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Ontologies in the Construction and Real Estate Sectors

Part 2 – Ontologies in Practice

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Part 2 – Ontologies in Practice

There is a lot of talk about ontologies, but what are they really? What benefits can they create? How can they contribute to making buildings smarter and more sustainable? In this second article, we discuss ontologies and how they can be used in practice. This time, Rafael Gómez García from RISE has contributed his expertise and provides clear examples of the differences and advantages between traditional and ontology-based approaches.

Introduction

Today's digital buildings generate vast amounts of data: temperature and humidity levels in different rooms, energy consumption, airflow, alarms, and more. However, when all this data is managed in separate systems — each with its own names and formats — it becomes difficult to get a clear overview. As a facility manager, you may need to spend significant time manually linking data, adjusting settings, and troubleshooting, rather than being able to quickly adapt the building's functions to changing needs. Additionally, many of these systems rely on proprietary solutions and tools, making it even more difficult to switch providers or upgrade existing solutions in the future.

From Fragmented Data to Meaningful Concepts

Imagine a scenario where you have just installed new sensors in two of your conference rooms (Room A and Room B) to measure temperature. You want the building's HVAC system (heating, ventilation, and cooling) to automatically activate if the temperature in any of these conference rooms exceeds a certain threshold **T** for more than **M** minutes. This allows you to quickly cool down the room if it gets too warm.

With Traditional Systems and Methods

To achieve this in an older, traditional control system, you must manually specify sensor IDs, describe how each room is linked to its sensors, and set threshold values and time limits — potentially for each individual sensor. Additionally, these processes are often tied to vendor-specific software and data formats. This means that if you later want to switch providers or upgrade within the same provider's product family, you may need to redo the entire integration process from scratch. This is time-consuming, requires detailed knowledge, and increases the risk of errors.

To illustrate a typical scenario more clearly, **Figure 1** below shows a building with different systems and sensors. A single sensor, such as the one in Room A, is referred to differently by different systems (e.g., "TEMP_A" in one building system and "TS-RA" in another).

