
GWF
GEOSPATIAL WORLD FORUM
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Sweco Digital Twins

Full life-cycle digital twins for City Infrastructure and Complex Plant

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Head of Digital Twins

Europe's leading architecture and engineering consultancy

- More than 21,000+ experts across more than 100 disciplines
- 120,000 projects pa – almost 30 Bn sek pa

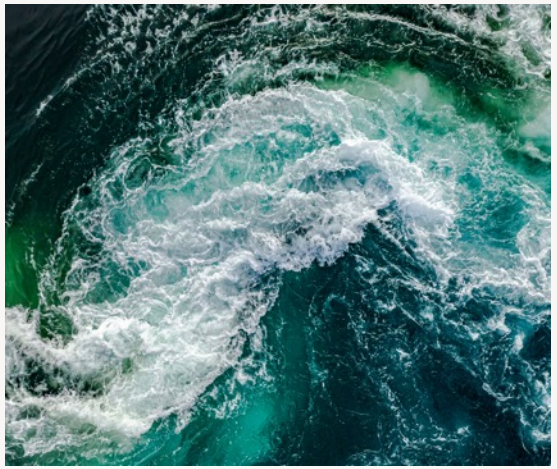
Local presence – global expertise

We combine a strong local presence with offering our clients access to the total knowledge at Sweco, to help you solve any challenge at hand.

Our segments and services

Buildings and urban districts

- Architecture
- Sustainable buildings
- City planning
- Climate and environment assessment
- Parametric design



Water, energy and industry

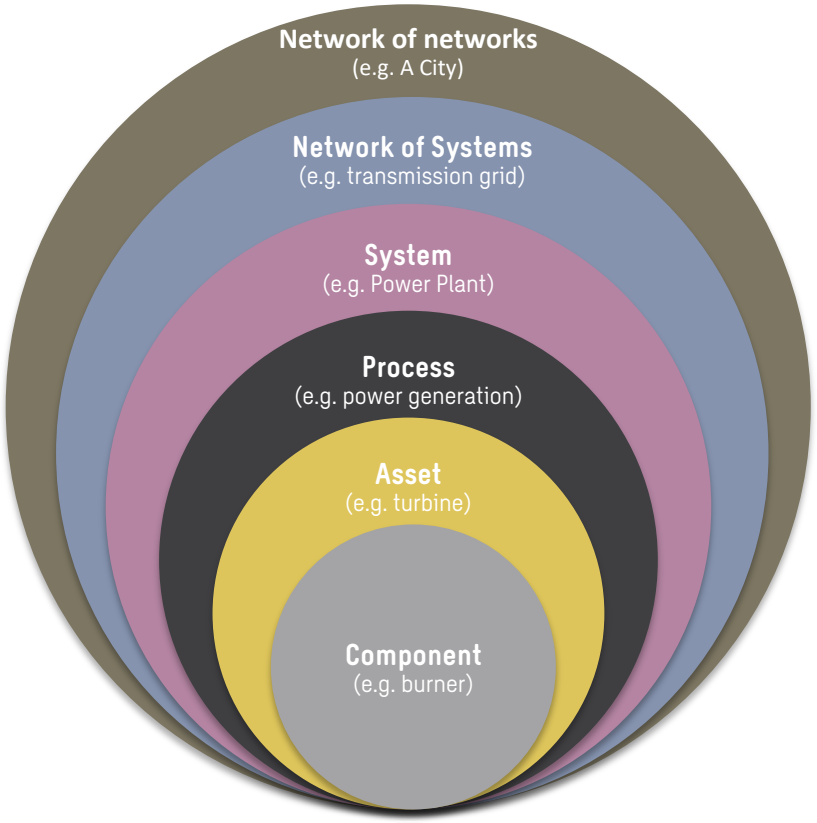
- Renewable energy
- Electrification
- Environmental impact assessment
- Efficient logistics and processes
- Water treatment and water protection

Transport infrastructure

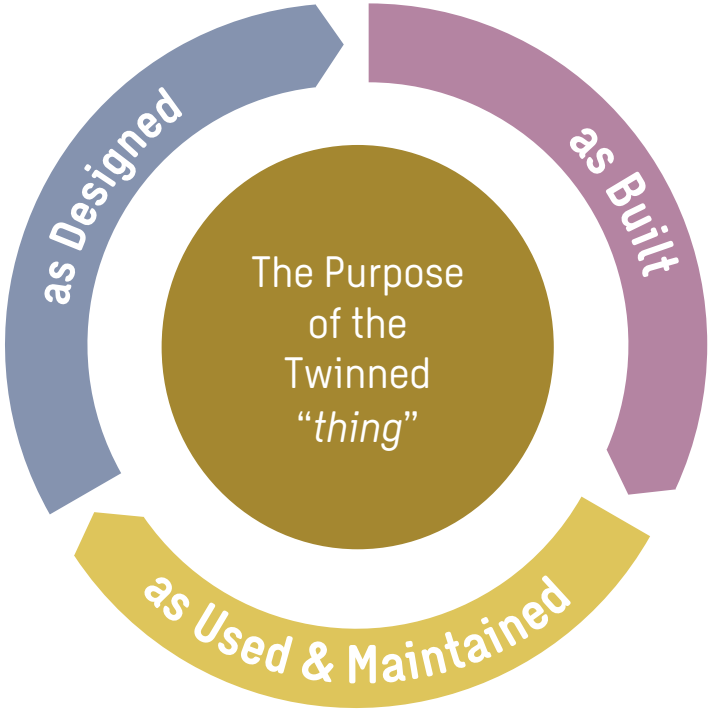
- Railway and rail-bound traffic design
- Public transportation planning
- Cycling in cities
- Traffic and urban planning

Digital Twin Sope and Type

Types of DT:



Phases:



Paradigms:

Tactical

limited scope | limited duration | limited value

Strategic

full life cycle| federated | ongoing | new value

The key is repeatability and scalability – with minimal marginal cost

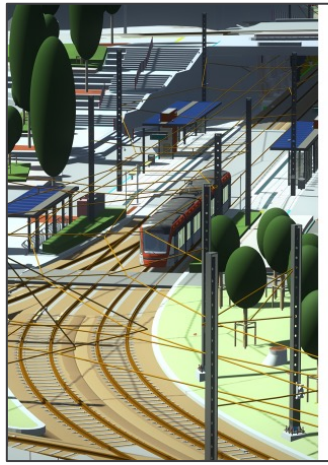
Digital Twin building blocks

SWECO

We work with existing data and combine our domain knowledge with yours to produce tactical or strategic digital twins that you can own and operate

