



TUNNEL OPERATION CENTER VS. DIGITAL TWIN

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TOWARDS BIM-BASED OPERATION AND MAINTENANCE
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Current situation

What will a digital twin look like?

What are benefits and risks?

Conclusions

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Current situation

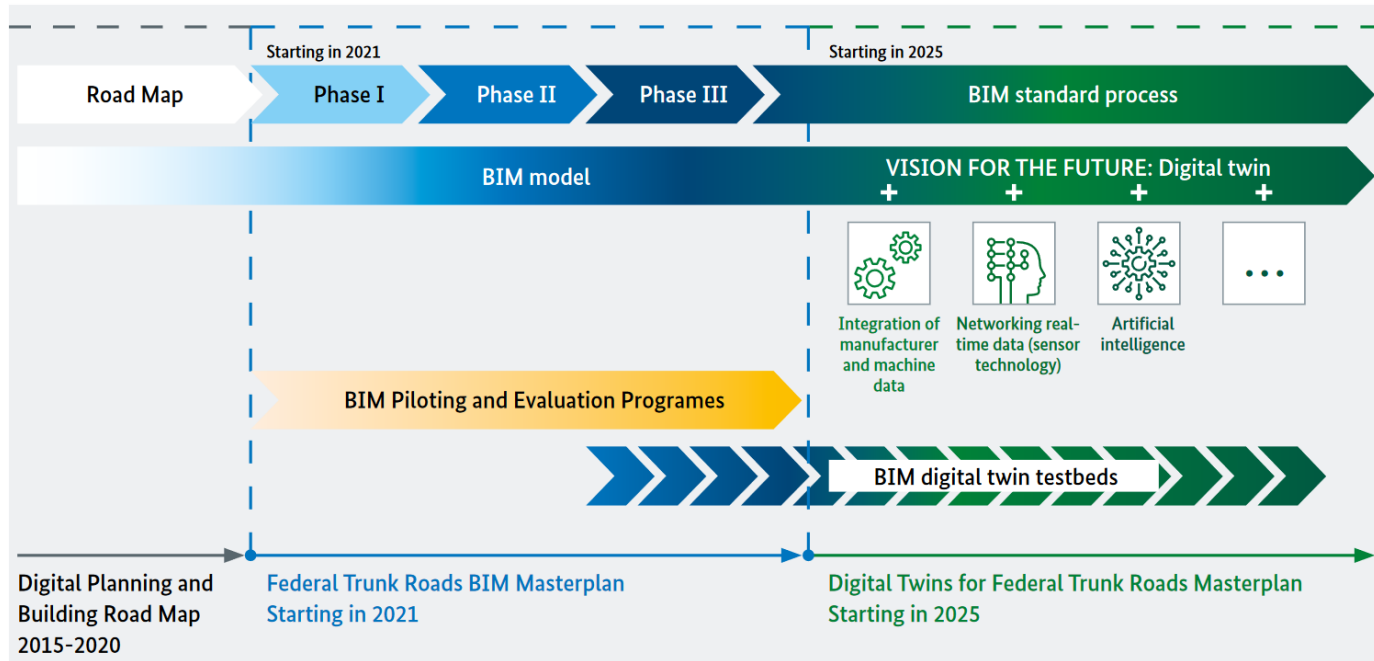
What will a digital twin look like?

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► The German approach....



Current situation

“The aim is to derive the digital developments and innovations required for the operational phase and, for example, to verify the possible combination of classic construction supervision and Internet of Things-driven construction and condition monitoring in an overall outline. The digital twins are built, tested, evaluated and evolved under real-world conditions. What is more, immense impetus for market development can be expected – i.e. dynamic research and development will be triggered. A nationwide masterplan for the establishment and operation of digital twins will be derived from the results of the BIM digital twin testbeds.”

