Phenomenological Ontology Guided Conceptual Modeling for Model Driven Information Systems

Tomas Jonsson[1] and Håkan Enquist[2]

[1] Genicore AB, Göteborg, Sweden
tomas@genicore.se
[2] Department of Applied IT, University of Gothenburg, Sweden
hakan.enquist@gu.se

Abstract. Langefors infological equation states the infological perspective that data alone is not information, but can give rise to information in the minds of people, if data is presented within a frame of reference i.e. knowledge or perception of reality, in these minds. In a model driven information system, the model directly defines the structure of data presented to its users and should therefore be founded in users knowledge or perception of reality. This paper describes a draft for a phenomenological ontology for modeling executable conceptual models in accordance with the infological equation.

Keywords: Executable Models, Information Systems, Ontology Driven Conceptual Modeling, Ontology, Phenomenology, Conceptual Modeling

1 Introduction

Enterprise Information Systems (EIS) are IT-based Information Systems functioning as an integral part of the enterprise actors work life i.e. integrated in the socio-technical system of the organization. EIS should provide information management support for enterprise actors according to their specific view of and understanding of that enterprise i.e. with semantic consistency.

The old vision of semantic consistency between minds, conceptual models and data in executing Information Systems (IS), in accordance with the Infological Equation (IE) [1] may be within reach even for full scale life cycle support of EIS.

$$IE: \; I = i(D, S, t)$$

I = conveyed information in specific actors mind
i = information function
D = set of data received by actor
S = actors pre-existing knowledge, perception of reality (structure of concepts)
t = time available to interpret data

When implemented appropriately, a semantic consistency will be achieved between minds of actors, codified concepts, terminology and data with the factual data management and information in user interfaces of the EIS. Discrepancies in semantic consistency decrease information quality and thus quality of actors work, productivity and effectiveness.

A major issue of EIS Life Cycle management in the digitization of work life is how to effectively achieve and maintain semantic consistency, with acceptable cost and time constraints. Model driven generation and execution of EIS, from conceptual models of the enterprise information, has potential to improve productivity, decrease error rate and costs at orders of magnitude.

The conceptual models play a fundamental role in facilitating semantic consistency since it must be valid both as a description of enterprise actors view of their work and also constitute an accurate and traceable design blueprint for the EIS.

Implementing conceptual modeling guidance by application of a phenomenology based ontology in an Ontology Driven Conceptual Modeling (ODCM) instrument could be a pragmatic way to capture enterprise actors views in modeling for EIS design.

A systematic literature review on ODCM [2] does however indicate a lack of an ontology for *executable conceptual models*, with the purpose of modeling perception of reality (IE:S) in such a way that information systems will communicate relevant data (IE:D) about this reality.

Our research scope is based in seamless life cycle management of EIS, which are semantically consistent with their users view of the enterprise and its environment. This paper focus on phenomenology as an ontological foundation for ODCM in that context.

2 Pragmatic foundations and knowledge needs

Core Enterprise Architecture Framework (CoreEAF) include method, tools and language for developing model driven EIS, based on conceptual models of the enterprise. CoreEAF has been applied for successful and proven EIS life cycle management, in large scale information systems (1500+ users) [3] over a period of 25 years. Lately, it has also been applied for successful design and maintenance of EIS for the social network enterprise Project Lazarus as demonstrated at ER 2018 [4]

Development of Phenomenological Foundational Ontology (PFO) is an attempt to further develop, formalize and disseminate the conceptual modeling approach in CoreEAF, by merging the pragmatics of CoreEAF modeling with matching theoretical contributions, e.g. Husserlian phenomenological philosophy and resent findings in ODCM research.

3 Phenomenology, Ontology and EIS Modeling

PFO is a novel ontology for ODCM, different from the most referred-to ontologies [5] Bunge Wand Weber (BWW) and Unified Foundation Ontology (UFO), in that modeled entities are phenomena representing *mind* objects, based on comprehension of existence in a metaphysical sense, Lifeworld (Lebenswelt) as in the philosophical school of phenomenology, with philosophers such as Husserl, Heidegger and Schutz. *Lifeworld* is that which is *perceived* as existing in reality, perception of phenomena and the foundation for shared human experience.

