Representing Digital Twins and their information resources with WoT

Ontology Engineering Group,
Universidad Politécnica de Madrid

Salvador González Gerpe, Andrea Cimmino, Socorro Bernardos,
Raúl García-Castro, María Poveda-Villalón

salvador.gonzalez.gerpe@upm.es

16/06/2023

COCITO

SUSTAINABLE PLACES
What are Digital Twins?

Physical entity

Real-world actions

Bi-directional information flow

Virtual entity

Simulations
What are Digital Twins?

Physical entity

Virtual entity

Real-world actions

Simulations

Bi-directional information flow
COGITO Project

COConstruction-phase diGiital Twin mOdel

Project Partners

Testlab - Austria

Pilot Site I - Denmark

Pilot Site II - Spain

www.cogito-project.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958310.
COGITO Project

Reality capture tools:
- Satellite images
- 3D scanning & photogrammetry
- Unmanned Aerial Vehicles
- Devices and Sensors
- Weather forecasts

Data pre-processing:
- 3D geometry
- Activities scheduling
- Budget and Costs

Construction Phase Digital Twin Platform

Digital Twin Applications:
- Health & Safety
- Quality Control
- Adaptive Workflow Mgmt
- GUI & support Apps

As-planned data

OPEN STANDARDS:
- W3C Semantic Web
- W3C OWL
- W3C RDF
- ETSI
- SAREF
- BOT
- BRICK
- WEB OF THINGS

Sustainable Places 2023
<table>
<thead>
<tr>
<th>Layer</th>
<th>Digital Twin</th>
<th>Semantic Digital Twin</th>
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<tbody>
<tr>
<td>Services Layer</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>Data Layer</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>Physical Entity Layer</td>
<td>✔️</td>
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<tr>
<td>Virtual Entity Layer</td>
<td>✔️</td>
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<tr>
<td>Connections Layer</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Semantic Interoperability</td>
<td>❌</td>
<td>✔️</td>
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<tr>
<td>Discovery Layer</td>
<td>❌</td>
<td>✔️</td>
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<td>Provenance Layer</td>
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Data distribution in COGITO Semantic Digital Twin

Triplestore DB (Semantically Linked Data; RDF)

Relational DB (Project Data)
Key-Value DB (IFC Data)
Timeseries DB (IoT Data)

BIM Data Post-processing Services
Extraction, Transformation & Loading Services
Data Management Services
Semantic Interoperability in Digital Twins

Ontology:
- Services
- Data
- Virtual Entity
- Physical Entity
- Connections

Semantic Model:
- Provenance

Data Harmonization:
- Heterogeneous Data
- Homogeneous Data

Data Enrichment:
- RDF

Heterogeneous Data

Homogeneous Data
COGITO ontologies classes described as Digital Twins
COGITO ontologies classes described as Digital Twins

COGITO Ontologies

- Facility
- Resources
- Process
- Quality
- Safety
- IoT

facility:Project
facility:Element

Digital Twin

platform:DigitalTwin

facility:Project
facility:Element
COGITO Platform Ontology
COGITO Semantic Digital Twin backbone based on WoT

Triplestore DB
(Semantically Linked Data; RDF)

WEB OF THINGS

Relational DB (Project Data)
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COGITO Semantic Digital Twin backbone based on WoT

Query

Discovery

Semantic DT Components

WoTHive

RDF

TD

RAW
Conclusions

- Digital Twins have **lots of data** and has **to be handled**.

- The development of a **Semantic Digital Twin** allows the management of all data to be **semantically interoperable**.

- In order to **not lose the heterogeneous data** belonging to the main entities described as Digital Twins, a **WoT-based backbone** has been developed, allowing the **maintenance of the provenance** belonging to **all the data** of the defined Digital Twin.

- In addition, thanks to the **WoT layer** given by the Thing Descriptions, **discovery** can be performed in order to **obtain all the information concerning a particular Digital Twin** in a more straightforward form.