	Design & Simulation	Control systems & Sensors	Domain Expertise	Data, AI & Analytics	Digital Twin Apps
Building Blocks	Structural **models** of all kinds, mathematical **models** and AI **models**.	Many types of SCADA and feedback loops, plus IoT sensor systems to transmit data from physical systems in real-time	**Process** and domain expertise across all major aspects of industry, urban development and infrastructure projects, as well as operations and maintenance.	Data management and analytics to transform raw data into insights based on customer and stakeholder needs.	Interface for humans to visualize and interact with digital twins
Examples	CAD, BIM, GIS, Scanning (point clouds & photogrammetry), AI/ML models, CFD/FEA models etc.	Process control, SCADA implementation, Sensor strategy, design & deployment, virtual sensors	Urban planning, environment, infrastructure, transport, energy, water, sewage, asset management, facilities management, industrial plant design, FMEA, maintenance	Ontologies, knowledge graphs, AI, ML and advanced analytic algorithms	WebGL, AR, VR, mobile, PC apps and APIs

Example Digital Twins



Light Railway - Design Digital Twin

- The client wanted: *"an open platform that shows an up to date and complete model that can be used on any laptop by all stakeholders, without requiring special software to be installed".*
- How we used it:
  - Design reviews
  - BIM coordination and validation
  - Clash detection and issue resolution
- Delivered benefits:
  - Reduced fail cost by 25%
  - Using scripts in combination with ProjectWise saved 15% in time
  - Reduction of 500 hours using OpenBuildings Designer per delivery
  - Delivering the project on time and within schedule
- Conclusion - using iTwin Services we can save 1.5 Million Euro a year on project this size

Hydroelectric Plant – Operational DT

Client
- Statkraft
- Statkraft Press Release (Swedish)

About the Ivarsfors hydropower plant:
- Location: Värnamo municipality
- Age: in operation since 1953
- Installed power: 1 MW
- Annual production: 3.3 GWh

Key requirements
- Explore potential for digital twin in plant monitoring, operations and maintenance
- Increase efficiency, reduce cost, improve safety
- Make information more accessible at point of need, out in the field
- Create capability that can be scaled across full fleet and larger plants
- Create foundation for other plant, including wind and solar

Challenges
- Routine inspection and maintenance operations, with frequent unnecessary site visits
- Incompatible information silos make it difficult to easily access correct information
- Difficult to provide analytics around each asset
- Operational data goes to central control room, before being sent back out to on-site field service engineers & technicians

Sweco solution and Outcomes
- Microsoft Azure cloud based hosting with integrated Azure IOT and analytics
- Integration to central control room systems & SCADA
- Sweco Twinfinity Digital Twin frontend

Achievements:
- Increased operational efficiency and minimised travel costs
- Mobile app enables accurate near real-time situational awareness and analytics, without control room intervention
- Technicians and FSEs can access all necessary data remotely and on-site
- Strategy development for scale-up to larger hydro-plants and other types of site

Twinfinity for Facility Management

Client
Property owners of residential, university and commercial buildings

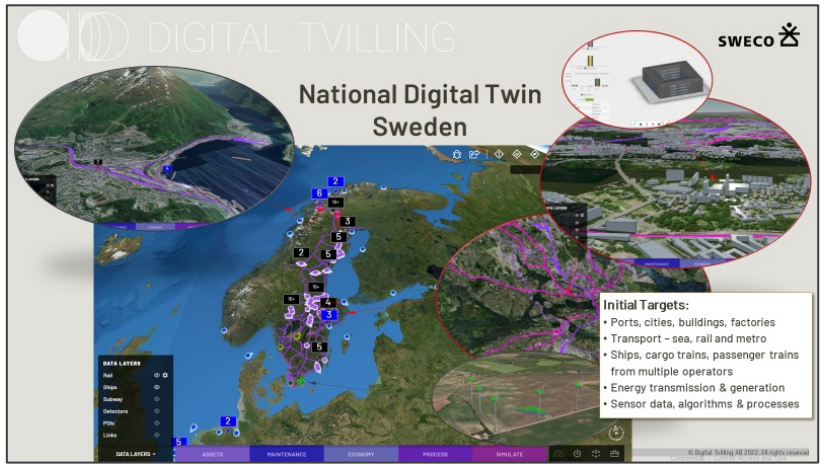
Key requirements
- Connect maintenance objects to their location in a 3D-model.
- Optimize maintenance work

Roadblocks faced
- Maintenance staff having difficulties finding objects in the building.
- Data only accessible in table form without proper context.

Sweco solution
Twinfinity® is embedded into the customers Facility Management Software to visualize maintenance objects and drawings in the right context.

DIGITAL TVILLING

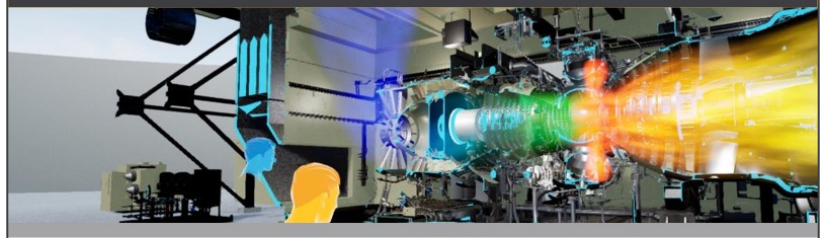
National Digital Twin Sweden



Initial Targets:
- Ports, cities, buildings, factories
- Transport – sea, rail and metro
- Ships, cargo trains, passenger trains from multiple operators
- Energy transmission & generation
- Sensor data, algorithms & processes

Power Generation and Industrial Turbines

Automated production of digital twins for thousands of turbine installations



Client
- Leading global energy OEM

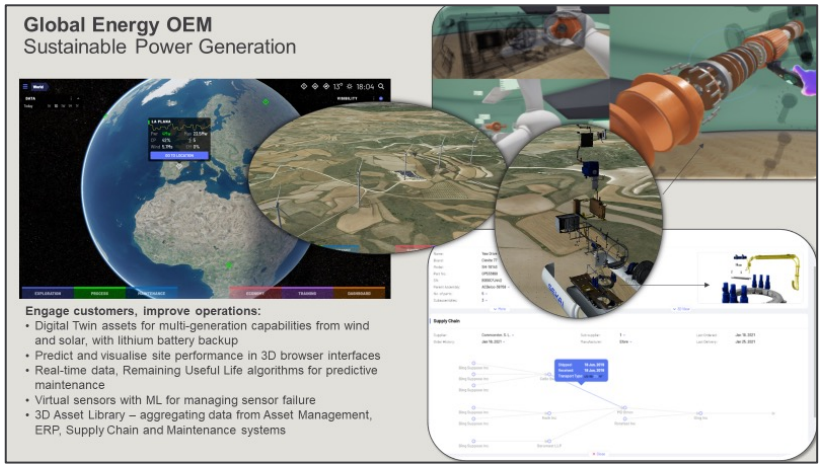
Key requirements
- Ability to cost effectively produce digital twins for a large fleet of gas and steam turbine installations used for power generation and industrial applications
- Use data from existing systems without having to change them

