelling Vs hours using traditional CAD methodologies

With a lower (if not null) margin of error.

3rd challenge: Metadata Validation process



Almost 160k elements
7 M of metadata
99.12% correctly populated

3rd and ½ challenge: Educate the team

TRADITIONAL DESIGN
PROCESS

DESIGN



3D MODEL

BIM DESIGN PROCESS

Clash det.
Coord. Review

Clash det.
Coord. Review

Clash det.
Coord. Review

FEDERATED MODEL

3D

3D

3D

3D

3D

3D

DESIGN

3rd and ½ challenge: Educate the team

1. **Australia**
 - Road Design
 - Retaining walls
 - Signage
 - Geotechnical investigations
 - Temporary works
 - Utilities
 - 4D Simulation
 - Visualization
2. **South Africa (9 hours less)**
 - Tunnel
 - C&C
 - Bridges
 - Miscellaneous structure
 - Culverts
 - Gantries
 - ITS
3. **Thailand (4 hours less)**
 - MEP models
4. **China (3 hours less)**
 - Drainage models
5. **Spain (10 hours less)**
 - General modelling service



Why are we going through this process?

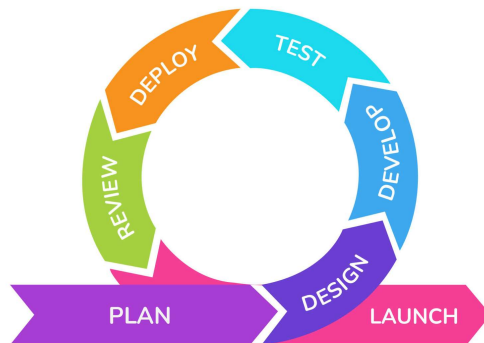


Because our industry has changed and now everything is changing quickly and constantly as long as the technology comes out with a new tool

How the market is changing

- New tools coming out frequently
- Digital Twin is still unknown and with a lot of variables
- New version of software implementing new features
- Client requirements getting higher and higher

WE NEED TO BE
AGILE



- Be able to adapt to the changes
- Flexibility
- Multi-disciplinary teams
- Cross-functional teams

Be prepared to the change



Lamborghini Trattori is an Italian agricultural machinery manufacturer. The company designs and builds tractors. It was founded in 1948 in Cento, Italy by Ferruccio Lamborghini, who later went on to establish Automobili Lamborghini.



Automobili Lamborghini S.p.A. is an Italian manufacturer of luxury sports cars and SUVs based in Sant'Agata Bolognese. Ferruccio Lamborghini an Italian manufacturing magnate, founded Automobili Ferruccio Lamborghini S.p.A. in 1963 to compete with Ferrari.

4th Industrial Revolution

The name 4th Industrial Revolution **was introduced in 2015** for the first time by Klaus Schwab during the World Economic Forum (WEF).

- **Digital Twin**
- **Metaverse**
- AR and VR
- AI and Machine Learning (chatGPT)
- Blockchain
- 5G
- IoT
- 3D printing
- Advanced robotics
- Quantum Computing
- Etc...