- Federal Trunk Roads BIM Masterplan, BMDV



Current situation

- ▶ On the 13th and 14th of December the next meeting regarding the development of a „DT“-Masterplan is going to take place in Germany, on behalf of the BMDV
 - ▶ Defining: What actually is a „DT“?
 - ▶ What functionalities are mandatory?
 - ▶ What is the time frame for the implementation?



Current situation

- ▶ To tell the truth: Currently there is even no coherent, precise and comprehensive definition about.....
 - ▶ What is a digital twin?
 - ▶ What kind of functions does he have?
 - ▶ What procedures does he cover?
 - ▶ Who is going to work with it and how?



Current situation

- ▶ That said, we – as the tunnelling experts – need to make up our minds about...
 - ▶ How and to what extent does the implementation of DTs in the course of our safety procedures have an influence on safety itself?
 - ▶ What kind of procedures do we hand over or transfer to digital twins (and possibly an artificial intelligence)?
 - ▶ What are the legal, moral, ethical and technical threshold levels that should limit future developments (if there are any)?



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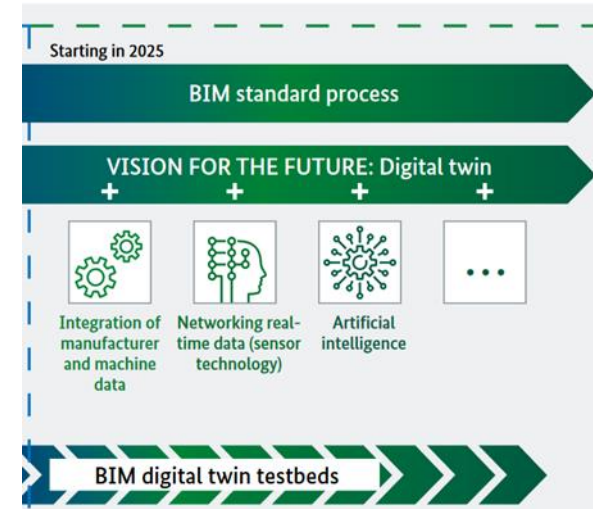
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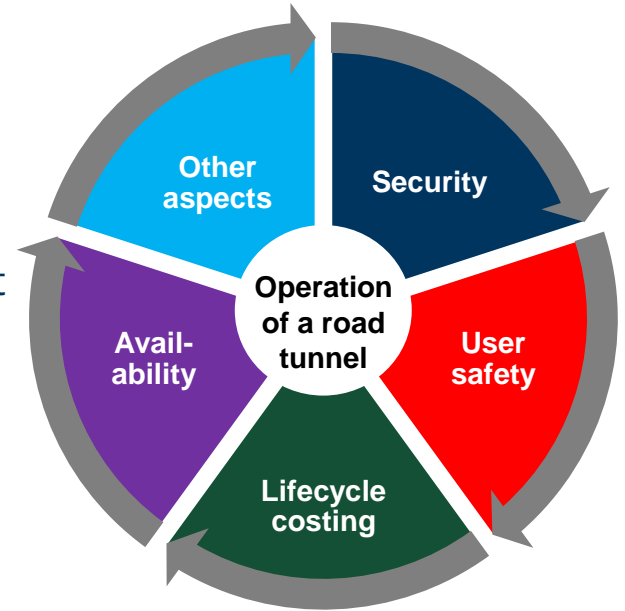
What will a DT look like?

- ▶ Basis for all works with a DT will probably be a BIM-related maintenance concept
- ▶ With such a model as the „backbone“ of the DT, procedures can be implemented such as:
 1. Predictive maintenance
 2. Lifecycle cost assessments
 3. Optimization of operation and availability
 4. Lifecycle management as a whole (combining 1., 2. and 3.)
 5. TBD



What will a DT look like?

- ▶ BIM has been developed and is currently mainly used as a tool for the planning and construction of buildings (e.g. tunnels)
- ▶ Some fundamental approaches to use building information modelling for the operation of buildings do exist but are not fully applicable for tunnels
- ▶ Up to know no digital model for the operation of tunnels (neither road nor rail) is commonly used, that incorporates the specifics of maintenance, repair and the different operational approaches (“normal” operation vs. “emergency” operation)
- ▶ First developments for instance in Germany (BASt)



What will a DT look like?