Roadblocks faced
- Large number of physical assets installed at remote locations
- 30% of each installation is different from reference design

Results
- Automated production using self-building technology
- Each digital twin build took approx. 20 hours, including only 2-3 hours of manual effort

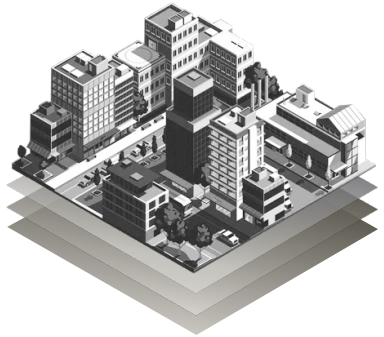
Global Energy OEM

Sustainable Power Generation



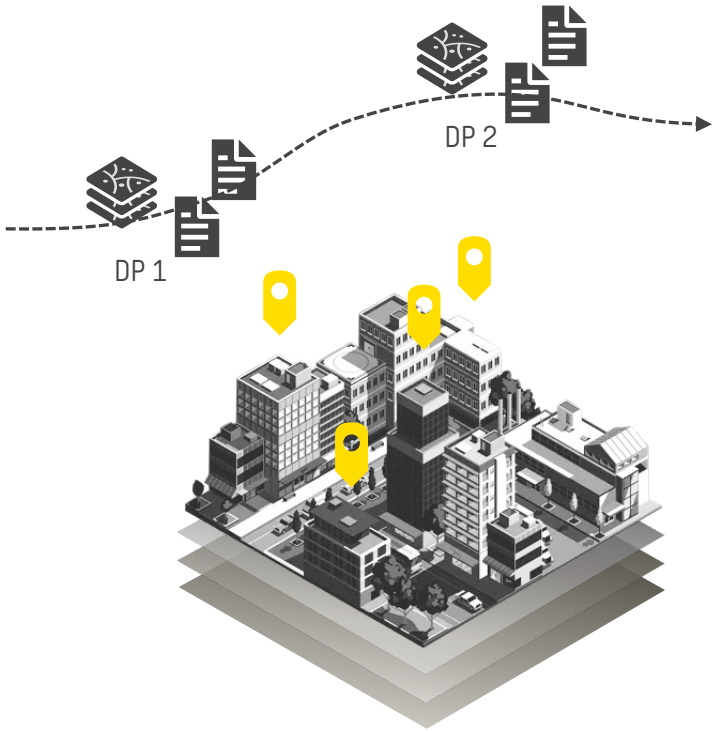
Engage customers, improve operations:
- Digital Twin assets for multi-generation capabilities from wind and solar, with lithium battery backup
- Predict and visualise site performance in 3D browser interfaces
- Real-time data, Remaining Useful Life algorithms for predictive maintenance
- Virtual sensors with ML for managing sensor failure
- 3D Asset Library – aggregating data from Asset Management, ERP, Supply Chain and Maintenance systems

