



Go with the Data Flow

Maximizing tunnel operation and maintenance

Ben van den Horn

Bart Duijvestijn



Introduction

Who we are, what we do...



Ben van den Horn
Safety Consultant at Arcadis



Bart Duijvestijn
Head department Tunnels at Arcadis



Content

What to tell

1. Introduction Arcadis & Waterwolftunnel
2. Tunnels (asset management contract)
 - Digital Strategy with our client optimizing tunnel operation and maintainance
3. Data driven tunnel maintenance; data model 2023:
 - Tunnel lighting
 - Tunnel ventilation
4. Lesson's learned: future challenges.



Arcadis at a glance



Arcadis With 35,617 people, in around 70 countries, Arcadis operates from a position of strength with well-established local expertise and services and global scale to meet client needs and ultimately **improve quality of life** for all.

Resilience



Rolling out hydrogen networks to support energy transition
Gasunie | Netherlands

Places



Net Zero distribution facilities
Hoogvliet | Netherlands

Mobility



New Mobility - Connected and Autonomous Vehicle solutions
Louisiana Department of Transportation | US

Intelligence



Map curbside data for city decision makers
Working in across cities in the US and Canada including Los Angeles and Toronto



Founded in 1888
in the Netherlands

36,000 people
across 70 countries



We work on more than
40,000 client projects
every year



€4.0 billion
in gross revenues in 2022



>80% of our revenues
are related to relevant Sustainable
Development Goals (SDGs)



Ranked #1
in our industry
for ESG performance by
Sustain analytics

Maximize impact in mobility solutions

With this Tunnel Operate & Maintain project we hit al the boxes:

- ✓ Unlocking data for clients
- ✓ Facilitate data driven decision-making
- ✓ Develop & deliver digital services & solutions



Mega trends will drive client's demands towards the full strength of Arcadis' resume and services



Data

2. Tunnels

Optimizing operate and maintain
in the Province of North-Holland,
the Netherlands 2012 - 2023

Facts & figures




Our Job on tunnel management; since 2012

Asset owner; province of North-Holland



Arcadis as a Managing Agent:

- Strategic director => plans for safe tunnel operation.
- A complex task for critical infrastructure
- Specific knowledge on tunnels is needed
- Cost effectiveness

Name	Year	Length [m]	Type of traffic	Traffic / year
Abdijtunnel	1996	1800/1360 m		182.500
Waterwolftunnel	2012	1270/670 m		13.140.000
Amstel aqueduct	2014	350/135 m		8.322.000



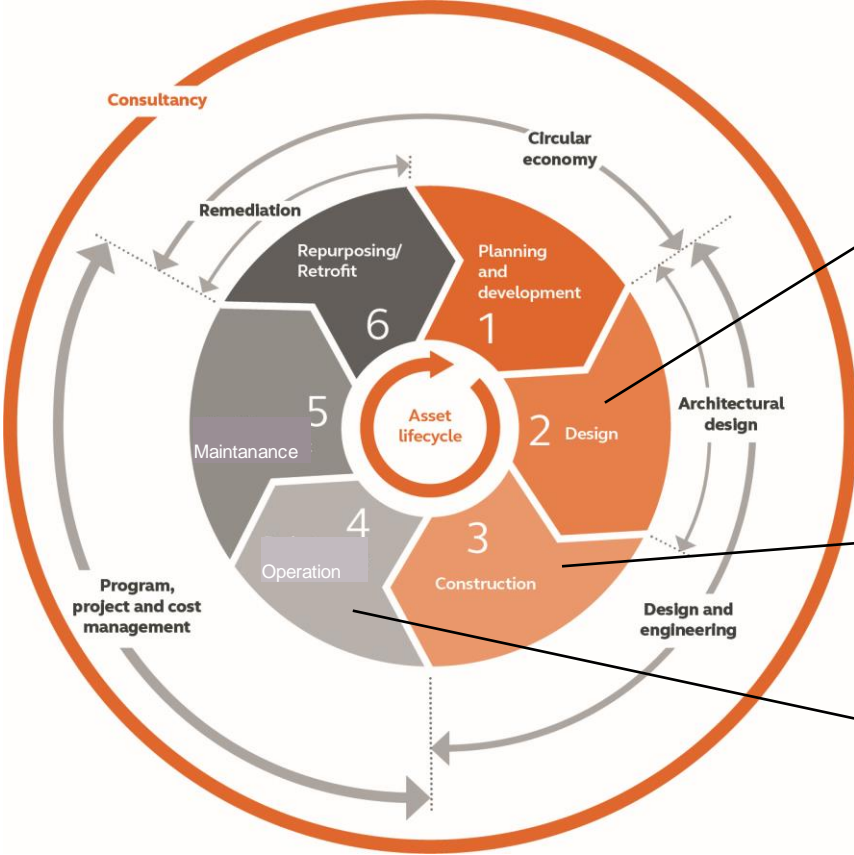
Responsibilities Managing Agent

- Reliable, available & safe
- Provide operation & monitoring
- Achieving optimal flow, no unexpected down time
- Maintenance when needed, not by habit (first time right)



