**Protocol for aligning SCO V1.0.0 to UFO**

**Aim**

To align the [Sustainability Core Ontology (SCO)](https://github.com/gioUbbiali/Sustainability-Core-Ontology) to the [Unified Foundational Ontology (UFO)](https://ontouml.readthedocs.io/en/latest/intro/ufo.html).

**SCO Description**

Sustainability is characterized by three major theoretical challenges (Ubbiali et al., 2024):

1. The polysemy of the term sustainability.
2. The relationship between sustainability and sustainable development.
3. The complexity underlying sustainability.

The Sustainability Core Ontology (SCO) is a middle-level ontology modeling those challenges with the purpose of establishing a core central hub to harmonize ontologies regarding sustainability.

Currently, SCO reuses [Basic Formal Ontology (BFO)](https://basic-formal-ontology.org/), one of the existing Top-level ontologies (TLOs), as the upper-level ontology, aligning with the ontological realism view - see Arp et al. (2015) and Smith & Ceusters (2010) for details - according to BFO has been designed. Nevertheless, we consider it essential to commit SCO representation to also other ontological views and approaches. This seems the most consistent way to establish a core hub that can effectively support the integration and interconnection of new and existing ontologies on sustainability. Thus, SCO should align with alternative TLOs other than BFO, to access the alternative ontological view proposed by such ontologies.

This document describes the process of alignment of the Sustainability Core Ontology (SCO) to the [Unified Foundational Ontology (UFO)](https://ontouml.readthedocs.io/en/latest/intro/ufo.html), another existent TLO. UFO counts among the major internationally recognized TLOs. In addition, several ontologies that address domains of primary relevance to sustainability such as resilience (Barcelos et al., 2025) and risk and value (Sales et al., 2018), employ UFO as upper-level ontology.

**Methods and Materials**

Sustainability

* The Sustainability Core Ontology (SCO) currently employs [Basic Formal Ontology (BFO)](https://basic-formal-ontology.org/) as the upper-level ontology.
* This work explores and sets directions for aligning SCO to other Top-Level Ontologies (TLOs), specifically the [Unified Foundational Ontology (UFO)](https://ontouml.readthedocs.io/en/latest/intro/ufo.html).
  + UFO OWL version: [gUFO](https://nemo-ufes.github.io/gufo/).
* Towards SCO V1.1.0.
  + SCO-B (B for BFO): alignment to BFO.
  + SCO-U (U for UFO): alignment to UFO.
* Goal: to ensure SCO leverages and incorporates different ontological perspectives to establish a common reference hub for sustainability.

*Alignment protocol*

Hierarchization

Example: [SCO “complex system” class](http://gioUbbiali.github.io/sco/SCO_0000015).

1. Background assessment

* Evaluating the position of [SCO “complex system” class](http://gioUbbiali.github.io/sco/SCO_0000015) in the BFO hierarchy.

(to use the materials documented in the “references” slide as a reference point.)

*Subclass of the system class (subclass of “material entity” BFO class).*

1. Exploration of correspondences

* Identification of the rough corresponding class position into the gUFO “individual” class hierarchy.

(to use the materials documented in the “references” slide as a reference point.)

*To position under the “endurant” -> “object” branch of the “individual” gUFO class hierarchy.*

1. Construction of SCO-gUFO “individual” class hierarchy

* Identification of adequate upper-level class(es) into the gUFO “individual” class hierarchy.

(to use the materials documented in the “references” slide as a reference point.)

*Subclass of: “object” gUFO class.*

* In Protégé: to add the [SCO “complex system” class](http://gioUbbiali.github.io/sco/SCO_0000015) *is\_a* (*subclassOf*) gUFO “object” class assertion.

1. Construction of SCO-gUFO “type” class hierarchy

* Identification of the “type” class that [the SCO “complex system” class](http://gioUbbiali.github.io/sco/SCO_0000015) instantiates into the gUFO “type” class hierarchy.

(to use the materials documented in the “references” slide as a reference point.)

*gUFO “phase”.*

* In Protégé: to create a corresponding individual (same class URI, *Punning*).
* In Protégé: to add the [SCO “complex system” individual](http://gioubbiali.github.io/sco/SCO_0000015) rdf:type gUFO “phase” class assertion.

In parallel: to carry on discussions with subject matter experts.

**Future Implementations**

**Get In Touch**

Please contact Giorgio A. Ubbiali in case you wish to get involved and participate in the development of SCO.

**Bibliography**

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