If accepting the *Lifeworld* definition in phenomenological philosophy as the foundation for shared experience, and in context of EIS for sharing information about enterprise experiences, between actors of an enterprise, we must ask the question: *What are these objects of shared experience, how do we capture them and how do we describe them?* In order to answer the question we start with a brief summary of a part of phenomenological philosophy.

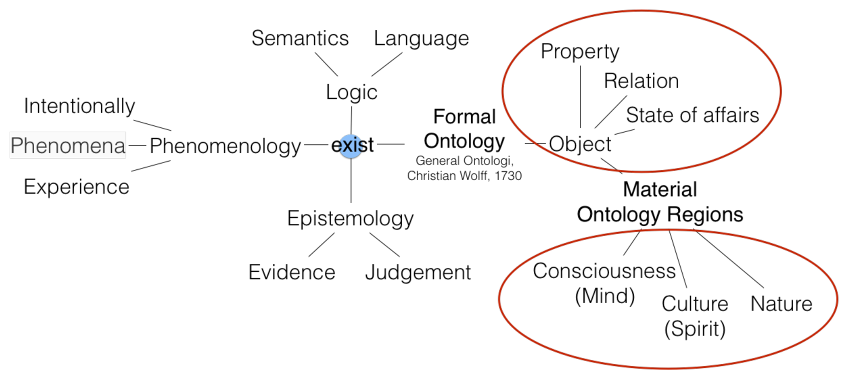

Fig. 1. Unified Theory of the Husserlian System

In Logical Investigations [6] and later works, Husserl lays out the foundation for phenomenological philosophy. Woodruff-Smith [7] summarize the *Unified Theory of Husserlian System* as depicted in Fig.1. Our focus of interest is the right side of the figure, the Formal Ontology and the Material Ontology Regions, indicating the existence of two orthogonal ontologies. Formal Ontology, the structure of (mental) existence as *objects* and Material Ontology Regions as mental (perceptual) regions to which these objects belong.

In this Husserlian System there is no explicit notion of time, however Heidegger's work Being and Time [8] extends phenomenological philosophy with aspects of time as a fundamental ingredient.

Starting from Husserlian System we added the time aspect, both to formal ontology and to ontology regions. In the formal ontology a *state graph* is added representing state concepts and transitions between these concepts. In the ontology regions, the region of *Nature* is further specialized into static physical world and temporal physical world.

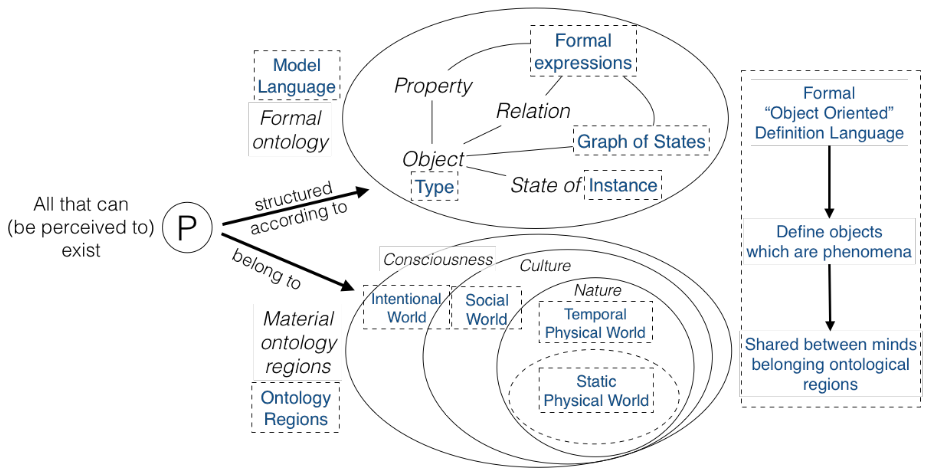

Fig. 2. CoreEAF ontological system with Model Language and Ontology Regions in relation to the Husserlian Ontological System. Concepts augmenting the Husserlian System in blue text and dotted lines.

Some other additions and modifications were made to transform formal ontology into an ontology for conceptual modeling languages, such as the notion of object type and formal expressions to augment definitions of property and relation concepts. The elements *object type*, *property*, *relation* and *state* represent concepts which can be labelled and defined in a structure given by the language ontology.

An overview of CoreEAF ontological system and it's relation to the *Unified Theory of Husserlian System* is depicted in Fig.2, where *Phenomenological Ontology Regions* represents that what should be modeled (using the language) and is the starting point for designing PFO.