Data Asset Lifecycle

Products & Services



Data Driven Design

- Parametric design
- Model coordination
- Constructability
- Lifecycle analyses

- Assumptions**
- Point cloud data
 - OTL/ILS requirements
 - Opensource Data
 - STD Meta Data

Data Driven Construction

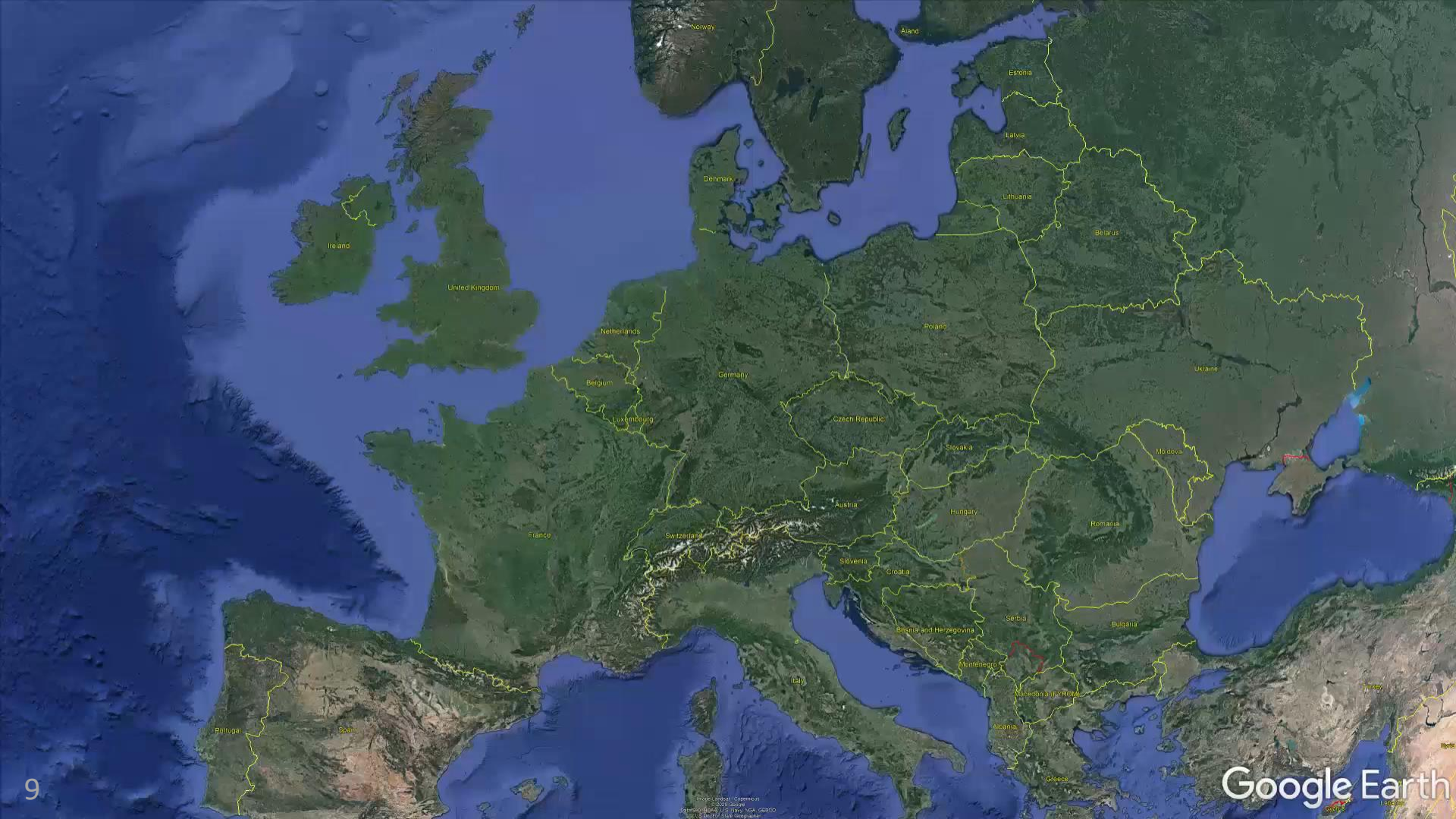
- File2Factory
- 4D simulation
- SA; Validation & Ver
- Data Q- Assurance
- Digital handover

- Construction results**
- Quantities
 - As build data
 - Product data
 - Data history

Data Driven Operation

- Geo Data Model
- Critical Data Points
- CTQ function plan
- Tunnel health check

- Performance data**
- Capacity
 - Safety
 - LCA data
 - Security*



Valuable Digital Tunnel Twin

Requires 'Boots on the ground' and 'Eyes in the sky'