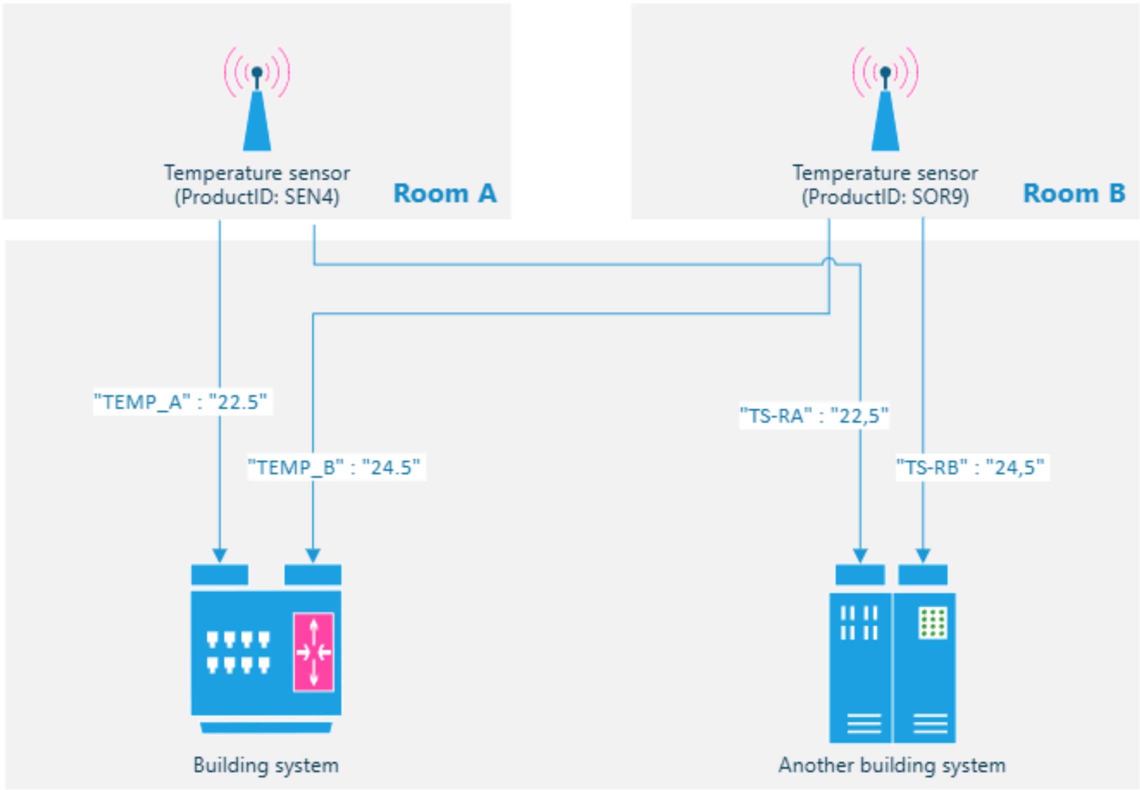

Figure 1 - The image above illustrates a building with various systems and sensors. A single sensor, such as the one in Room A, is referred to differently in different systems (e.g., "TEMP_A" in one system and "TS-RA" in another).

Ontology-Based Approach

This is where ontologies can help. An ontology functions as a shared vocabulary that defines how different parts of your building relate to one another. When you use an ontology to describe your rooms and sensors, you create a **semantic model**. This model makes it explicitly clear that "Room A" is a "Conference Room" and that its "Temperature Sensor" is precisely that — a temperature sensor, rather than just an arbitrary ID.

Through the ontology, the system not only recognizes the existence of a sensor but also understands what type of sensor it is, that it belongs to a conference room, and that there are rules for managing the room's climate. The data becomes meaningful and structured, rather than just a collection of sensor IDs and raw values.

Figure 2 below provides a high-level illustration of how ontology-based information management can work. The same building from **Figure 1** now has a central component — usually a **data platform** — that uses a semantic model. This model, built on an ontology, maps out rooms, sensors, and systems, serving as a reliable information source for various applications and systems.

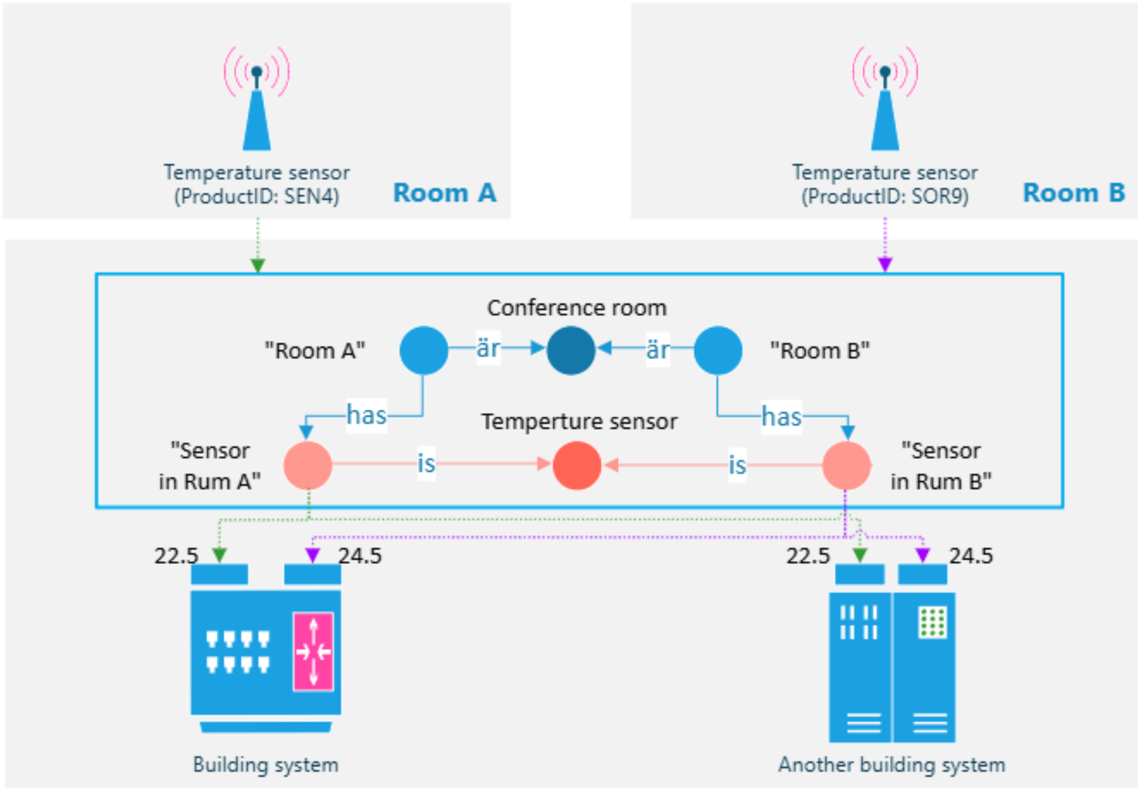

Figure 2 - The image above shows the same building as in Figure 1 but now with a central component that manages a semantic model of the building — created using an ontology. This semantic model describes rooms, sensors, and systems and acts as a central, reliable source of information for other systems and applications.