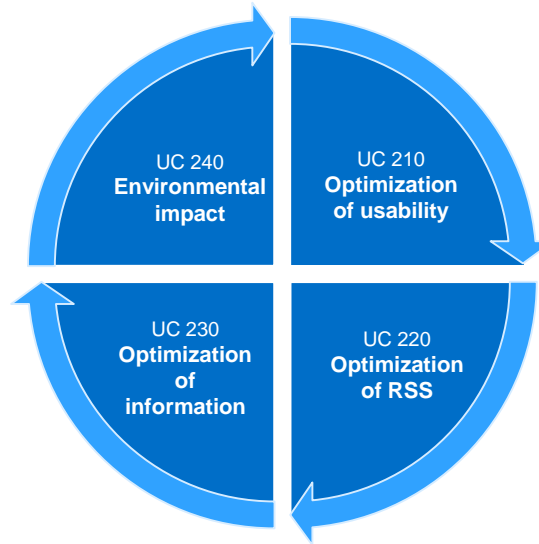
Defining Use Cases (UC)

Environment:

- Ecological impact of the tunnel
- Sustainability

Information:

- Information relevant for the maintenance of the building as well as all
- Localized information about



Usability:

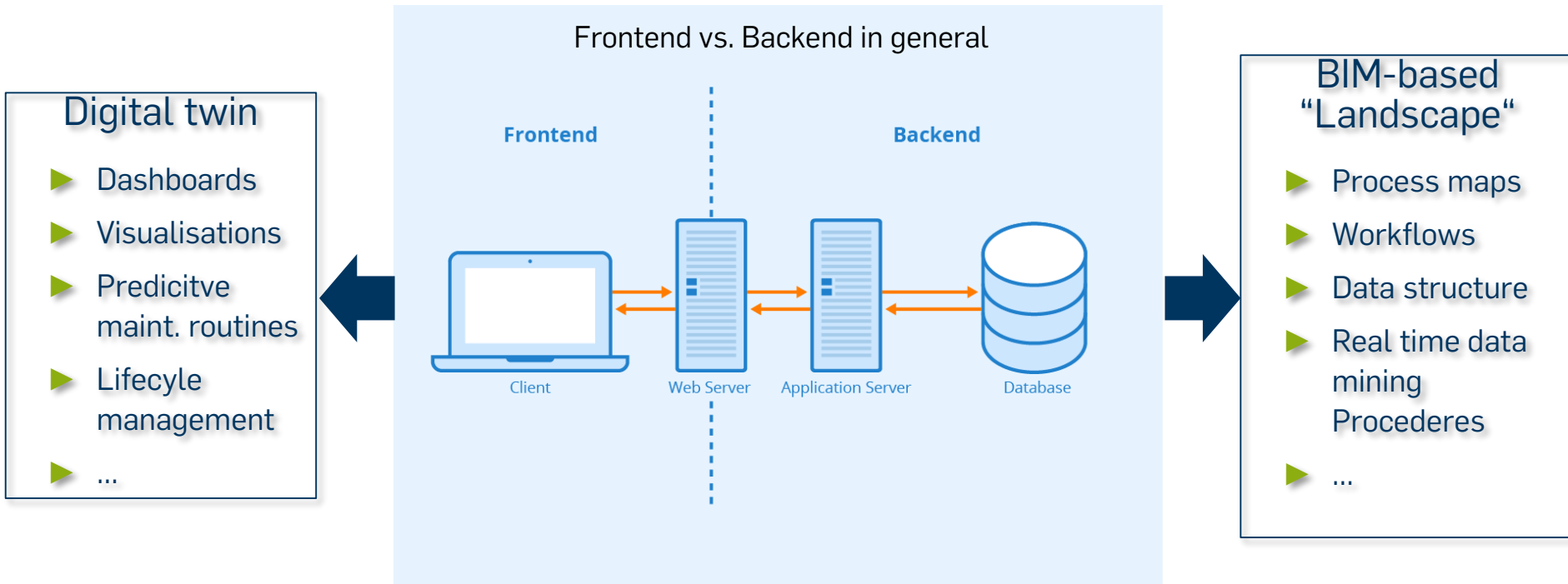
- Avoiding damages done by the tunnel users
- Availability of all safety systems
- Availability throughout the lifecycle of the building