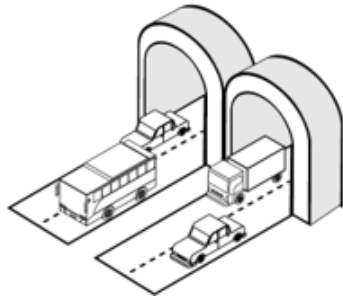


3. Tunnels

Data model 2023

Data platform

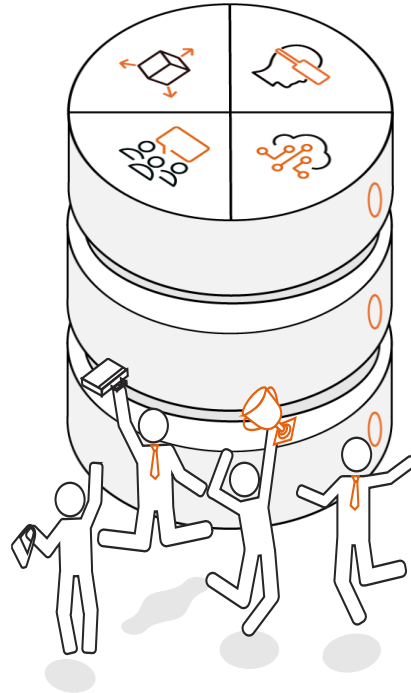
Asking the tunnel 'how are you today? and what do you think for tommorow?'



Tunnel decomposition



Maintenance plans and solutions



Failure Modes and risks



Monitoring and planned research

Aim to work data driven

How data can help

Developing a digital twin:

- Analyzing the current maintenance process.
- Optimize by making it digital.

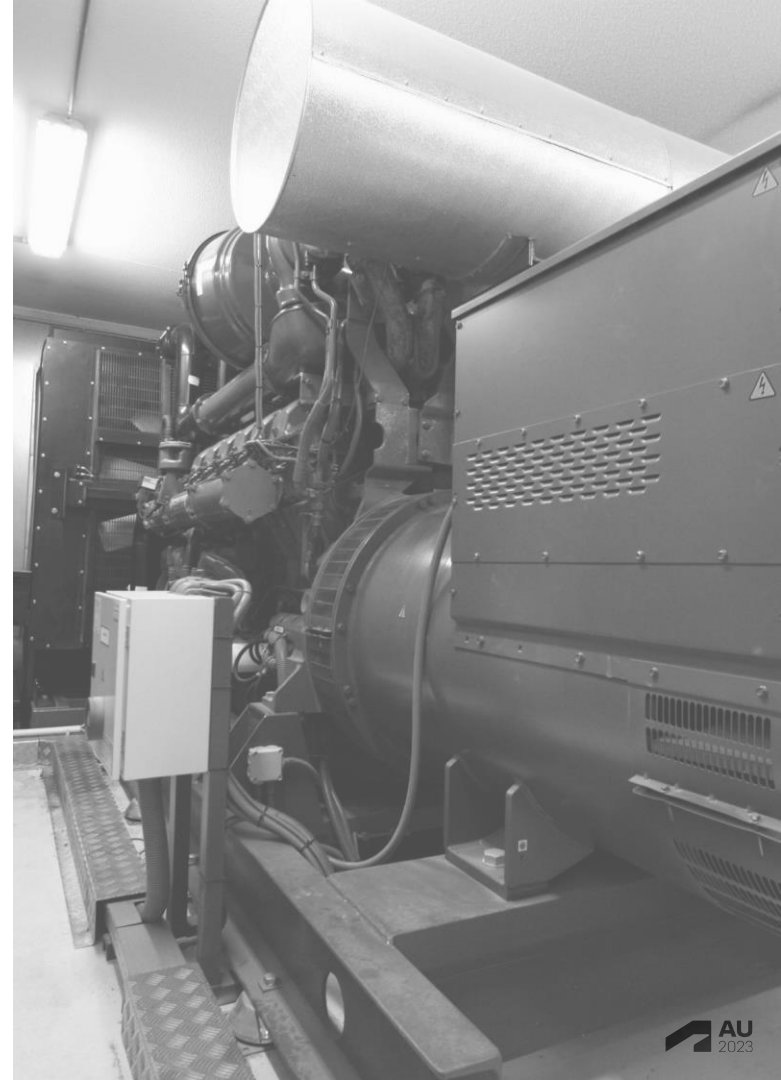
Integrate design requirements into Operate and Maintain. Transfer from design to implementation.