D in City Managmet



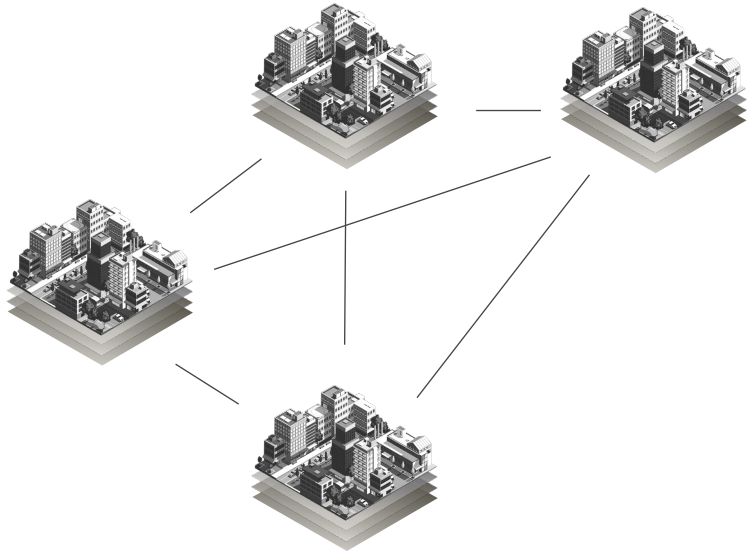
Poject iformaion model

Overview plans
Detailed plan
Building Project



“Digia” urban planning poess

Departments
Disciplines
Projects

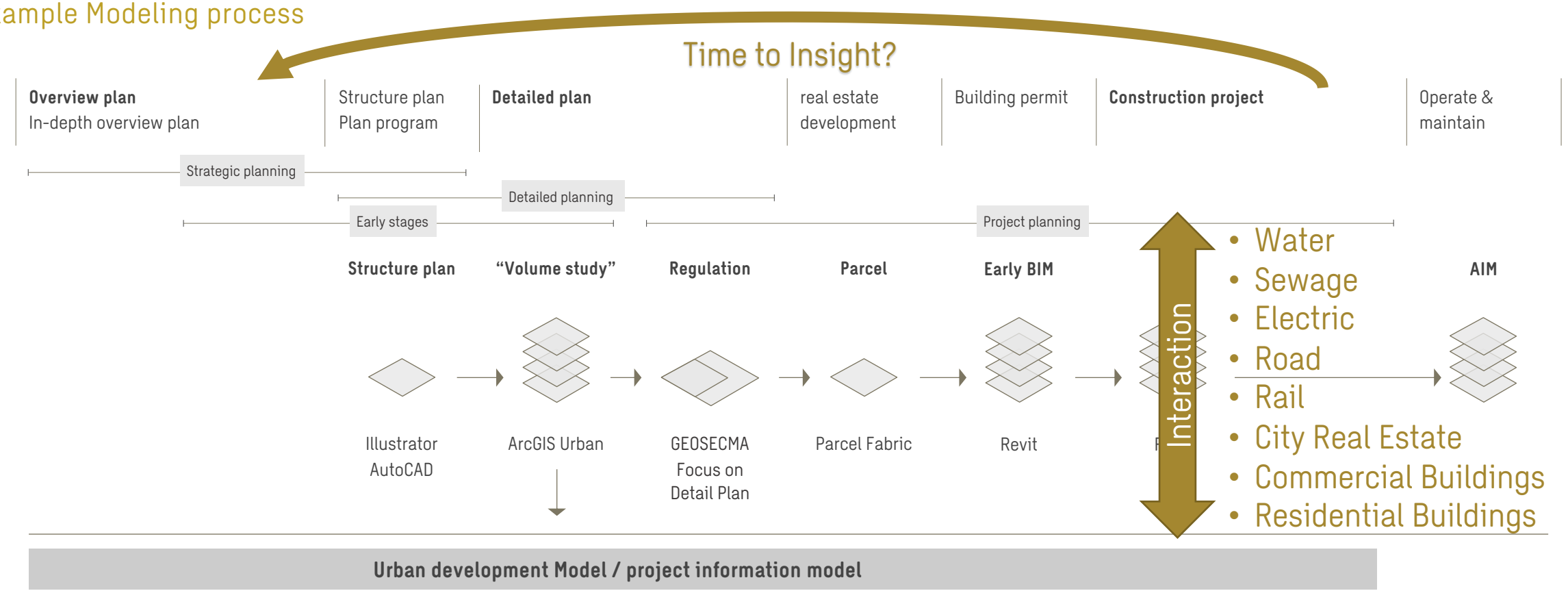


City Digia Twin

Federated digital twin

Urban Planning Process (Sweden)

