Poster: Relative Relationship ODP: Scaling Case

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Abstract. This research describes a proposed case study utilizing the Dynamic Relative Relationship (RR) Pattern. This poster is aimed at those interested in Linked Open Data (LOD) and Decision Support (DS) integration, ODP translations and mappings, and/or Building Information Management (BIM). Specifically, it is an ontology design pattern for dynamically conceptualizing, establishing, tracking, and updating relative relationships and dependencies between entities (real or representational) of a physical, temporal, and/or importance scope; it is potentially an intermediate step for facilitating data transitions between LOD and DS Frameworks. We present an RR pattern use case from the BIM domain showing how a translation between two building models with different physical scales and different geometric coordinate systems are given foundation relative to one another for data/schema interoperability.

1 Introduction & Motivation

As professionals continue to answer increasingly complex questions with more than two decision criteria, the more demands are added into the Multi-Criteria Analysis Decision Support (DS) Tools that process data for answers. This level of DS requires integrations of data from distributed sources to be pre-structured via consumable Linked Open Data methods. Our research group is involved with building simulation technologies, their data semantics, and techniques to improve interoperability [5]. Currently in the building professions, tools rely on secular data schemas each with their own set of semantics making it difficult to know which tools are the most accurate. In order to compare and integrate the plethora of data available to each of these separate tools, we need methodologies for integrating sets of data from a variety of ontological structures, the ability to swap between different data schemas such as Building Information Modeling (BIM/IFC) [1], and for capturing the relationship between two entities.

Data interoperability via translation automation mean building models could be mapped to a common schema allowing simulations across platforms without laborious and often ineffective intervention; thus, we developed the Dynamic Relative Relationship (RR) Pattern that provides this functionality. In a larger scope, previously incomparable entities now have a foundation from which to be related via any type of relationship. Thus, we can now effectively handle, rank, and structure data over distributed data access points, potentially allowing data to be computationally constructed, enabling more powerful inferences, and reaching more accurate predictions. This paper describes the core RR Pattern, gives an example Physical Scale translation instance between two buildings, and discusses some of the overall implications. For additional details and examples beyond that provided, please see the WOP 2015 full research paper entitled, "An Ontology Design Pattern for Dynamic Relative Relationships."

2 Core Pattern for Dynamic Relative Relationships

Currently, the gap between Linked Open Data and DS Systems is problematic, especially when there are more than two decision criteria and domain specific applications (city planning, geospatial, engineering, architectural) that need to consume distributed data sources exposed using Linked Open Data principles. Patterns capable of computationally (and eventually automatically) interconnecting data, concepts, and methods are required to relate entities across a variety of domains as well as track changes and dependencies over time; below we discuss one possible use for building model interoperability. Additionally, there is the challenge of automatically integrating [6] newly discovered intelligent data sets [2] into tools in real-time to enhance DS Systems [4].

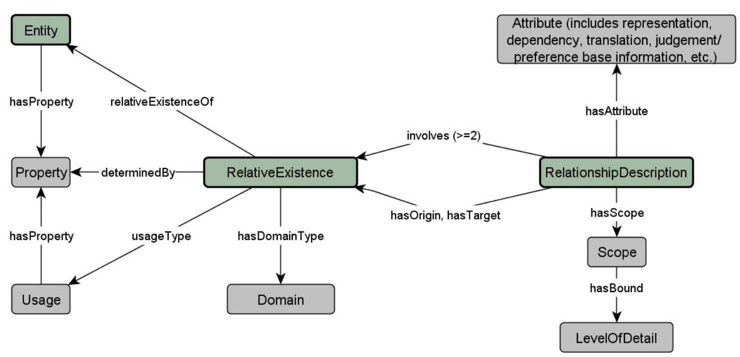

Fig. 1. Dynamic Relative Relationship Core Pattern.

The RR Pattern [Figure 1] can record physical, temporal, informational, idealistic, and other data/entity relationships and dependencies; it essentially creates a framework a relationship between any two entities. Instances require an origin and target entity, representations of those two entities, and the relationship description that links them together. The pattern provides data hooks that allow dynamic updating of linked data as changes occur in preference systems, scaling systems, or temporal parameters. The goal of the RR Pattern is to provide a way to create instances, link them together for updatability, and use them to automatically integrate several types of ontologies or patterns [3], [7]. The situation-based objectives for the example explored in the next section are solved in the context of the RR Pattern [Figure 1]. In particular, the example demonstrates a translation and links two separate scaling systems-or geometric relationships. *Scale* itself is the definition of the impact or perception of one entity relative to another, making it a specialized *relative relationship*.