Digital delivery

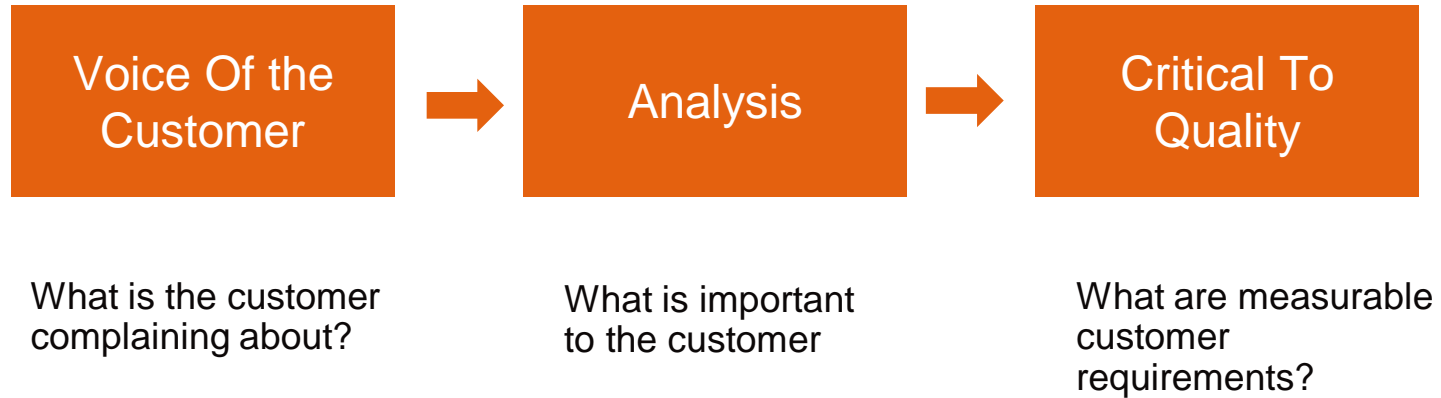
How data can help

- Asset owners realize that knowledge of history of the asset is indispensable.
- We deliver:
 - Our results digital to the client in a way according to ISO 55000
 - Share our view on risks and challenges.
 - In connection to the specified goals, define value for our client: what's Critical to Quality