Ontologies and Data Platforms for Scalability

When the building is described using an ontology, a central **data platform** can receive real-time sensor data and interpret it through the semantic model. When a sensor reports a high temperature, the platform understands that the sensor is located in a conference room governed by specific rules.

It is then sufficient to define a **simple, declarative rule**:

> If a conference room has a temperature above T for more than M minutes, activate HVAC.

Compared to programming each sensor and room individually (a more **procedural approach**), ontologies and semantic modelling offer a **declarative approach** — you describe **what** should be achieved, not **how** each detail should be handled. The central data platform, which understands the ontology, can then automatically determine which sensors and rooms are relevant and act accordingly.

This might seem straightforward in a small-scale example with three or four rooms, but consider how this scales in larger buildings or across an entire portfolio of properties.

When dealing with hundreds of rooms, multiple floors, and numerous sensor types, the traditional approach quickly becomes unmanageable. An ontology-based, semantic model allows you to **easily add new rooms, adjust threshold values, and modify rules without having to reconfigure everything manually**.

Practical Benefits

Fundamental Advantages

To further clarify the differences, the table below compares the traditional and ontology-based approaches using our example scenario — a simple case, but one that illustrates principles applicable on a much larger scale.

Aspect	**Traditional Approach**	**Ontology-Based Approach**
Integration	For each new sensor in a conference room, you must manually enter sensor IDs, link them to the correct room, and configure thresholds — often in proprietary formats.	Add the sensor to the ontology and mark the room as a "Conference Room." The rules apply automatically — no need for manual adjustments per sensor.
Flexibility	Changing threshold values **T** and **M** requires manually updating each sensor's settings, which can take hours.	Adjust **T** and **M** once. The platform, understanding the ontology, updates all conference rooms automatically. This reduces hours of work to just minutes.
Comprehension	You are met with cryptic identifiers and internal codes. To determine which sensor belongs to which room, you may need documentation or vendor assistance.	The semantic model makes relationships explicit: "This is a temperature sensor in Conference Room B." No guessing required.
Scalability	As the number of rooms and sensors increases, complexity explodes. Managing everything manually quickly becomes unsustainable.	Whether you have 3, 30, or 300 conference rooms, the same rule applies. New rooms are added to the ontology and seamlessly integrated.
Quick Decision-Making	To determine whether a room has been too hot for too long, you must manually search the system, interpret identifiers, and compare timestamps.	Ask the platform: "Which conference rooms have exceeded T for more than M minutes?" You receive an immediate answer and can take action without wasting time.

Table 1 – Comparison between traditional and ontology-based approaches

Enabling More Advanced Applications

The simple example of temperature regulation illustrates the core principle, but the potential extends far beyond this. When an ontology is used to create a **semantic model** of the building, you gain a **unified, shared representation of building data and structure**.

This model serves as a **central, reliable source of information** for all services and applications — whether they are built into the platform or developed by third parties.

For service and application providers, this offers several benefits:

- **Simplified development:** Services can be designed to work with a standardized model rather than needing to be customized for each unique system.
- **Cost efficiency:** Solutions can be reused across different buildings and projects, since they all rely on the same ontology-based foundation.
- **Faster integration:** New services can connect to the building's data without requiring manual mapping or translation between different data formats, as everything is already semantically described.
- **Freedom of choice:** Open ontologies give both property owners and service providers greater flexibility to select and combine solutions from different vendors over time.

Beyond applications for **building operations** — such as **predictive maintenance, energy management, and indoor climate optimization** — the **semantic model also facilitates integration with other systems**, such as:

- **Facility Management:** Integration with property management databases and tools ensures a holistic overview of both operations and long-term maintenance.
- **Finance:** Energy consumption and maintenance cost analysis can be linked to **financial planning tools** for better forecasting.
- **Strategic and Business Planning:** Data from and about the building can be connected to broader **organizational goals**, such as **optimized space utilization** or **sustainability targets like climate neutrality**.