3 Example Use Case for Describing Physical Scales

At a basic level, the RR Pattern [Figure 1] is meant to answer "How does one entity compare to another? Within the Construction Industry alone there are any number of data integration challenges that can be ameliorated by using the RR Pattern. For example, if a client has several houses proposed for construction with computational models existing in different data formats (suppose one model is a CAD File and one is an IFC file) and they need to be processed through a common application to test building footprint areas against available space on potential building sites, there will need to be a way to integrate these file types [Figure 2]. To comprehensively synthesize these pieces together that are not otherwise directly comparable, we need a mechanism such as the RR Pattern that records and maintains how the data in these two models relate, so this problem tractable over different semantic contexts and distributed sources [Figure 3].

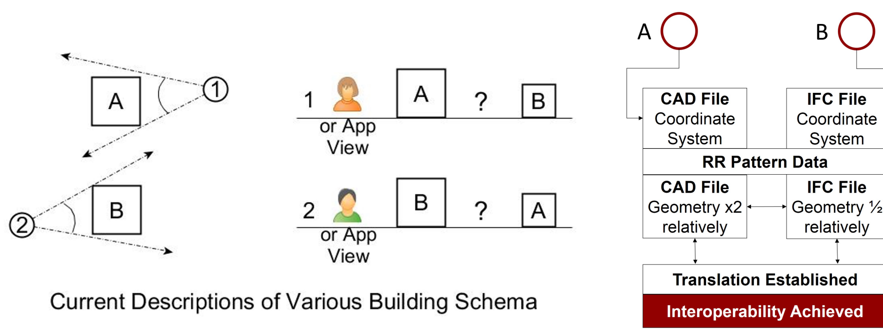

Fig. 2. Conceptual Need for Building Scale Translation.

While the pattern may include only the establishment of scale between one building model and another to have a method of finding the best fit selection for a site, it can also record any other desired data with this relationship instance or by including several instances as a sequence describing the necessary contextual limits. In addition to this scale data [Figure 3] that informs us that geometries in the CAD File are twice as big as geometries in the IFC File, the example populated pattern also indicates the dependency of the relationship, coordinate system, scope, domain, usage, scale type (volume), entity age, and entity expected lifespan-to name a few possibilities. Apart from this example use case, the RR Pattern can also potentially become a dynamic "link" for communication and provides a tool to maintain data or preferences so that solutions can be better understood, tracked, and updated as needed for decision making.

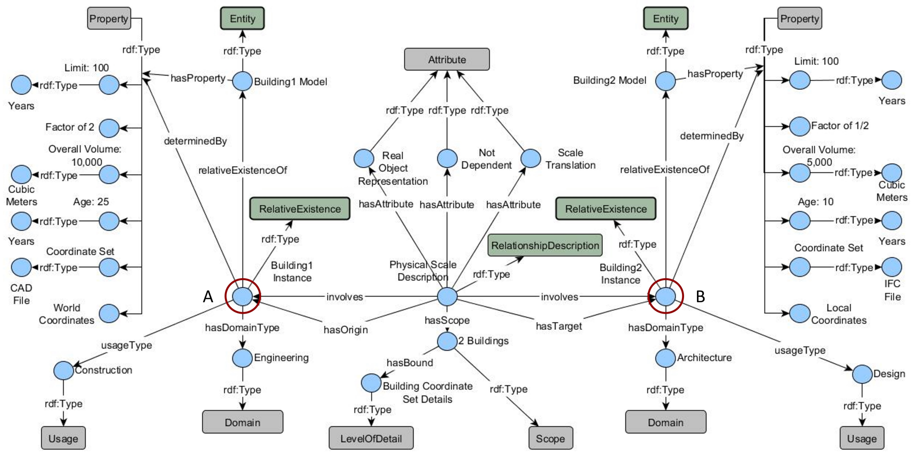

Fig. 3. Instantiation of RR for Comparing Two Building Scales.

4 Conclusion

We present a Dynamic Relative Relationship ontology pattern in the context of comparing two building models of different coordinates systems and file types. This pattern provides a relationship tracking mechanism and a connection between data and the decision frameworks that might use it as a meta-data layer of information. In addition to a physical scaling use case, the RR Pattern can be used for other physical, temporal, and informational relationships so that structured data over distributed data access points can be computationally created to enable more powerful inferences and reach more accurate predictions.

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