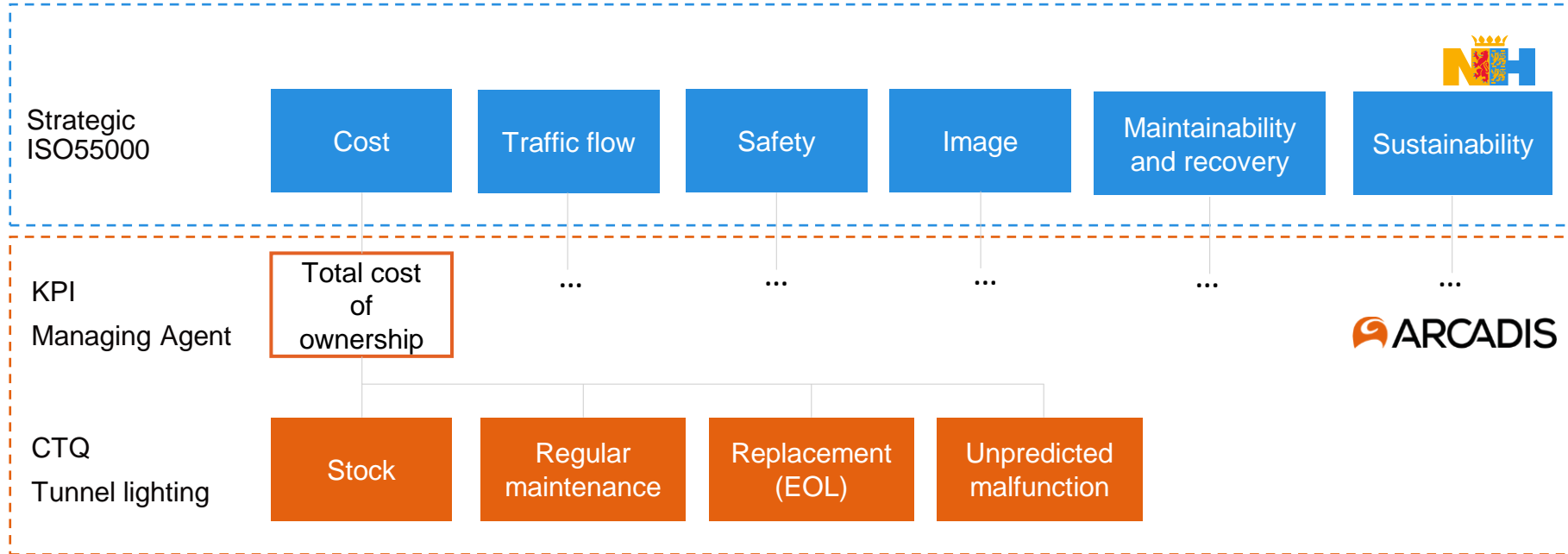
Steps in the maintenance process

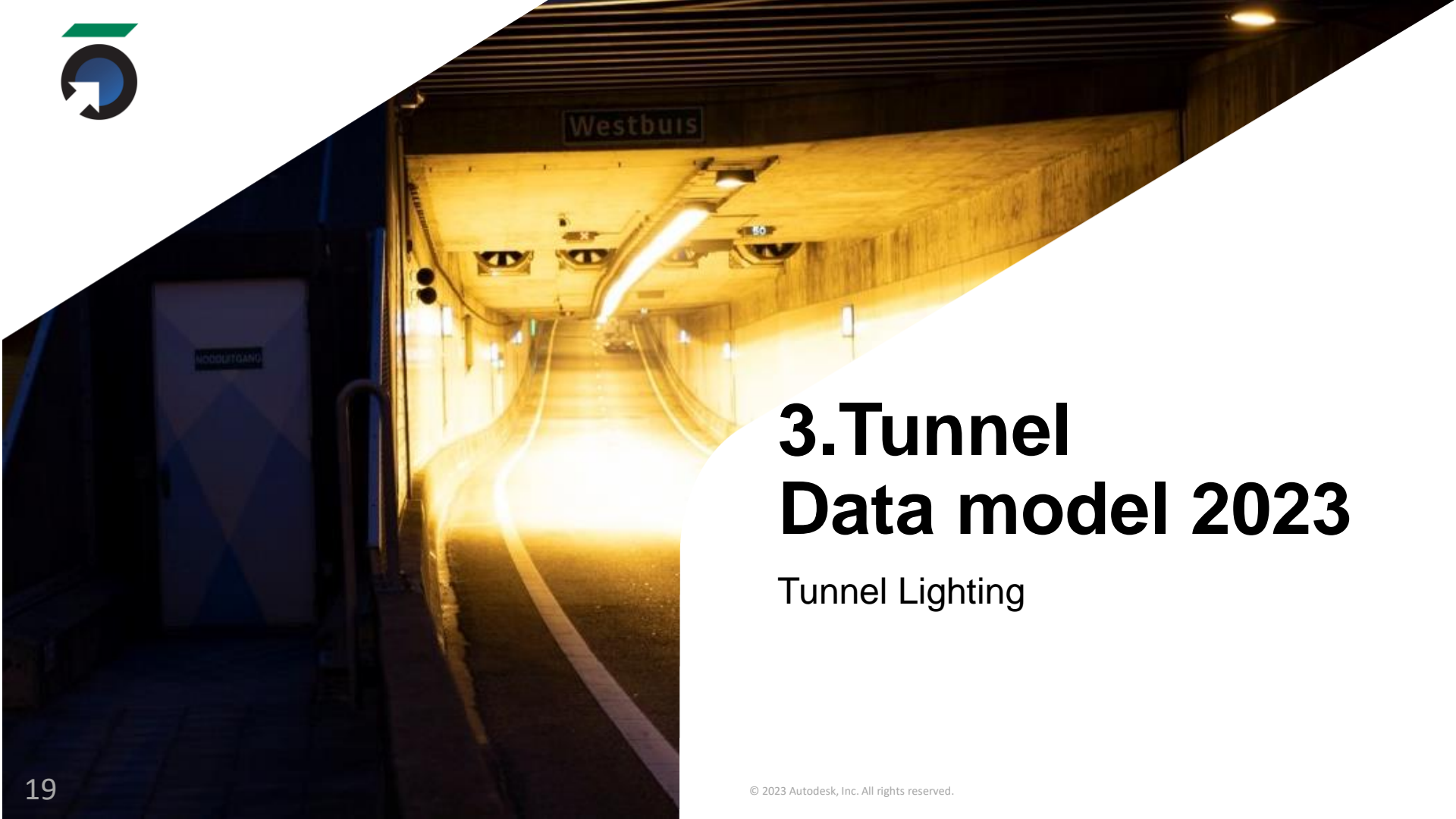
How data can help



From strategic goals to CTQ's

How data can help

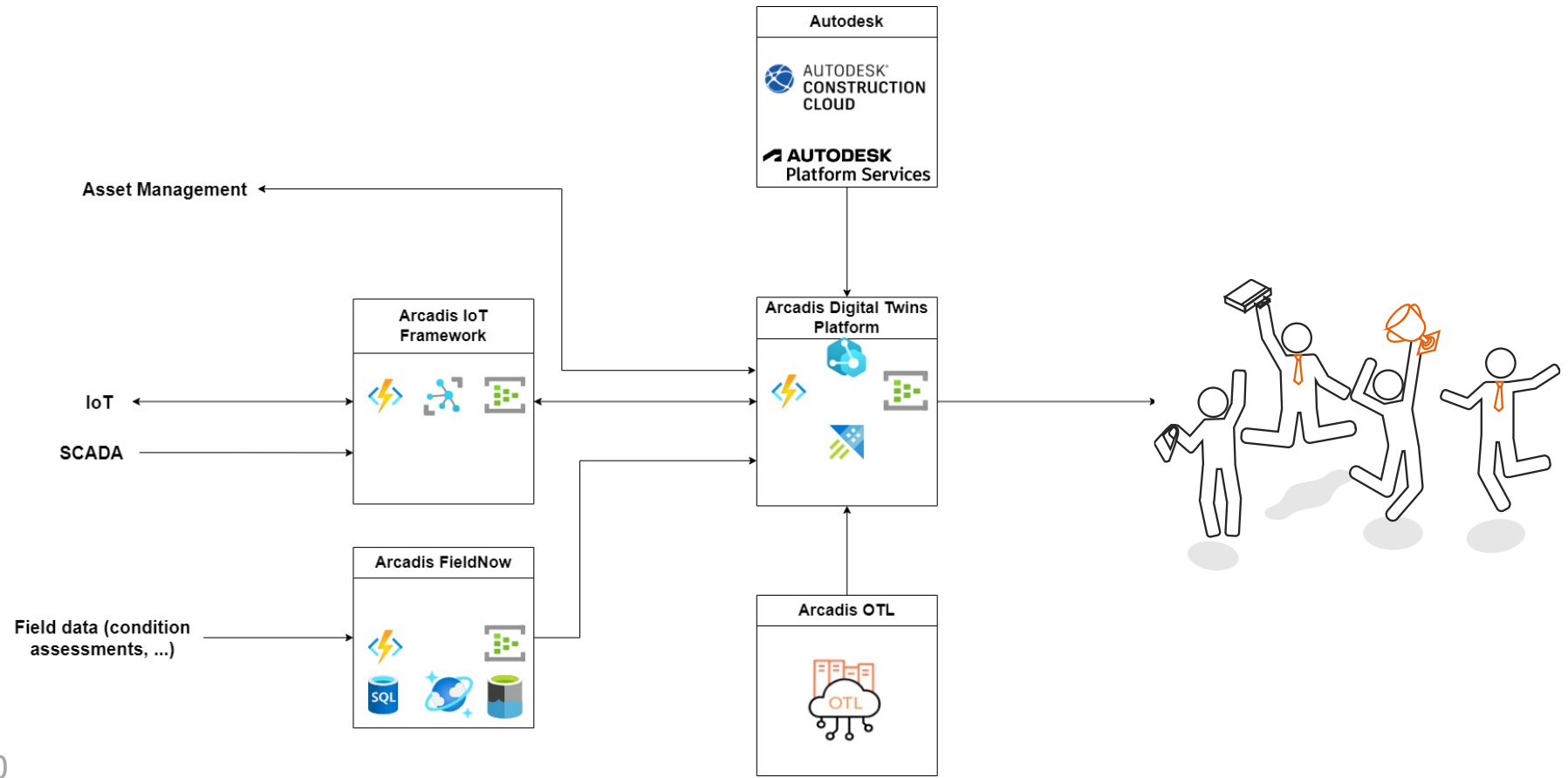




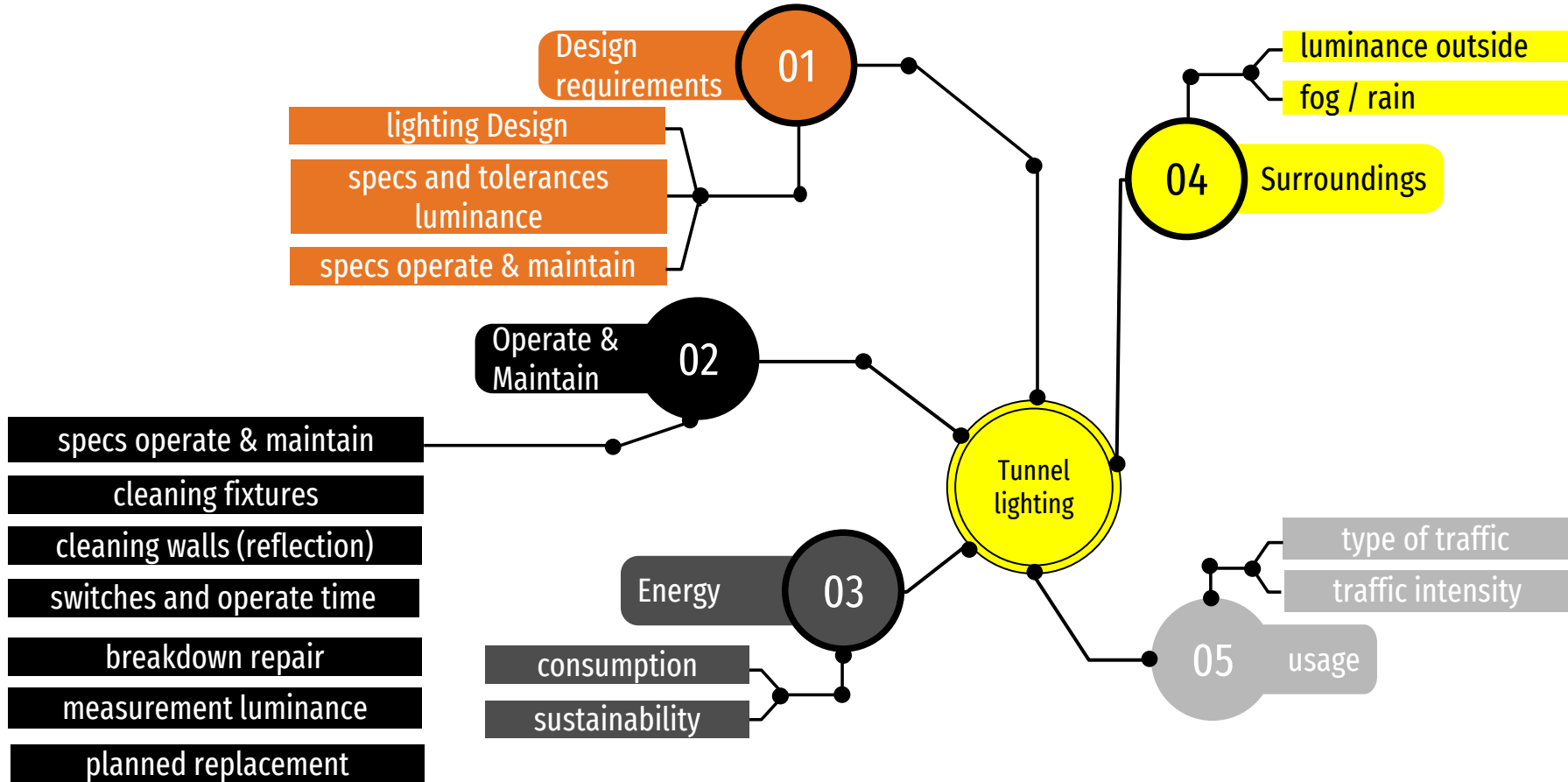
3. Tunnel Data model 2023

Tunnel Lighting

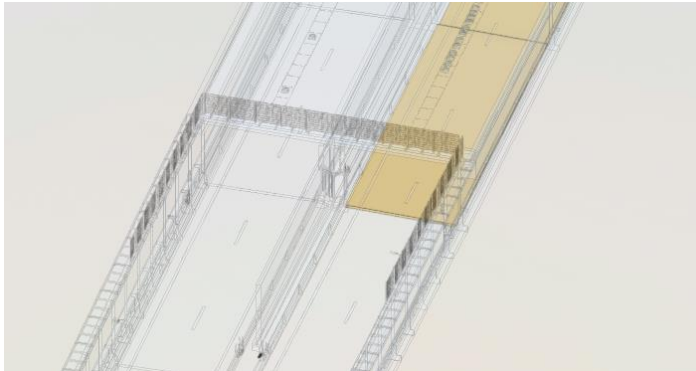
Architecture of the data model



Data sources to analyse tunnel lighting



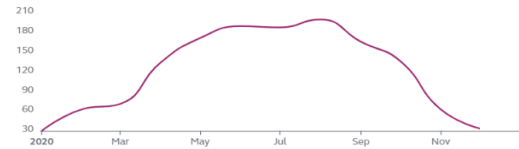
Predictive maintenance of lighting