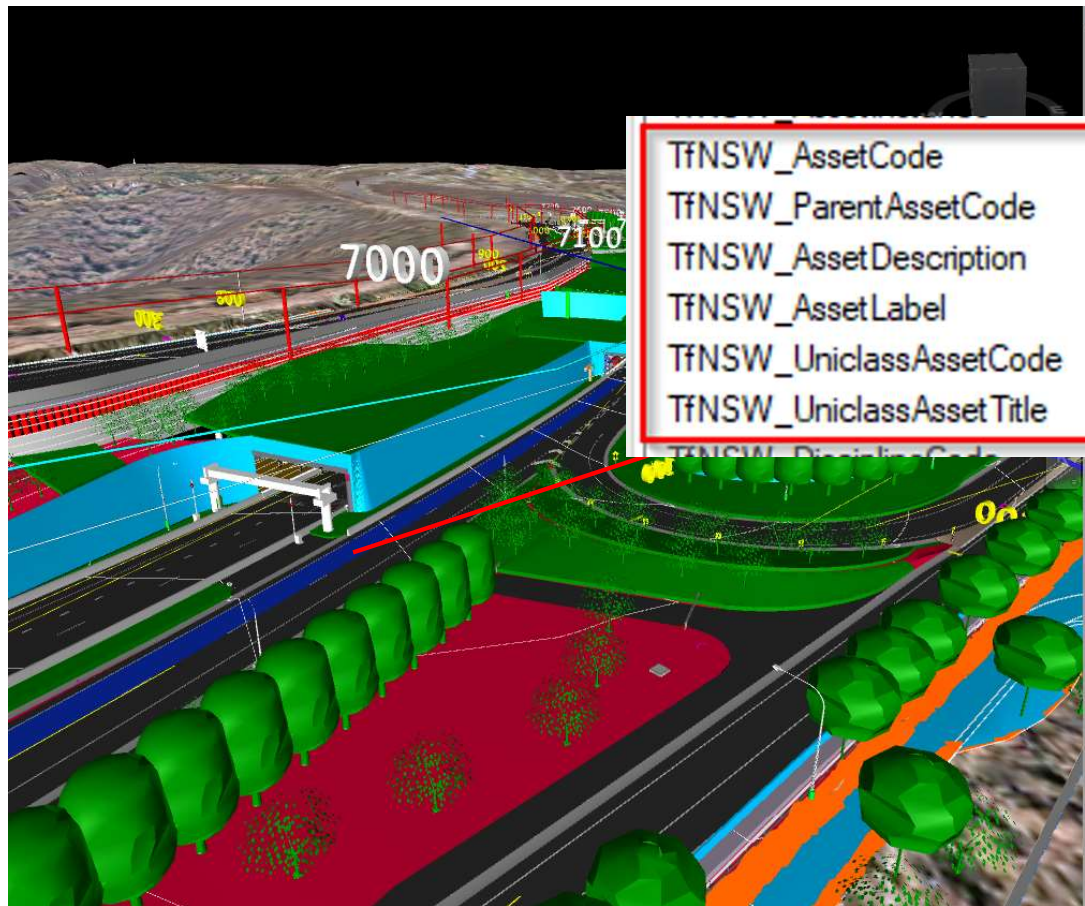
The **Fourth Industrial Revolution, 4IR**, or **Industry 4.0**,^[1] conceptualises rapid change to technology, industries, and societal patterns and processes in the 21st century due to increasing interconnectivity and smart [automation](#). The term was popularised in 2015 by [Klaus Schwab](#), the [World Economic Forum](#) founder and executive chairman, and has since been used in numerous economic, political, and scientific articles^{[2][3][4][5][6]} in reference to the current era of emerging high technology. Schwab asserts that the changes seen are more than just improvements to efficiency, but express a significant shift in [industrial capitalism](#).^[7]

A part of this phase of industrial change is the joining of technologies like [artificial intelligence](#), [gene editing](#), to [advanced robotics](#) that blur the lines between the physical, digital, and biological worlds.^{[7][8]}

Throughout this, fundamental shifts are taking place in how the global production and supply network operates through ongoing automation of traditional manufacturing and industrial practices, using modern smart technology, large-scale [machine-to-machine](#) communication (M2M), and the [internet of things](#) (IoT). This integration results in increasing automation, improving communication and self-monitoring, and the use of smart machines that can analyse and diagnose issues without the need for human intervention.^[9]

It also represents a social, political, and economic shift from the [digital age](#) of the late 1990s and early 2000s to an era of embedded connectivity distinguished by the omni-use and commonness of technological use throughout society (e.g. a [metaverse](#)) that changes the ways humans experience and [know](#) the world around them.^[10] It posits that we have created and are entering an [augmented social reality](#) compared to just the [natural senses](#) and industrial ability of humans alone.^[7]

