1 Question 2

1.1 Nature and Purpose of Foundational Ontologies

Foundational ontologies, also sometimes called upper ontologies, focuses on modeling the very general and primitive objects and relationships (Borgo & Masolo, 2009).

According to Borgo and Masolo (2009), foundational ontologies have the following characteristics: "(i) have a large scope, (ii) can be highly reusable in different modeling scenarios, (iii) are philosophically and conceptually well founded, and (iv) are semantically transparent and (therefore) richly axiomatized."

Numerous foundational or upper level ontologies exist. For example SUMO (Pease, Niles, & Li, 2002), DOLCE (Borgo & Masolo, 2009), BFO (Arp & Smith, 2008), BORO (De Cesare, Henderson-Sellers, Partridge, & Lycett, 2015), and UFO (De Cesare et al., 2015).

Some believe that there will eventually be only a couple of foundational ontologies. Where people will prefer to share ontologies rather than have to translate between them constantly (Pease et al., 2002).

1.1.1 Advantages of using an ontology

Firstly, using a foundational ontology lets the ontology designer use concepts and models that have been thoroughly tested and designed by experts in the field (Pease et al., 2002). This speeds up development of the ontology and reduces errors, thus reducing cost. This can be put another way. According to De Cesare et al. (2015) foundational ontologies provide "general architectural infrastructure for roles".

Secondly, using a foundational ontology can reduce the amount of rework that needs to be done on an ontology due to changing requirements. Such ontologies anticipate changes because they have been designed to handle challenging modelling situations (Pease et al., 2002).

1.1.2 Differing philosophical positions

The designers of a foundational ontology need to decide which philosophical standpoints the new ontology will reflect. Here we will only briefly mention some of the more significant ones.

An ontology can be seen as either descriptive or revisionary. A descriptive ontology builds its models based on the assumed ontological structure of natural language and human thought. These ontologies do not limit their categories to "philosophical or scientific paradigms" (Masolo, Borgo, Gangemi, Guarino, & Oltramari, 2003). Whereas revisonary ontologies limit all assumption to those that can be regarded as scientific.

There are 2 differing views when it comes to the nature of time. The endurantist sees an entity (as an individual or thing) as always completely or "wholly" present at every moment in time, where the perdurantist believes the same entity

has different constituent parts at different times(Borgo & Masolo, 2009). In this way entities "endure" for the endurantists irrespective of time.

An ontology can also be regarded as either multiplicative or reductionist. Reductionist ontologies aim to have as few as possible primitives. They regard the reduction of complexity as a high priority. Multiplicative ontologies regards the need for expressiveness higher than that of the reduction of complexity and therefor tend to have many more primitives than reductionist ontologies (Masolo et al., 2003).

1.2 SUMO

Numerous foundational ontologies were combined to create the Suggested Upper Merged Ontology (SUMO)(Pease et al., 2002). According Pease et al. (2002), amongst those are ontologies from ITBM-CNR, Stanford KSL and content based on the works of Sowa (Sowa, 2000), Guarino and colleagues (Borgo, Guarino, & Masolo, 1996), Allen (Allen, 1984) and Smith (Smith, 1996).

There are 11 sections with documented interdependencies. These include sections on structure of relation, entity abstraction, graph theory, and units of measure (Pease et al., 2002).

1.3 DOLCE

DOLCE (Descriptive Ontology for Linguistic and Cognitive Engineering) is another foundational ontology. The originators of DOLCE believe there should be a library of foundational ontologies. This library is called the WonderWeb Foundational Ontologies Library (WFOL). Developers who need a foundational ontology should be able to choose an ontology that best suit their needs and assumptions. DOCLE was intended to be a "reference" ontology. In other words it is intended to be used to in comparison with other ontologies, comparing how relationships are implemented and which fundamental assumptions were made (Masolo et al., 2003).

DOLCE can classify an entity as either an Endurant or a Perdurant. From the name it is obviously a descriptive ontology and focussed on the ontological meaning in natural language. Additionally DOLCE regards itself as multiplicative (Masolo et al., 2003).

(Borgo & Masolo, 2009)

1.4 BFO

The aim of BFO is to assist in the integration of scientific data (Arp & Smith, 2008) and was developed at the IFOMIS institute in Leipzig (Masolo et al., 2003). BFO contains both endurant and perdurant entities while following a multiplicative approach /citeparp2015building. Endurant entities are named continuants and perdurant entities are called occurants.

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