

THE VIRTUAL-REAL CONTINUUM FOR COLLABORATIVE EARTH ENGINEERING

The evolution of the natural environment is closely related to—and influenced by—human activities. During the last century, we experienced the power of continuous innovation and progress of technology, and the doors remain open for as-yet unexplored opportunities offered by our planet.

On the other hand, we have also become more conscious about the vulnerabilities of what we have achieved in the face of environmental changes occurring on Earth. Moreover, these environmental changes are happening alongside unprecedented population growth and socio-economic development.

We need to constantly push the limit of what's possible by asking:

- How can we better benefit from existing infrastructure to accommodate new functionalities or repurpose it to perform multiple functions?
- How can we take advantage of natural conditions, soil or rock mass properties, hydrogeology and thermodynamics to minimize the cost of lifecycle operations and maintenance?
- How can we minimize the logistical and processing costs of reusing and repurposing natural materials?
- How can we safely build in dense urban areas with minimal impact on day-to-day life?

Now comes the era in which we can accelerate our understanding of the complexities of the natural environment and the causal relationship with human activity. With more clarity into how decisions will play out, we can make better-informed choices about the future.

This acceleration is propelled by new technologies enabling end-to-end, multi-stakeholder, concurrent workflows. This collaborative network incorporates cutting-edge solutions in IoT data capture, 3D-empowered rich semantic modelling, multi-scale and multi-physics simulation and automated reconciliation of the virtual twin against real world observations.

The creation of the end-to-end, virtual-real continuum is particularly important for Earth science and engineering. We need real-world validation to refine and enhance our knowledge of the planet and optimize our human footprint accordingly.

Some feedback is significant only over a long time span—many effects make sense only on a scale well beyond an individual project. Often, the mechanisms or patterns can only be captured on the crossroads of several disciplines with big data. Consequently, collaboration is at the heart of this endeavor.

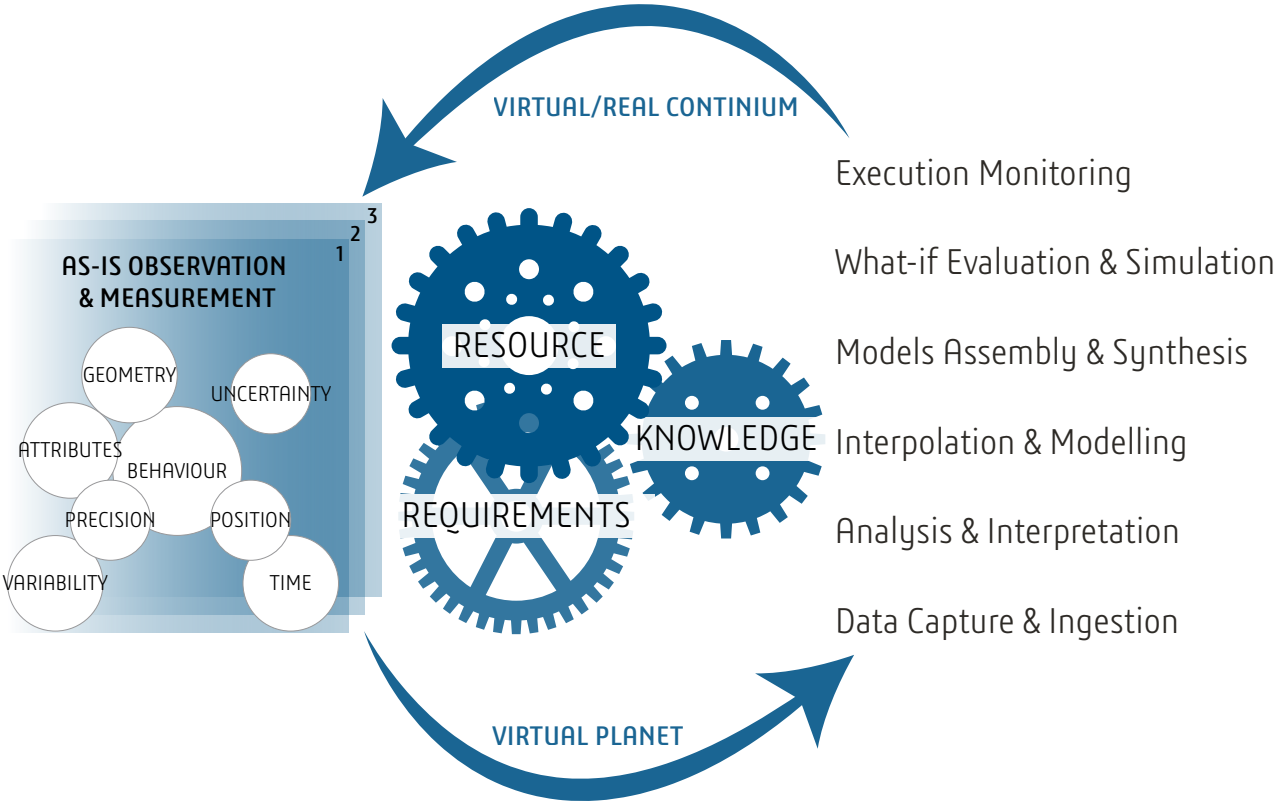
Information needs to be unlocked from spatial, temporal, disciplinary and process silos to create a virtual twin with retrospective learning capabilities based on real-world observations and measurements. Information also needs to provide *visible uncertainty*—in terms of operation bias, natural variability, interpretative logic hypothesis, and numerical precision—to reveal the unknown to non-experts. The capturing, transmission and transformation of this information should be traceable to improve transparency and facilitate the reuse of knowledge.