Digital Twin

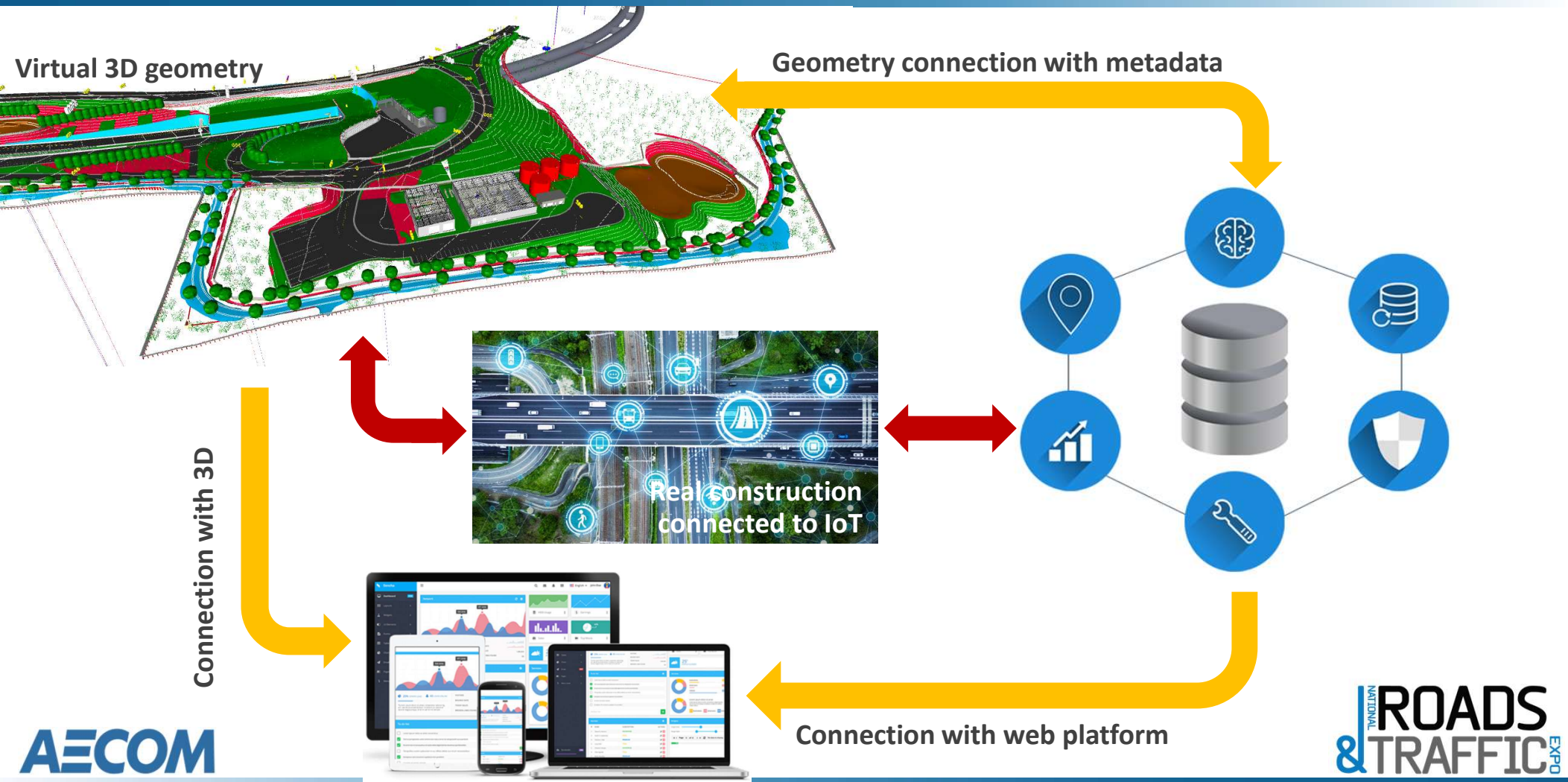


TfNSW_AssetCode	PV.PLWS.F1.7
TfNSW_ParentAssetCode	PV.PLWS
TfNSW_AssetDescription	Wearing Surface - Pavement Type F1 - Layer 7
TfNSW_AssetLabel	GWHCCT1.PV.PLWS.F1.7_GWHCCT1L16641
TfNSW_UniclassAssetCode	Pr_35_31_05_40
TfNSW_UniclassAsset Title	Hot-rolled asphalt (HRA) surface courses and sluries

Properties

Item	IFC	TfNSW_Project	TfNSW_Location	TfNSW_Asset	TimeLiner	Material
Property						
GLOBALID				20J15X172QJFK7MaS		
TfNSW_ParentAssetID				GWHCCT1.PV.PLWS.F1.7_GWHCCT1L16641		

Digital Twin



Digital Twin

What is a Digital Twin?

