

# Modelling Realism in Digital Twins: Issues and Solutions for Interoperable Manufacture

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This workshop involved around 20 participants drawn from both industry and academia with the key objective of advancing the understanding of the key issues and possible future solutions to fully exploit the potential value of digital twins, whether that be towards improved product development, more efficient production systems or more effective enterprise network interoperability.

The workshop was structured in 2 parts with the first part being focused on four short presentations, provided as stimulus for the subsequent discussion in the second part of the workshop. The four presentations were based on the papers published in this section of the proceedings. Interestingly, while all the presentations focused on the same overall problem, they each provided quite different perspectives on the problem, although raising similar issues and provided a range of points concerning subsequent potential solution paths.

During the second part of the workshop the issues and solution paths raised in the presentations were discussed and extended. A summary of the main resulting issues, structured into technical and business issues, along with design solution paths drawn from the workshop are listed below.

## 1. What are the issues that prevent DTs from being interoperable – within themselves and with other DTs?

### 1.1. Technical issues

- How to decompose a DT environment
- Bridging knowledge chasms – range of different contexts
- Managing multi-purpose platforms – e.g. maintenance and design departments have different requirements
- Data reliability
- Managing complexity as we move to more realistic digital twins
- Mismatches in syntactic, semantics and pragmatics across systems
- Potential lack of regulation e.g. Smart Cities and the need for open source data
- Standard development methods to support digital twin interoperability

### 1.2. Business issues

- Cost/benefit issues in building/exploiting (interoperable) digital twins and how can they be minimised/maximised
- Managing security, trust and IP
- Vendor neutral information management across interconnected proprietary systems – technical and commercial software has developed separately
- Understanding different business perspectives such as OEM versus tier 1 supplier

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**2. In what ways should DTs be designed to be interoperable with other DTs and with other systems?**

***2.1. Understand and define the features they should possess***

- A numerical model of the 'real' twin where there is synchronisation between the two
- The intelligent linking of a digital master with a digital shadow with bidirectional interaction between the real twin and the digital twin
- A DT must include sufficient analyses to predict the behaviour of the physical twin that can thereby enable responsive decisions to be taken to enhance the physical twin's performance.

***2.2. How should a DT environment structure be defined?***

- A vertical, layered, hierarchy building from some component DT plus some associative composition coupling multiple enterprise DTs into supply chain DTs
- Specific ontologies covering behaviour, reaction times, laws, business indicators as well as product information need to be correlated across different sources
- Evolution from heterogeneous to well-structured data content in business networks by exploiting formally defined digital twins in hyperconnected ecosystems
- Achieve vendor neutral information management across interconnected proprietary systems using directive driven approaches to manage data chasms
- Build and exploit standards to develop an Internet of digital twins.