Ressources:

- Optimized usage of RSS
- Usage of renewable energies

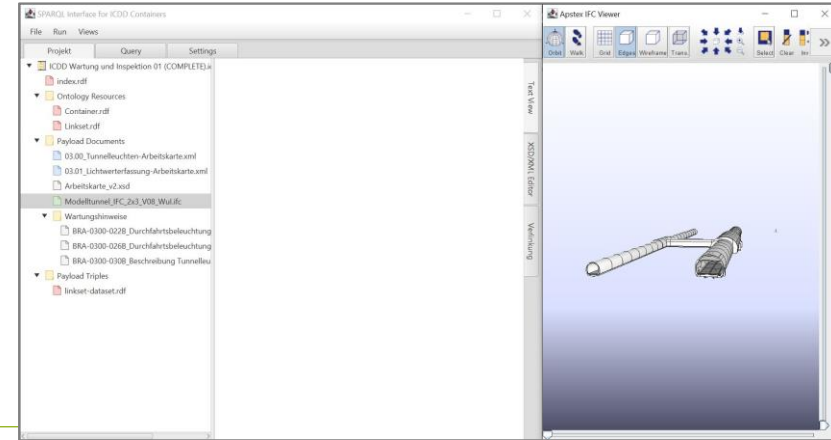
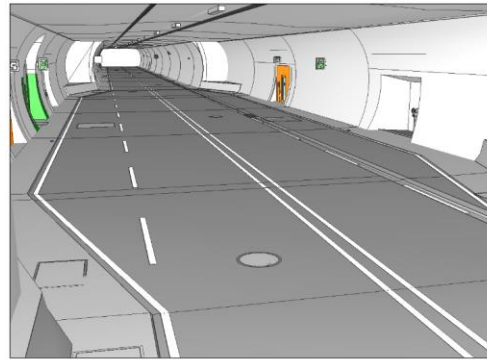
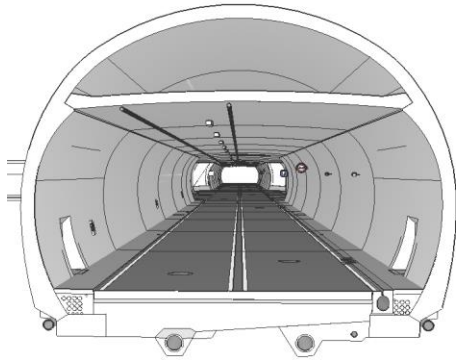


What will a DT look like?