Imagine if all the information we capture from commonplace excavations, equipment, probing or survey instrumentation, plus all the intelligence from high-precision or large-scale imagery, can stream into a single data lake. The earth could be analyzed along various socio-economic themes such as housing, business, transportation, manufacturing, water supply, waste management and more.

Continuous analysis and diagnosis can reflect early warning signs and trigger preventive adjustments to our actions at the individual level. Each diagnostic component can be linked through time and space to reveal the causal relationship at various scales, benefiting from worldwide multi-disciplinary expertise.

Imagine that at each major decision gate about where and how to make our next footprint on the planet, each stakeholder, expert or not, can easily obtain an in-depth understanding of the what-if scenarios. And this with full consciousness of the underlying uncertainty.

Imagine that each crack or millimeter of deformation in a tunnel lining, or each water infiltration through the tunnel, can help to optimize maintenance costs, inform a predictive maintenance plan and operational schedule, and improve simulation models. Imagine these models are available not only to engineering consultancies for this tunnel, but also for all other structures under similar ground conditions, in use or in inception. Such collaborations can also help identify previously overlooked risks by infrastructure owners or



developers, and can inform regulatory authorities to shape better practices and improve the normative and planning frameworks.

What if you could have a complete range of technologies federated in a single source of truth that can be used to continuously refine our understanding of the earth in a holistic and comprehensive way?

All these scenarios are becoming a reality thanks to the silos of information, knowledge and technology breaking down.

The **3D**EXPERIENCE platform from Dassault Systèmes can reveal how the earth and human activities interact by encapsulating information from exploration, modeling, and simulation and providing a Virtual-Real validation feedback loop.

Our **3D**EXPERIENCE® platform powers our brand applications, serving 12 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3D**EXPERIENCE® Company, provides business and people with virtual universes to imagine sustainable innovations. Its world-leading solutions transform the way products are designed, produced, and supported. Dassault Systèmes' collaborative solutions foster social innovation, expanding possibilities for the virtual world to improve the real world. The group brings value to over 210,000 customers of all sizes in all industries in more than 140 countries. For more information, visit **www.3ds.com**.

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