Designing and Building Interconnected Ontologies to Ask: "Where's Waldo" (*and his friends*)?

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The Army Corps of Engineers is engaged in research focused on creating a GIS-based decision support tool that will provide military planners with situational awareness of how the local population operates in time and space and how people move through and make use of the built environment in certain culturally proscribed ways. This requires understanding the cultural influence on how people interact with their built environment and using this knowledge to capture and model the rhythm and flow of daily life in an urban environment. Using this information, the military planner can make better-informed decisions during the mission planning process that will maximize mission effectiveness and minimize collateral impact on the local population.

The data available for this research is limited and inconsistent. The building identification database has detailed information for built environment elements and only identification information for other buildings. Cultural information—as provided by the CIA World Factbook—is fairly consistent across regions. These two sources (built environment identification and cultural facts) are the only data sources utilized in the research.

In order to perform cultural characterization, it is necessary to develop models which can be used to derive built environment behavior in this data-poor environment. This poster presentation describes the Geo-Cultural Ontology (GCO) approach.

The applications identified by the Army Corps of Engineers require the GCO to be able to describe where people are located and to use this information for a wide range of applications—from route planning to humanitarian food drops. While the rules for moving through the built environment change with the mission, the fundamental question of *'where people are'* remains the same.

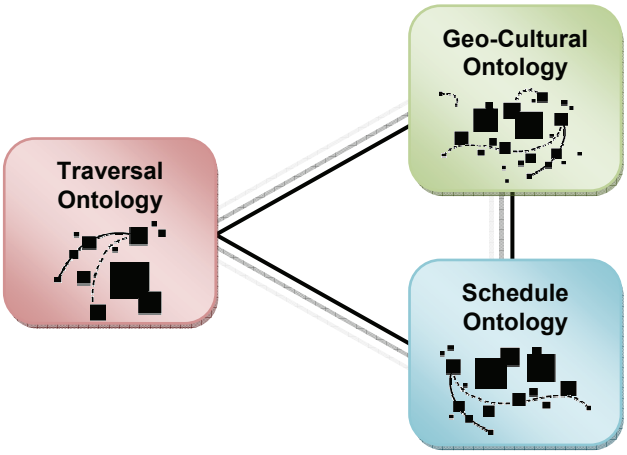
Modeling Challenge

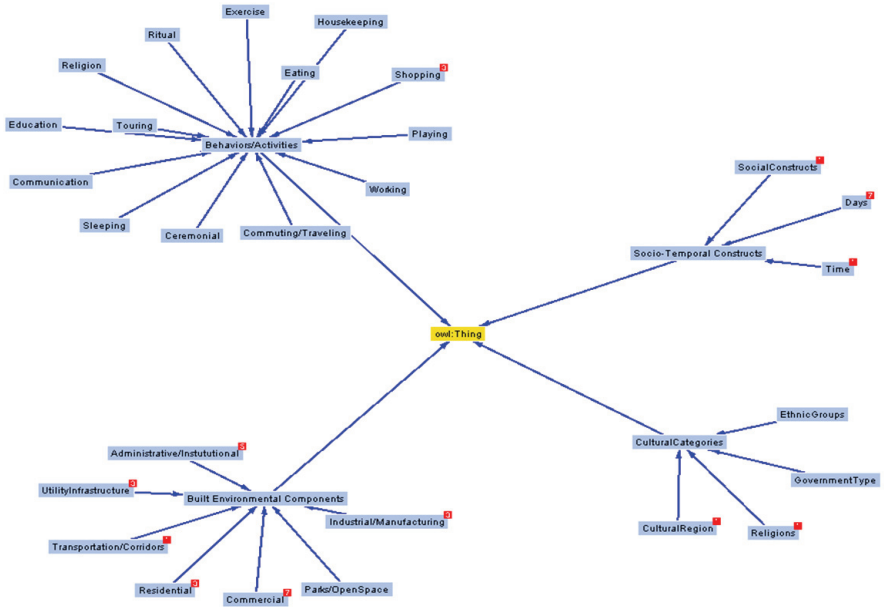
Since the data is sparse and inconsistent, building behavior often needs to be derived by using the parent class characteristics. This poses challenges as the cultural information is not structured such as to provide a meaningful cultural representation. For example, if a country is a subclass of a world region, it does not always make sense for a country to inherit the characteristics of the world region. Geographic entities do not subclass well when the intent of the application is to add specificity to the description of a built environment's elements.

The derivation path also does not subclass well. For example, if a religion is derived from another religion, it does not always inherit the behaviors of that religion. The paths for derivation require careful evaluation. However, the hierarchy for looking for data should not subvert the description of the world cultural description. In order to find the right data, it was necessary to describe a taxonomy of traversal. This ontology (a taxonomy of traversal or hierarchy of linked things) provides both the navigation description and introduces the conceptual distance without subverting the cultural description.

The Modeling System Architecture

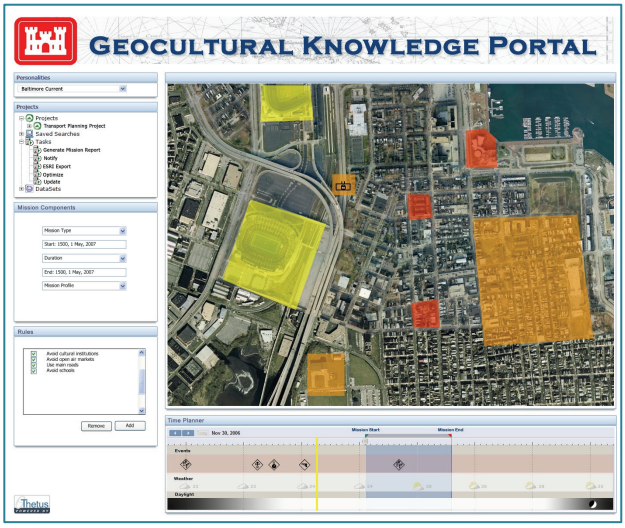
The overall modeling approach focused on using three distinct yet interconnected ontologies: a Geo-Cultural Ontology that describes geo-cultural elements and behaviors; a Schedule Ontology which describes recurring things that happen in embedded cycles (for example, a school has an annual schedule, a semester schedule, a daily schedule, etc.) and a Traversal Ontology which describes the traversal path and distances in seeking the "closest" relevant data source.





Visualization of the Upper-Level Concepts within the Geo-Cultural Ontology

These ontologies are mapped into the data to allow users to search for buildings (or other built environment elements) that are currently in use or may be in use at the time of a scheduled mission. The end application combines these ontologies and data with a set of mission specific rules.



Browser-Based Access to Geo-Cultural Analysis Tools

Unique Contributions

- The Geo-Cultural Ontology demonstrates a unique approach to encoding patterns of usage based on cultural archetypes. The abstraction approach enables support of a wide range of applications in a data-sparse environment.
- The Traversal Ontology is a very simple way of describing the derivation paths without affecting the cultural description.
- The result is an ontology-driven application that combines multiple subject ontologies, various databases of information with different formats, and allows for inferencing based on overarching cultural archetypes.

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