By using a **shared semantic model**, **data silos and fragmented solutions are eliminated**. Instead, an **integrated environment** is created where **all systems and applications** can leverage the **same data foundation**, reinforcing the building's role as an integral part of an organization's overall **strategy and objectives**.

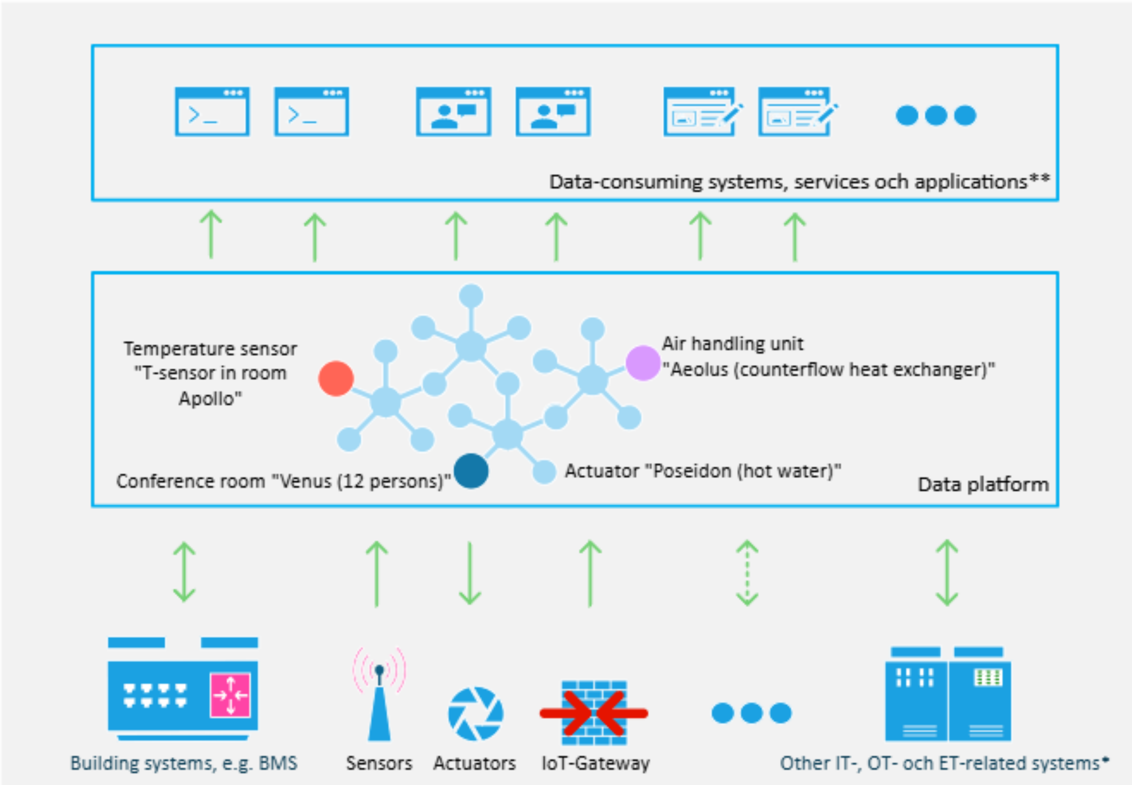

Figure 3 - The image above shows the same building as in previous figures, its underlying building systems and other units, as well as its semantic model in the centre, represented as a standardized information source. The 'overlying' systems, services, and applications consume data from the common foundation that the semantic model constitutes. [Information Technologies (IT), Operational Technologies (OT), Engineering Technologies (ET)] [** More or less advanced]*

Summary

By using a small, concrete scenario, we hope to illustrate how **ontologies and a semantic model make building data more structured and actionable**. Instead of struggling with IDs, fragmented formats, and manual configurations, you can **describe building components declaratively** — their relationships, attributes, and rules.

As buildings become larger and more complex, this approach becomes even more valuable. A **shared semantic model** provides a **consistent view** of the building that can be utilized across applications — not just for building operations but also for **facility management, financial analysis, and strategic planning**. By embracing **open standards**, you also **reduce vendor lock-in**, ensuring greater **flexibility and long-term adaptability**.

Are you technically inclined or eager to learn more? Then read the **Technical Appendix** to Part 2.