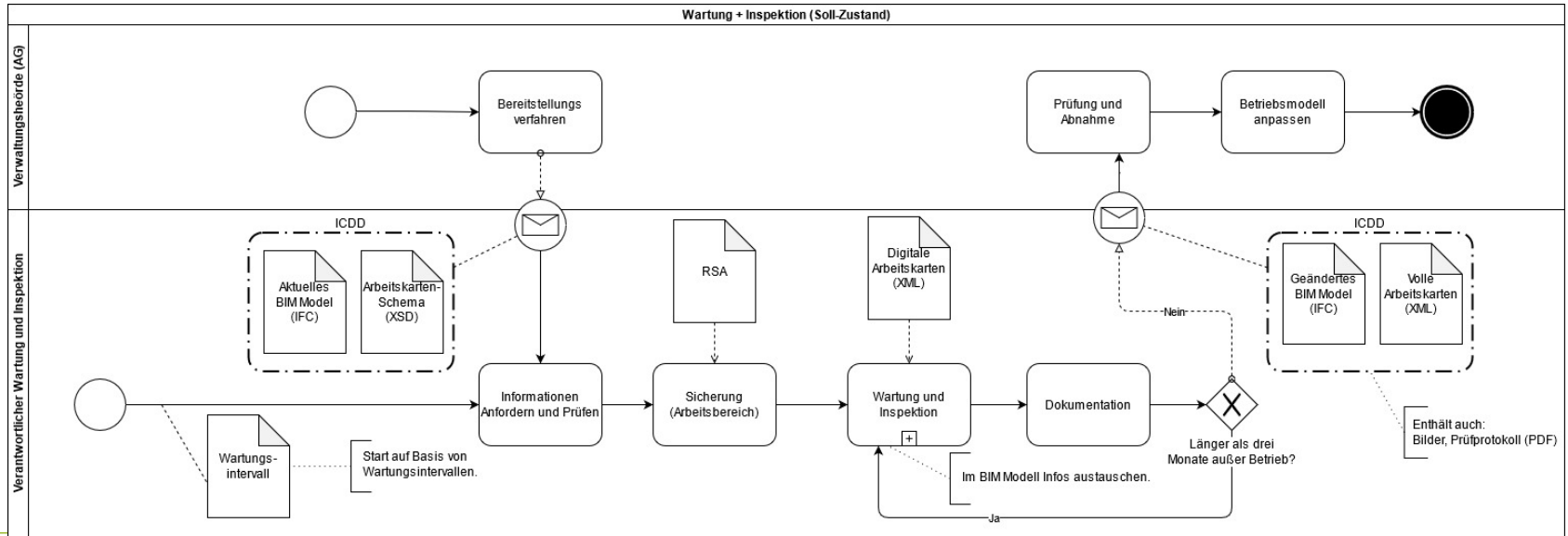
What will a DT look like?

- Visualisation (frontend) and data model (backend)



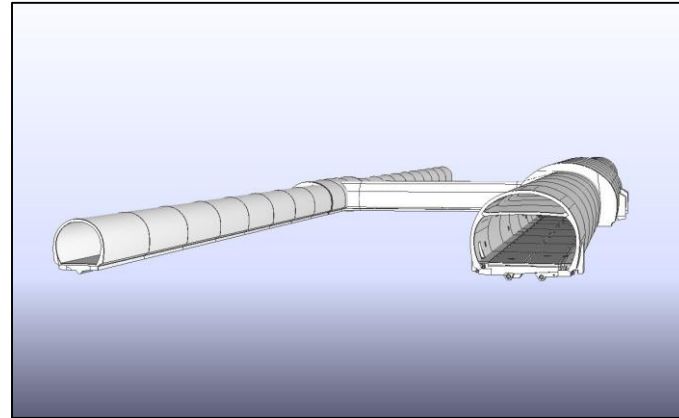
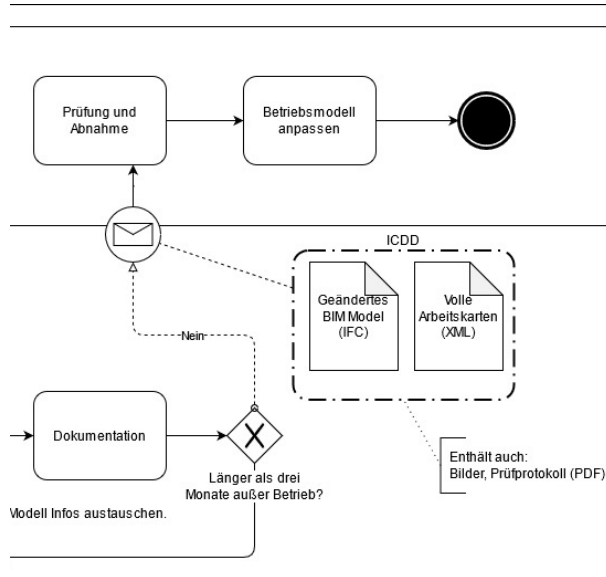
What will a DT look like?