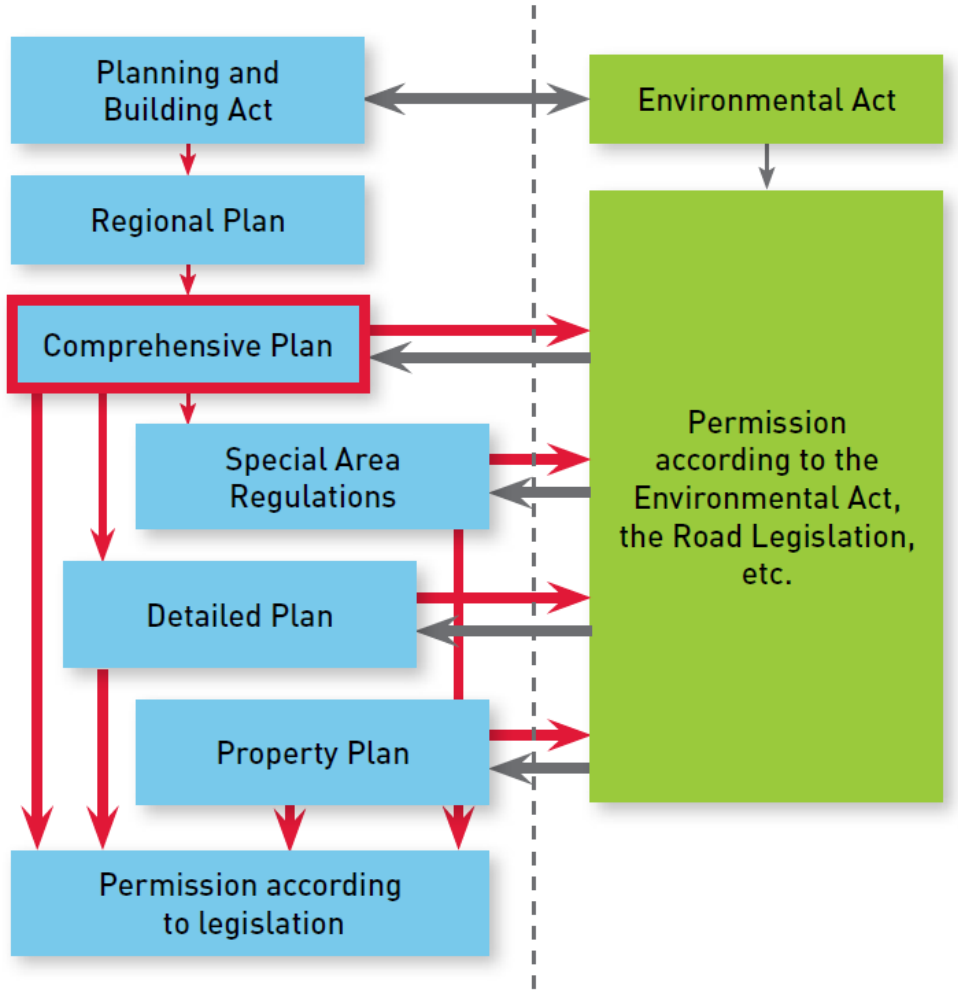
Example Modeling process



Political

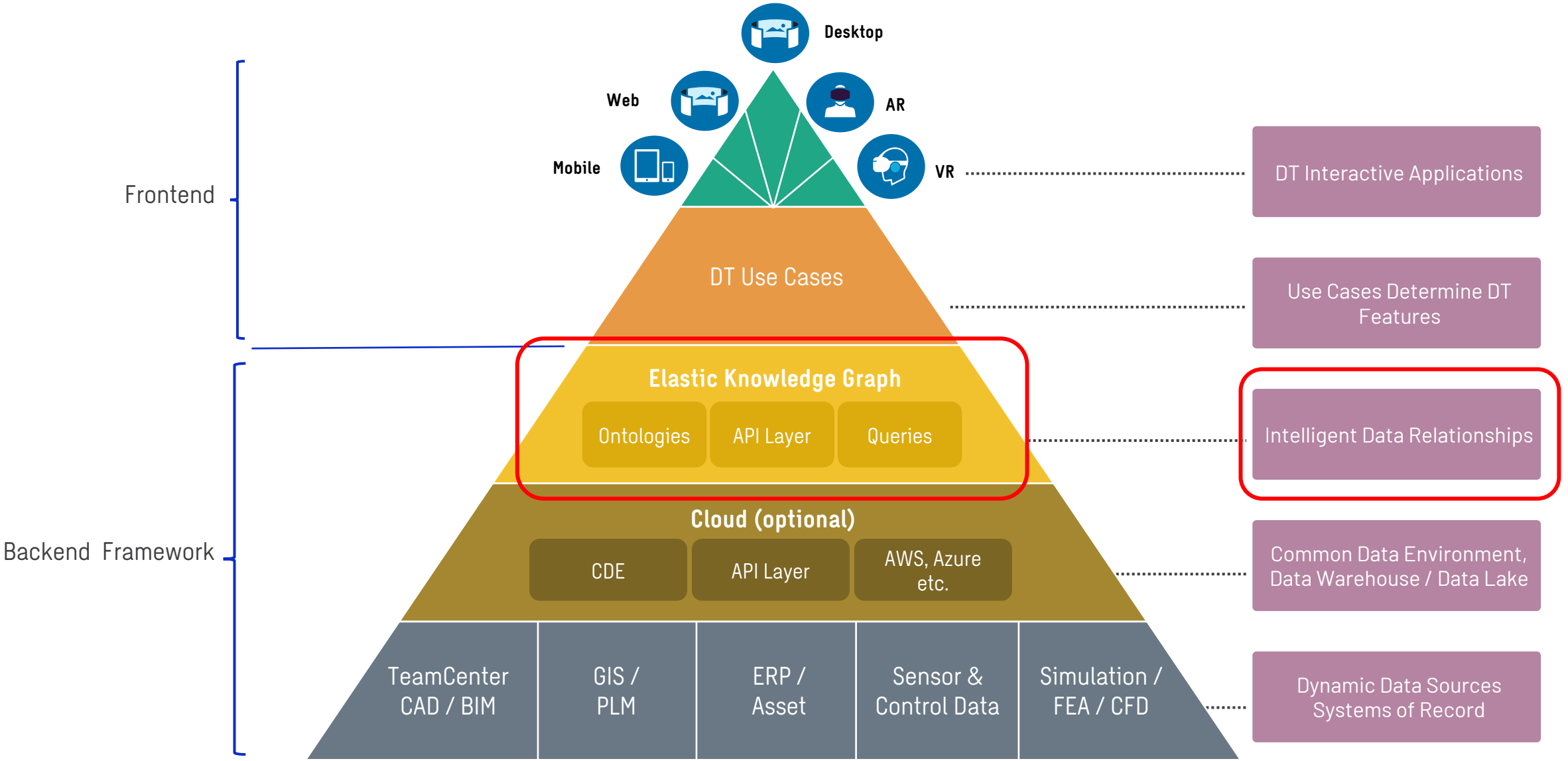
Engineering

Planning & Buiding Acts v Environmental Code

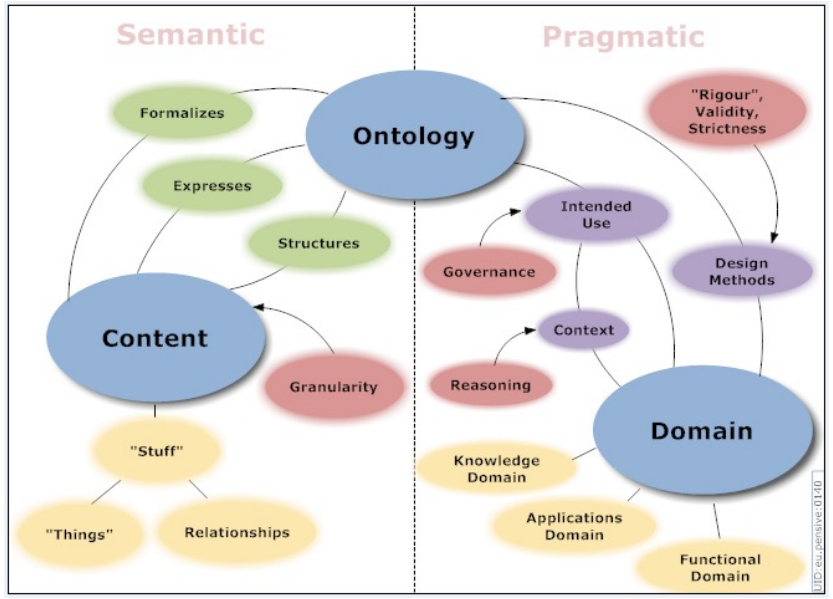


How could we do it?