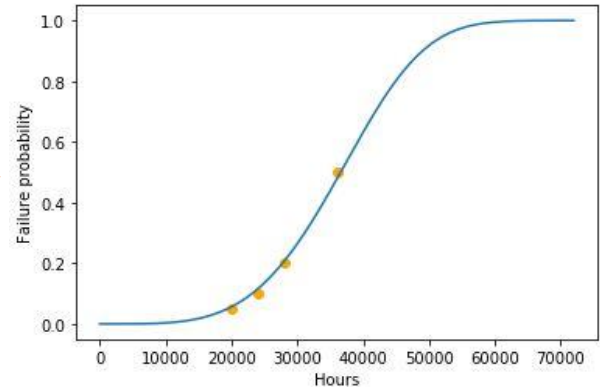
Linkerbuis-A

Average ▾





Burning hours per month (total)



Number of switches per month (total)



Select an environment

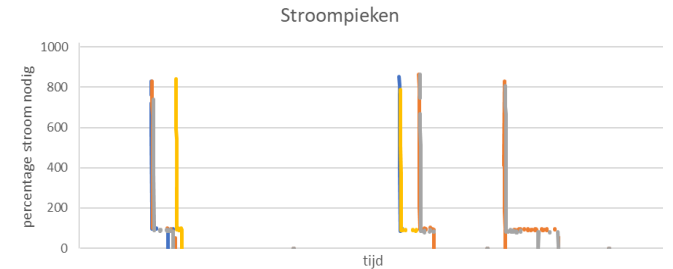
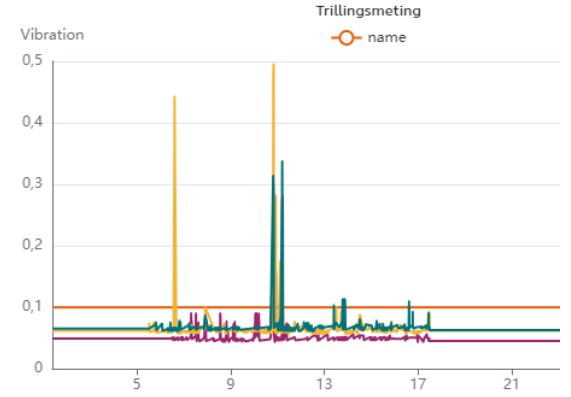
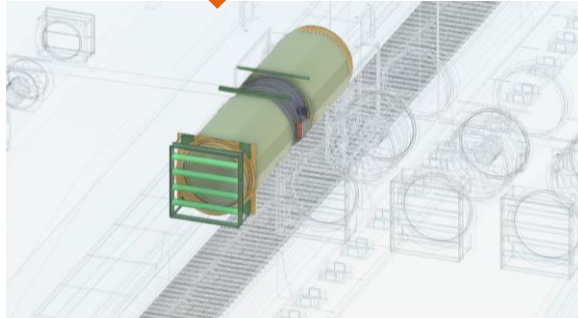
 <p>Development Development environment. Do not store any sensitive data! Your data will be deleted!</p>	 <p>Spijkenisserbrug D08001.202001.0314 Spijkenisserbrug Digital Twins omgeving</p>	 <p>Arcadis Rotterdam Arcadis Rotterdam Digital Twin environments</p>
 <p>Intelligent Water demo Demo environment. Do not store any sensitive data! Your data will be deleted!</p>	 <p>Waterwolftunnel Waterwolftunnel Digital Twin omgeving</p>	 <p>Development Development environment. Do not store any sensitive data! Your data will be deleted!</p>
 <p>Arcadis Belgium Offices Arcadis Belgium offices environment</p>	 <p>Connectimmo Connectimmo BRAIN environment</p>	 <p>Trains DB Train Digital Twins dashboard</p>



