Smart Building Services Using Bosch Building Ontologies and Digital Twins

10th Linked Data Architecture and Construction Workshop
May 29, 2022
Agenda

01// Background
02// Bosch Building Ontology Central
03// HVAC Performance Analyzer Cockpit
04// Insight Models
05// Outlook
Background
Building in Operation Stage

**Climatec Building, Phoenix USA**
- 678 Datapoints
- >50,000 Events per day

**Equipment**
- 6 AHUs
- 74 VAVs
- 1 Chiller
- 2 Chilled Water Plants
- 3 Cooling Towers
- 2 Water Pumps
- 75 Zones

**Office Space**

**HVAC systems**
Background

Current Software Solution
Background

High Data Complexity

Data points tagged during system setup and configuration

On a system by system manual labor intensive task

Requires highly skilled domain field expertise
Digital Twin Context
Semantic Models

HVAC Ontology
Space Ontology

HVAC Topology
Space Topology

HVAC System
Office Space
Semantic Models

HVAC Ontology
Space Ontology

Digital Twin

HVAC Topology
Space Topology

HVAC System
Office Space
Takeaway

The power of standardized ontologies result in modularity and reuse

- University
- Office
- Hospital

Standardized Ontologies
Different Topologies
Different Space Types
Bosch Building Technologies Ontology Central

Open-Source Ontologies

Foundation

HVAC Systems

Fire Alarm System

Explore our ontologies on GitHub: https://github.com/boschglobal/building-technologies-ontology-central
Space package in DTDL

-space package in OWL

Digital Twin

Zone

Asset

Site

Building

Storey

Space

<Classes>
Site=bot:Site
Building=bot:Building
Storey=bot:Storey
Space=bot:Space
Asset rdfs:subClassOf bot:Element

<Relationship>
Building::isPartOf=bot:hasBuilding
Storey::isPartOf=bot:hasStorey
Space::isPartOf=bot:hasSpace
Asset:locatedIn=bot:hasElement

More information about BOT Mapping on Bosch Ontology Central

The RDF-Version of Foundation will be made public soon!

DTDL= Digital Twin Definition Language; OWL= Web Ontology Language
HVAC Performance Analyzer Cockpit
HVAC Performance Analyzer Cockpit
A live walk-through

- Ontology Management Services
- Building Digital Twins
- HVAC Performance Analyzer
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Insight Models
Insight Models

Overview

Identified more than 100 Insight Models

Growing Everyday!
Does the AHU coil work properly?

The supply air temperature should be within +/-4 °F of the setpoint, when the air is delivered into the zone.

Insight Models
Overview

Expert

Insight Model

1. Query graph (ADT)
2. Query Time Series (ADX)
3. Patch the twins for insight

Not transparent enough for operators
Labor intensive and time-consuming
Tailor-made solution only

Transparent system perspectives
Proactive, predictive and prescriptive
Transferability
Summary and Outlook

**Take-aways**
- **Open-source ontologies** and Building Digital Twins are the key elements to support an open building ecosystems
- **One digital representation** of the building and system in the operation phase for **all services among buildings**
- **Third parties** can implement and integrate **their own services** with their own models based on the foundation ontology

**Outlook**
- Connections between ADT and RDF world
- Semantic-assisted predictive control services for the HVAC system using RDF technology
Thank You!

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