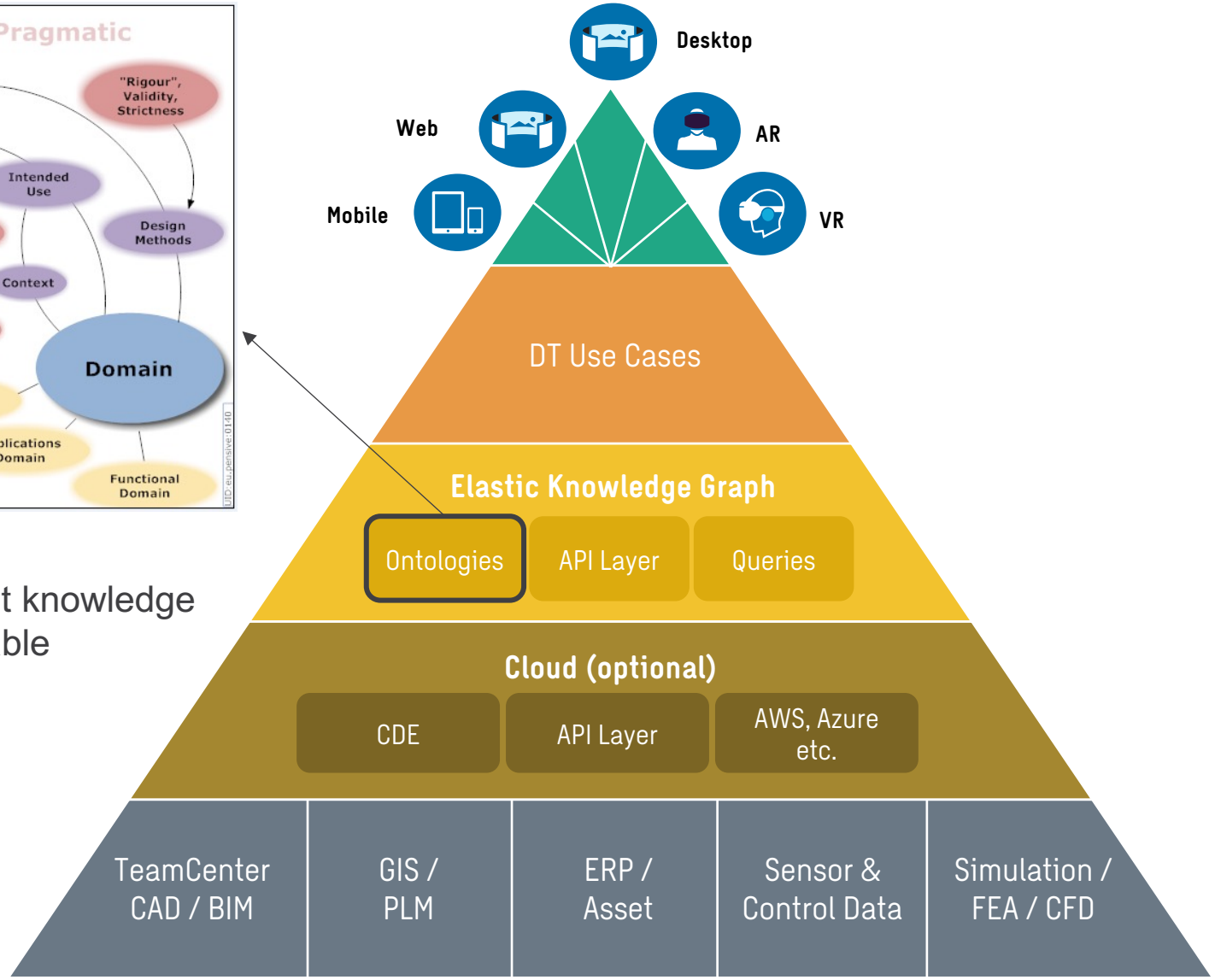
Enterprise Level Architecture



What is Different?