3. Tunnel Data model 2023

Tunnel ventilation

The model for predictive maintenance ventilation



- 36TUV01R11.Value.ValPvCur Stroom [36TUV01R11] %
- 36TUV01R12.Value.ValPvCur Stroom [36TUV01R12] %
- 36TUV01R13.Value.ValPvCur Stroom [36TUV01R13] %
- 36TUV01R14.Value.ValPvCur Stroom [36TUV01R14] %





4. Challenge

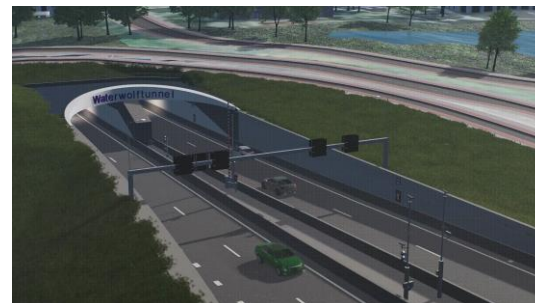
For the next 10 years..



Arcadis wins 10-year, €125m infrastructure contract extension in Netherlands for smart operations management and data driven asset maintenance

September 12, 2023 - Arcadis, a leading global design and consultancy organization for natural and built assets, has been selected to lead the operational management and maintenance of three major infrastructure assets in the Netherlands over the next ten years – 'Waterwolf tunnel', 'Abdij tunnel' and 'Amstel Aquaduct'. The contract is awarded by the province of North Holland, a key Arcadis client, and is a continuation of the current maintenance and management contract won by Arcadis ten years ago.

Digital Twin 2.0



Predictive Maintenance / AI



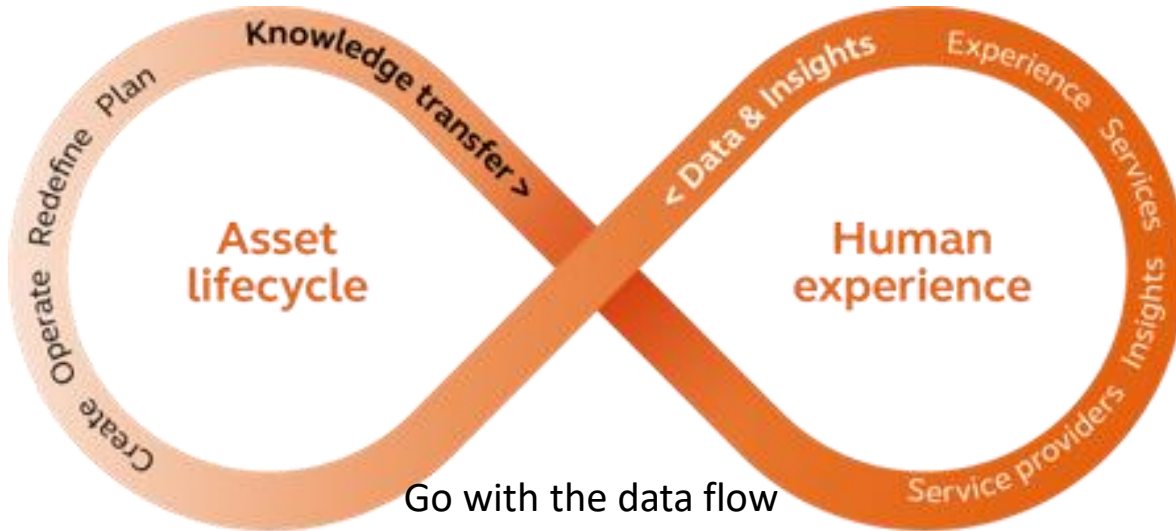
What is next?

- Our challenge for the future:
 - Adding specific items
 - Collecting & connecting the right data
 - Intensifying data analytics and AI; to learn about relations & impact
- Approach:
 - Pareto, first things first (key costdrivers, critical to quality)



Roadmap to talking asset

Integrate 3 critical datapoints next year



Energy Supply



Fire Detection



Fire Resistance



Take aways

Attention:

- Invest in client communication
- Data exchange, connectivity & **security**

Benefits:

- Real time tunnel data became real time tunnel status
- Business case models to decide on alternatives

We can ask the tunnel:

‘how are you?’ in different ways ;-)

How are you?

- How's it going?
- How's life?
- How are you doing?
- How are things?
- How are things going?
- How have you been?
- What's up?
- What's new?
- What's happening?
- What's going on?
- What are you up to?
- What have you been up to lately?





Questions?