A digital twin is a **virtual replica** of a **physical object**, system, or process that is created using digital technologies. It enables the representation of the physical object in a digital format, capturing its characteristics, behavior, and performance in real-time or over time.

Digital twins can help improve **efficiency**, **optimize performance**, and reduce downtime by allowing users to **monitor and analyze the behavior** of the physical object in **real-time** or in a simulated environment.

Overall, a digital twin is a powerful tool that provides a deeper understanding of the physical world and **enables better decision-making** through the use of data and analytics.

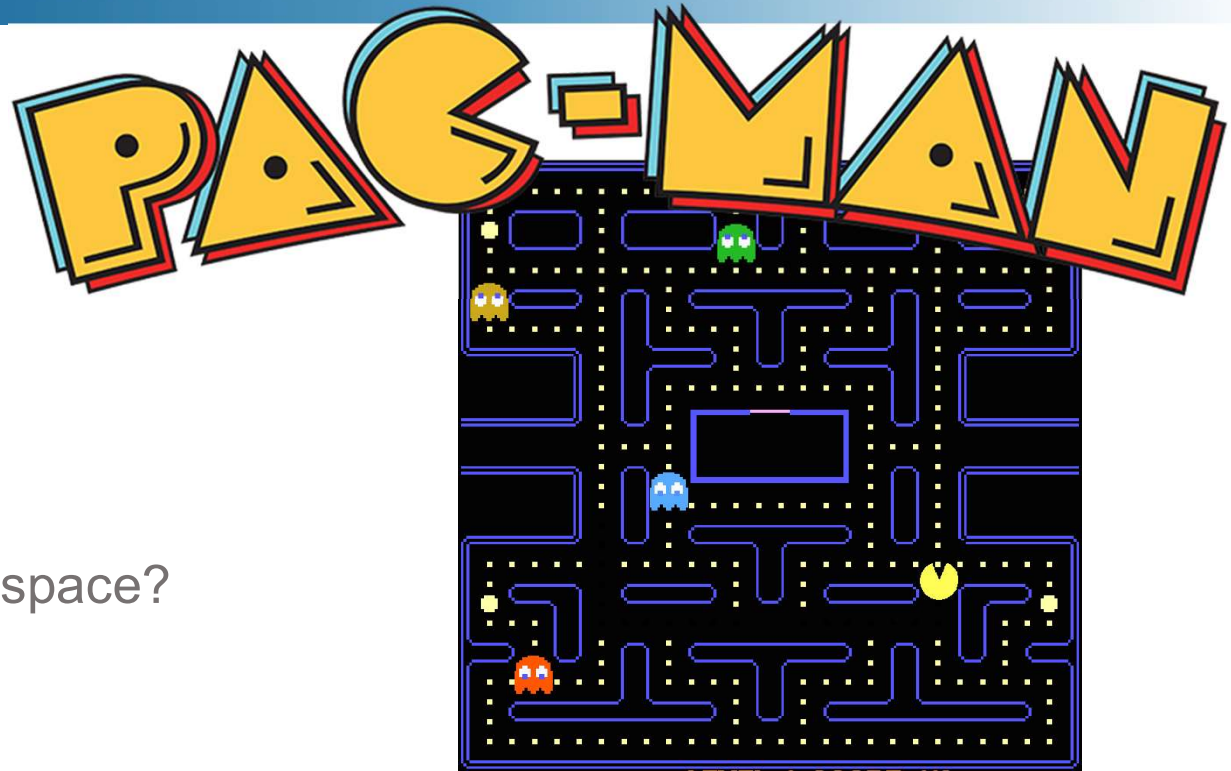
Metaverse

- Meta and all big companies hasn't hit the critical mass yet, but when this will happen Metaverse will come and will **change** our way of living
- Next common device will be **“high-tech contact lens”** instead of our mobile?
- Will we have a **parallel “virtual” life**?
- How will this **affect** our business and industry?
- How should we **adapt** to this big change?