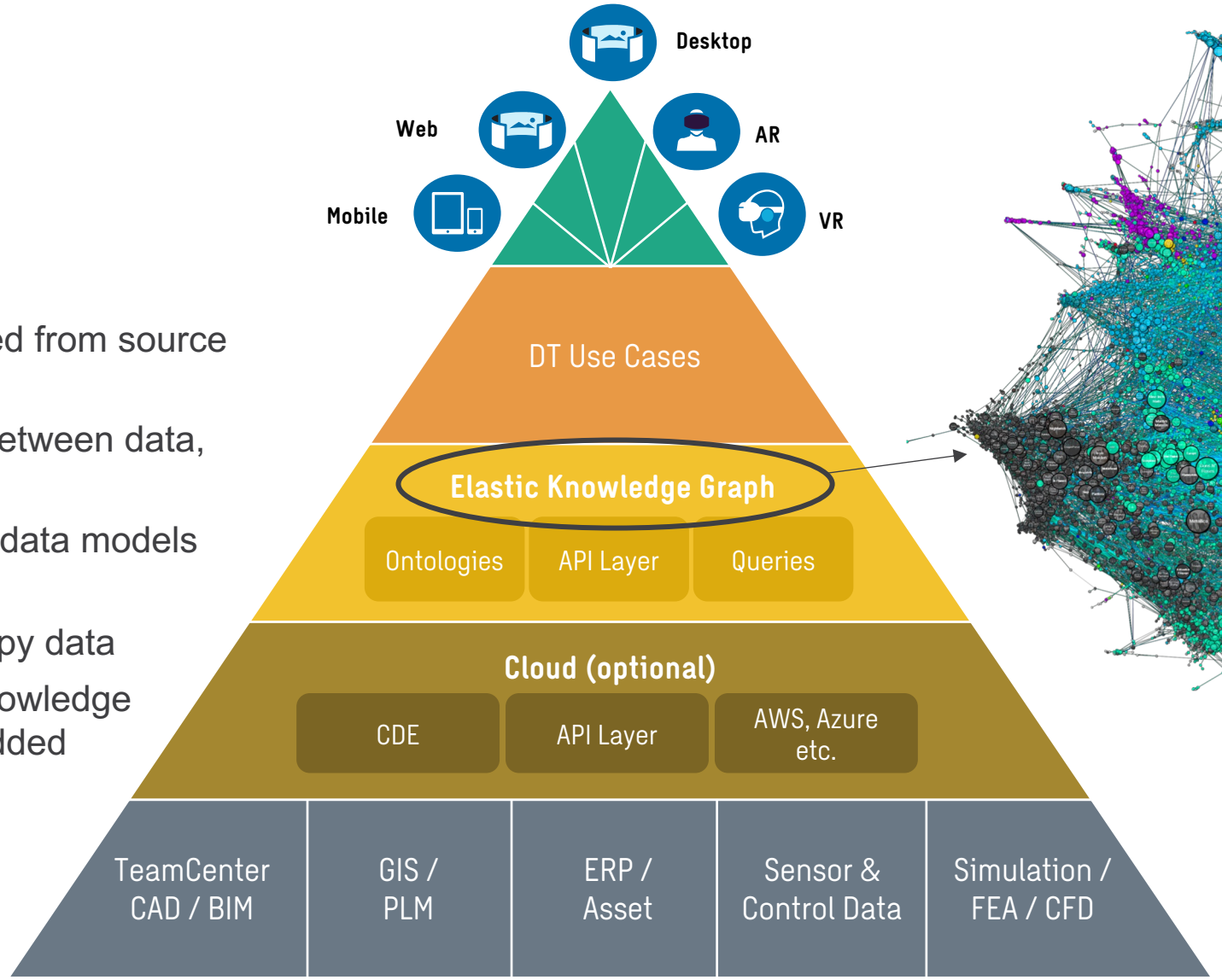


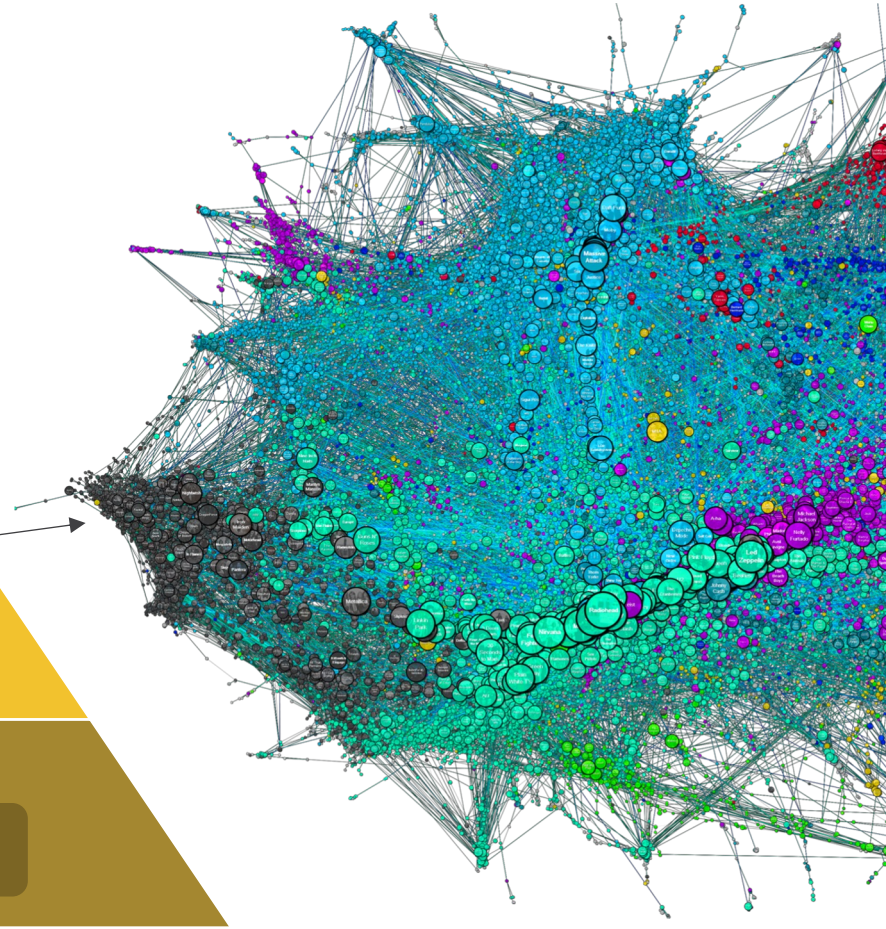
- Abstraction layer
- Capture explicit and implicit knowledge
- Machine and human readable
- Layered with *Inheritance*
- Modular
- Federated
- Data schemas
- Large number of reference ontologies already exist



What is Different?

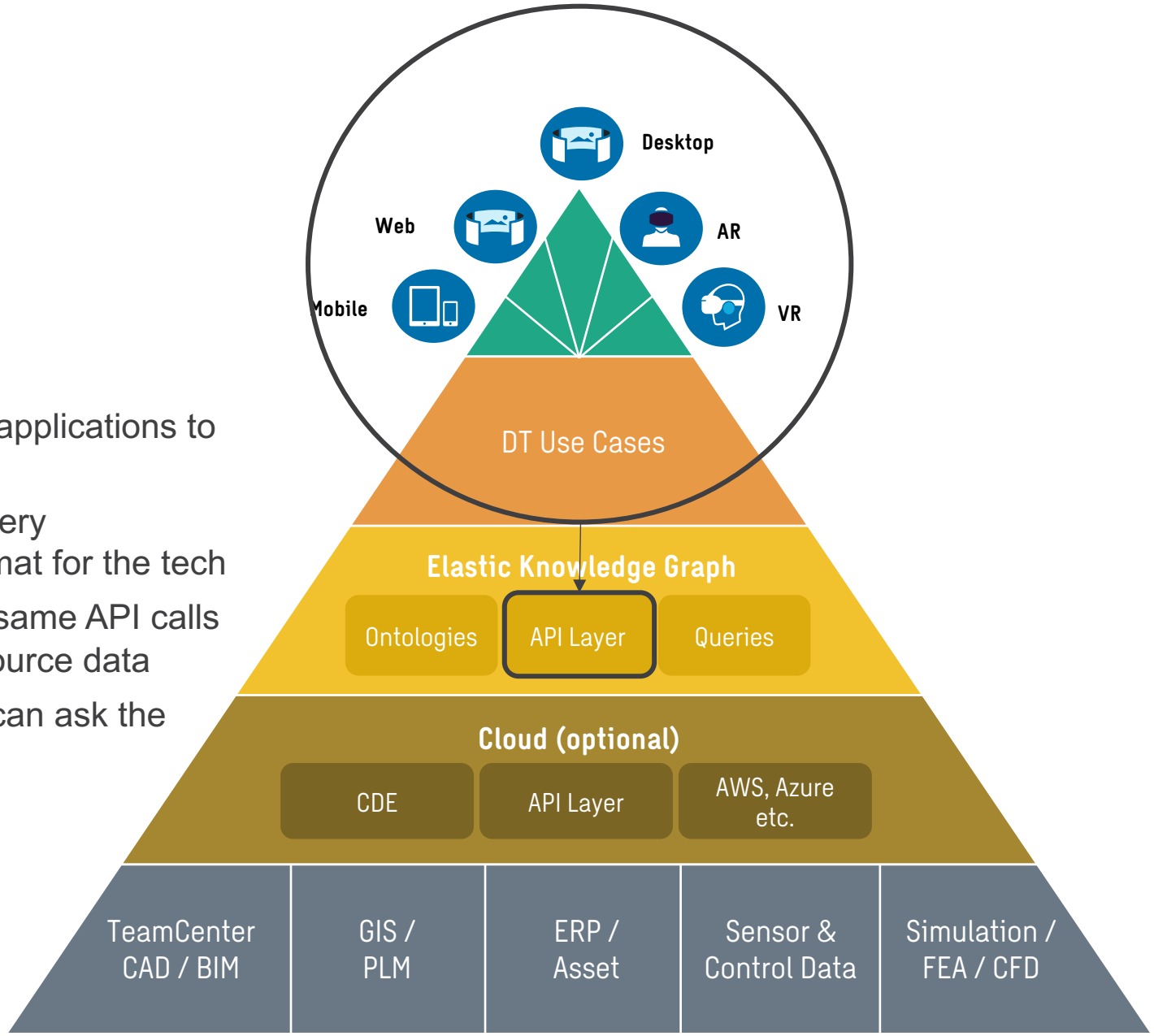
- Elastic structure instantiated from source data, **using ontologies**
- All possible relationships between data, **without coding**
- Multiple concurrent logical data models **without conflict**
- Federated – no need to copy data
- Mutates in-situ as more knowledge captured and more data added
- Massively scalable