- Process map “Maintenance and inspection” in the backend



What will a DT look like?

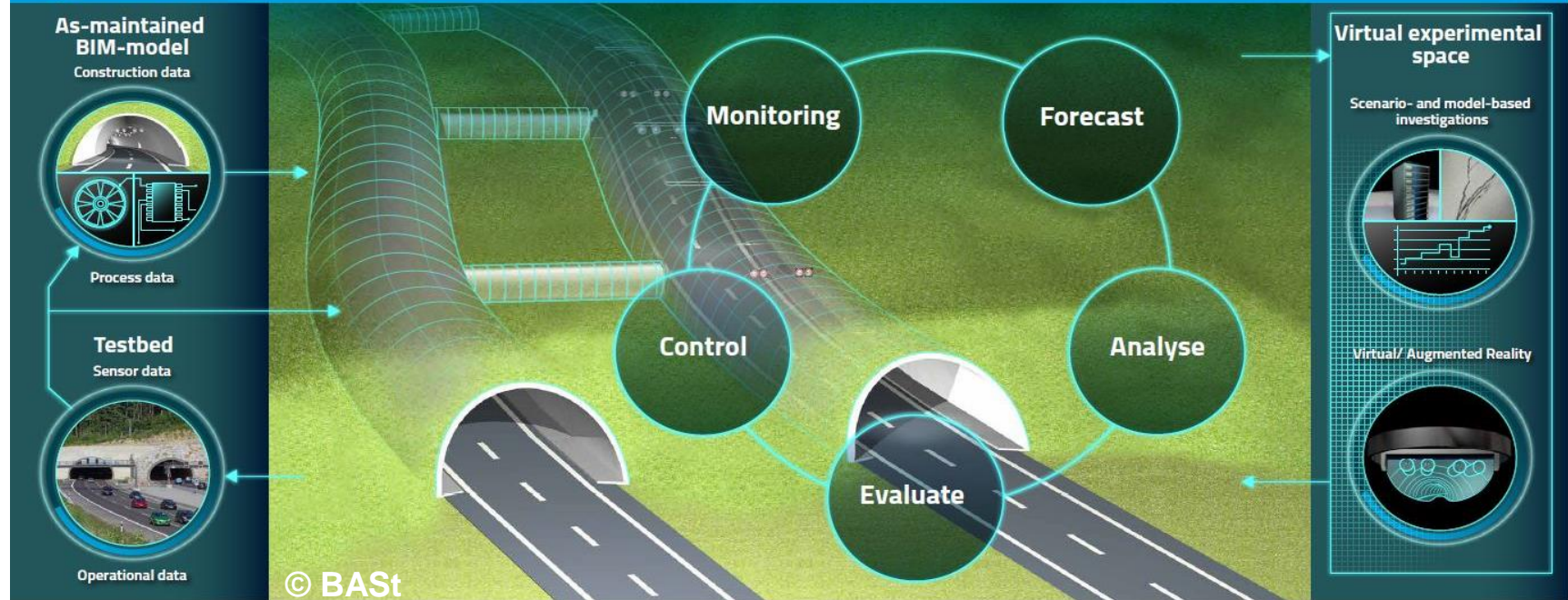
- ▶ Adapting operation model by „Administrative authority“



Data for the DT

What will a DT look like?