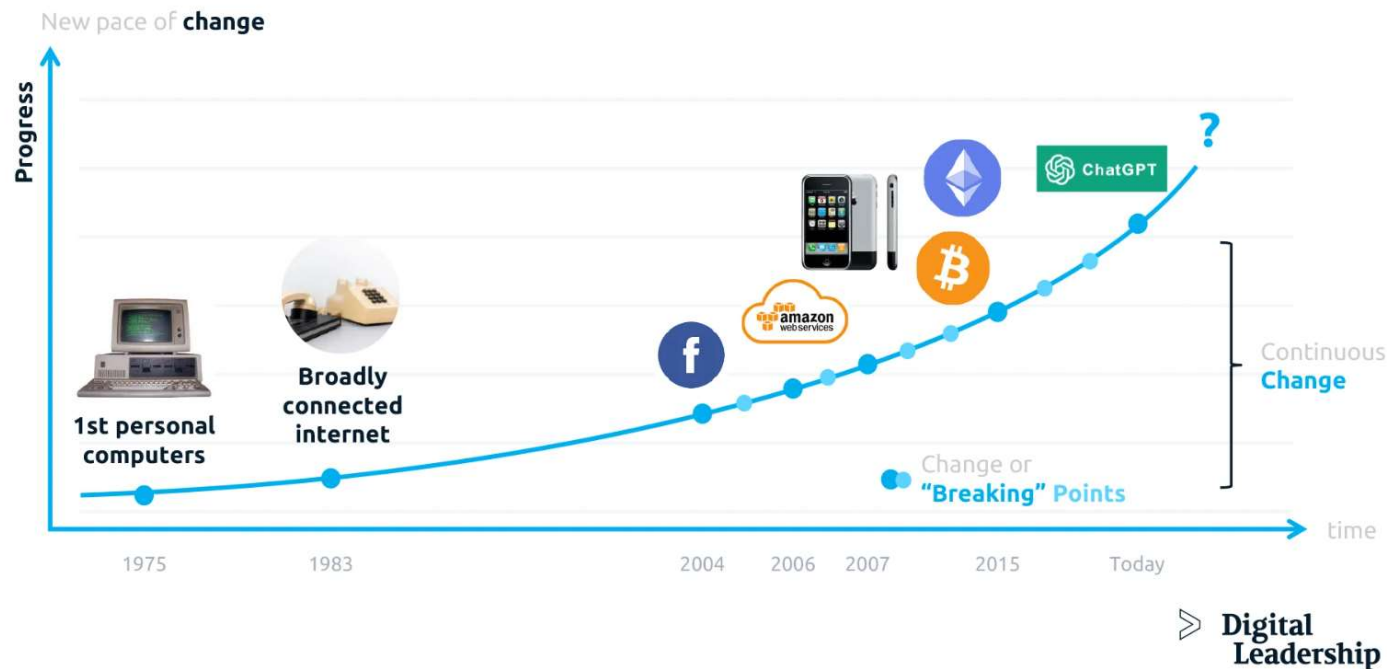
Metaverse, AR and VR

- Digital Twin ?
- Safety simulations ?
- Facility Management ?
- Design exploration ?
- Design interaction ?
- Gamification?
- Teams meeting in a metaverse space?



What can we propose to our clients that can fit with metaverse, AR and VR?

Conclusion



...we are designing using the same standards and codes...the **technology is changing**
and **the way we use the technology is crucial**

It will be the key factor in the future of our industry and our/your enterprise

Thank you



Scan the QR code to get in touch on LinkedIn



Christian Pallaria

Digital Engineering Manager

AECOM