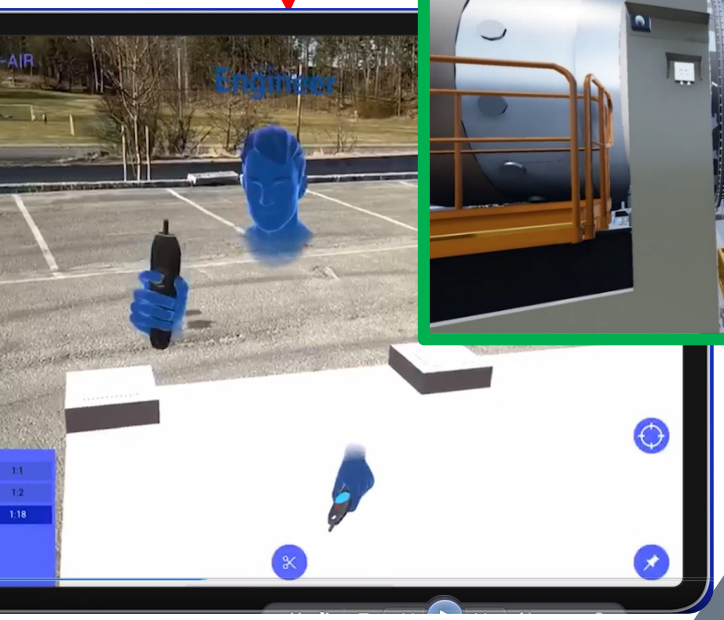
What is Different?

- Users do not need source applications to access data
- Same data available for every application, in the right format for the tech
- Re-use without recoding - same API calls available, irrespective of source data
- Self-documenting, so you can ask the EKG what you can ask it



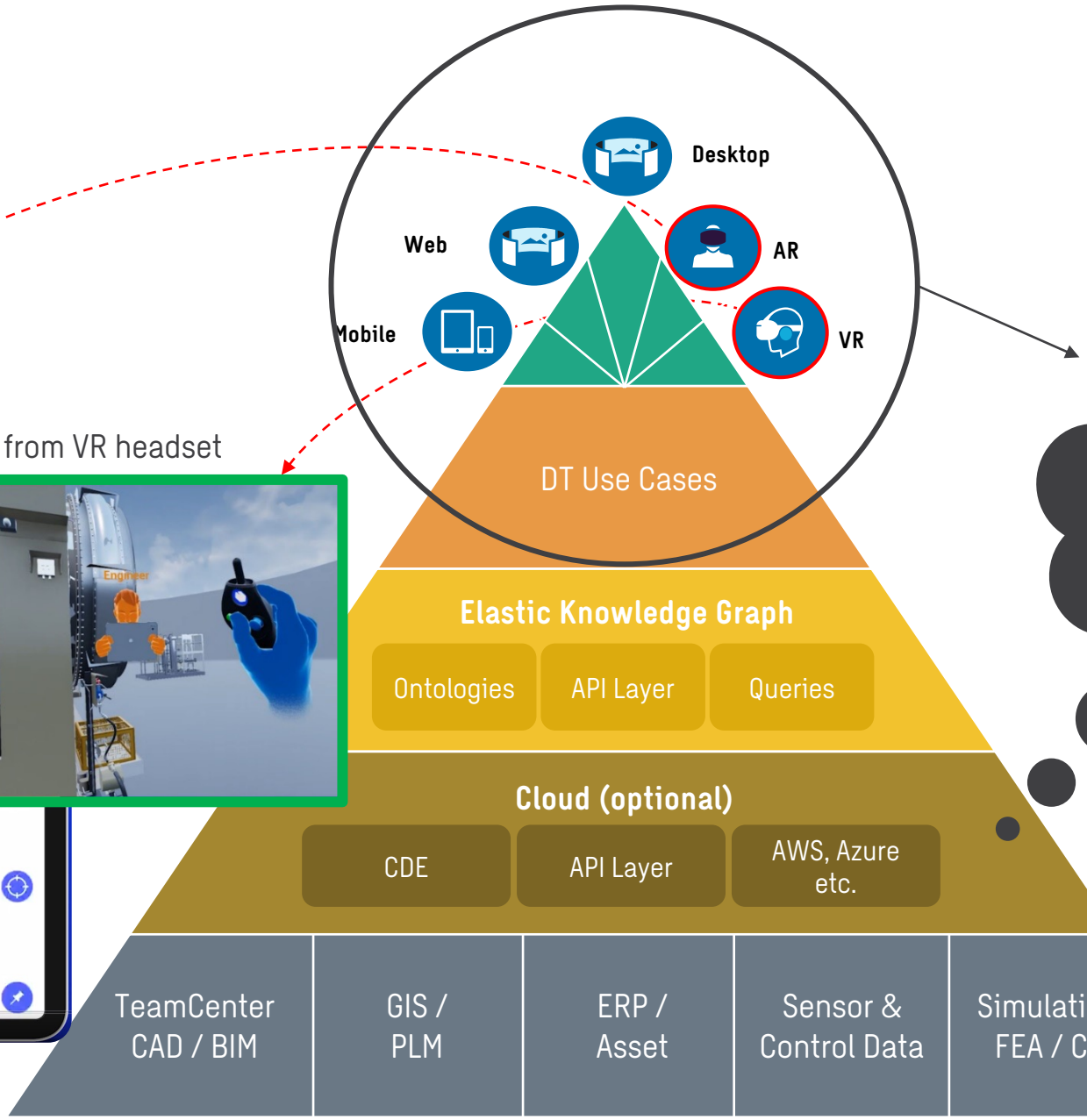
What is Digital Twin?

SWECO



Screen shot from AR (iPad)

Screen shot from VR headset



Virtual Collaboration

Urban Planning - Opportunities for improvement

SWECO

- Each project reinvents the wheel
- Individuals in the projects gain experience, but the organisations as a whole do not systematically gain knowledge
- Knowledge about design and construction changes locked in with project data
- Projects may have to re-do work due to late changes in the detailed plan
- Early decisions that could reduce carbon footprint in later projects missed
- Difficult to use multiple information models from many different stakeholders
- Silos persist and data not readily shared between them

Waste, longer time, higher costs, greater risk, minimal re-use
Difficult to meet triple challenge

- Processes are the same, only the navigation and creativity need to be different
- Repeatable stuff is context, creativity / innovation is core
- Constellation of people, developers, tools, styles and boundary conditions changes each time – digital twin can "record" the process and be used as a learning tool
  - Formalise organisational knowledge (collective intelligence)
  - Independent of constellation
  - Allows evaluation and articulation of newly created value (not drowned by context)
  - Repeat what works
  - Learn from mistakes
- Accessible historic data - replay any project or sub-project
- Create opportunity for early insights (across municipalities)

Creates foundation for attacking the triple challenge
Creates the foundation for Smart City and connected citizens

There is no reason why Digital Twins cannot be used to transform Urban Planning.....

....except there are no policies and decision makers don't understand

SWECO