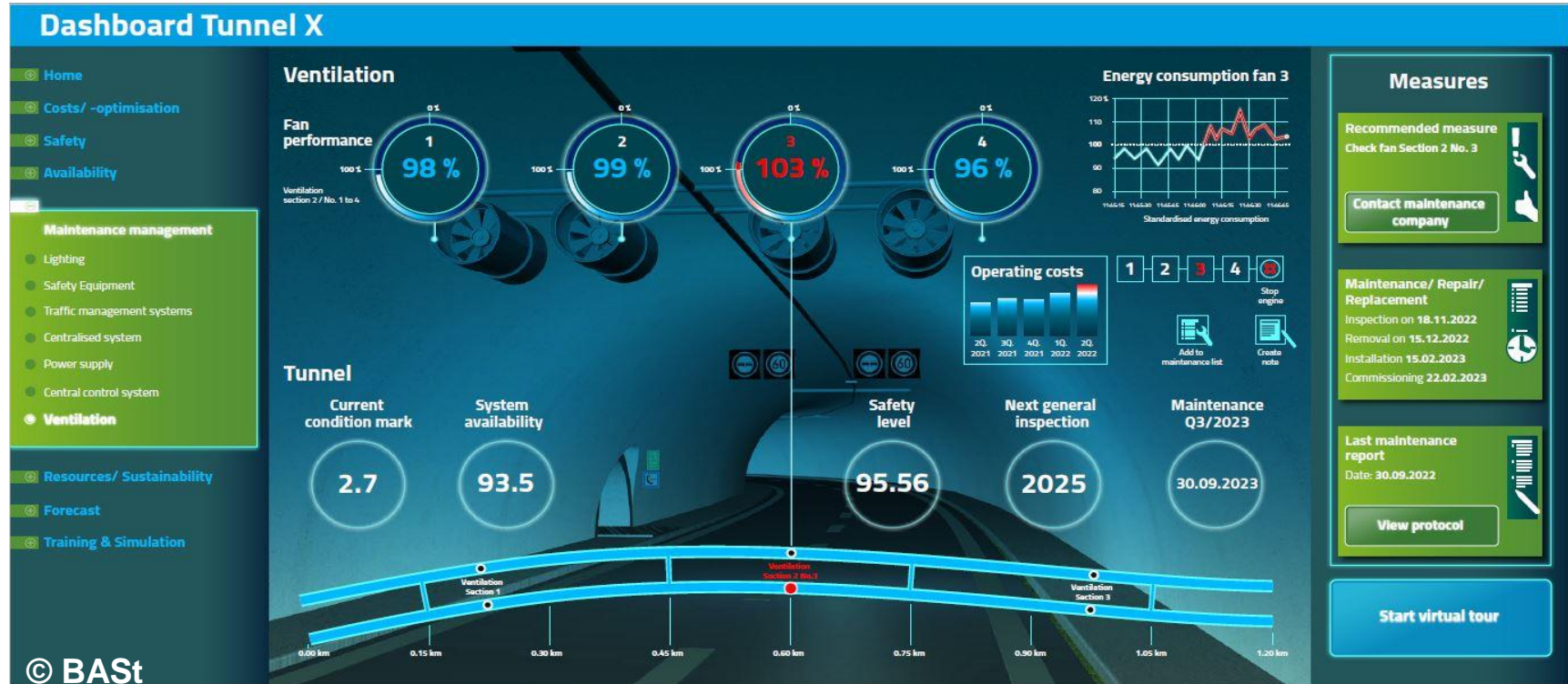
Life cycle management using digital twins



What will a DT look like?



What will a DT look like?



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What are benefits and risks?

► Benefits

- Better understanding and knowledge of your tunnel
- More control about costs
- Reduction of costs
- Higher availability (in theory)



What are benefits and risks?

► Risks

- We might “loose” our operation personel...
- We are combining classical procedures of inspection with the operation of the facility...
- We have to make sure, that every process that we hand over does not interfere with the user safety...



What are benefits and risks?

► Risks

- ▶ We might loose “the battle” with the bridge guys...
- ▶ We might loose coherence with the European directive...
- ▶ We might end up in “West world”...



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- ▶ We, as the tunnel experts, need to make up our minds about what – from our perspective – a DT of a tunnel should be, what kind of functionalities he should have and what his responsibilities are within the safety-architecture of a road (or rail) tunnel.
- ▶ We need to gain full control about the process going forward, emphasising the need of tunnel safety and its control
- ▶ And we need to start all of that right now....





Glück auf!

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