Phenomenology of Husserl and others was from the beginning focusing on perception of reality of individuals (as first person view), not in social contexts such as societies and enterprises. The work of Schutz [9] and others, put phenomenology into the context of social worlds, adding the notion of *intersubjectivity*, a shared worldview of phenomena among groups of individuals. When applying PFO in the context of modeling EIS, it is specifically this shared worldview which is of interest, modeling the types of phenomena which are shared and communicated about, between actors related to an enterprise.

4 PFO and Phenomenon Kinds

Basic components of PFO are phenomena, properties, relations and state concepts. In this paper, we focus only on ontology regions and phenomenon kinds. Ontology for phenomenon abstractions, relations, properties and state concepts are still subjects for research and empirical evaluation.

Phenomenon kinds are grouped in four regions, Fig.3, representing world-view awareness domains, building outwards from the most concrete awareness of existence, the static physical world. We use the term *physical object* to refer to that which exist outside the mind, observable through perception.

Static physical world: Phenomena as mind items, representing that which is considered to exist in a static physical world. Physical here means, that outside minds, which could be observed. However, could be observed, does not mean that something has to exist for observation, it can be just thought of or imagined to exist as observed.

- Things: Predominantly inanimate physical objects which are not considered to act, have their own will.
- Actors: Predominantly animate physical objects and groups of such objects, e.g. people, organizations, animals, herds. Also automata such as automated machines, robots and information systems could be considered actors, if they seem to act i.e. take actions.
- Localities: Concepts of location e.g. spatial relations, position, area or volume, coordinates in a coordinate system defining position, area or volume.

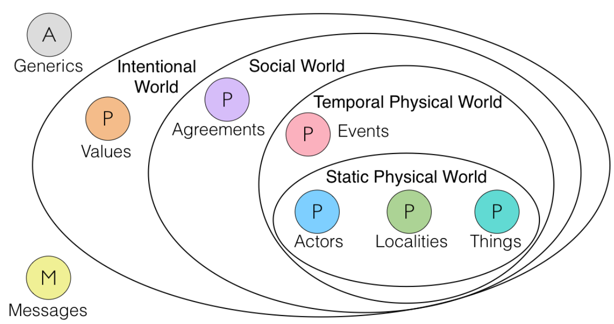

Fig. 3. Phenomenon kinds, their world-view awareness domains, combined with a coloring scheme used in modeling tool and runtime environment.

Temporal physical world: A physical world which changes over time. All phenomena have a past, a present and a future, but when we want to understand and reason about change, change itself is the phenomenon.

- Events: Phenomena of change. Events can be observed only when they happen, are in progress, but as mind items they can exist as plans before and memories after they are observed.

Social World: The social world is regulated, driven, by agreements between actors in relation to the temporal physical world.

- Agreements: Phenomena of relationships between actors, possibly also with relations to other phenomena included in the agreement. Agreements are either informal, undocumented, subconscious or formalized and documented, e.g. legal systems or written contracts.

Intentional World: A world of intentionality which motivates, drives, gives purpose for individuals and organizations.

- Value: In the perspective of an actor, related to social and physical world, describing that which is value and possibly its measure. For actors as individuals, Maslows hierarchy of needs indicates a starting point for possible values. For profit making enterprises, value is money but also other values are considered, such as customer value.

Additional Entity Kinds: The following two kinds of entities are not considered to be pre-conceptional mind items from the point of view of phenomenological philosophy. They are conceptual abstractions, which however play an important role as entities in conceptual modeling for information systems.

- Message: As in the widest sense, generally unstructured (non modeled) information, usually as textual or image data. E.g. email, documents, pictures, books in their non-physical sense i.e. in the digital universe.
- Generic: Should not be used when modeling according to PFO, except when a phenomenon type represents an abstraction of two different phenomenon kinds, e.g. phenomenon *sales item* can be either something physical (thing) or service (event).

5 Continued Research

- Extending the description of PFO foundation, related to empirical work and theoretical support for PFO for ODCM in literature and contemporary research.
- Enrichment of PFO with regards to ontological detail, conceptual modeling language implementation and modeling rules to support is use by practitioners.
- Development and integration of PFO in ODCM enabled EIS life cycle management.
- Exploring relationships between PFO and other ODCM approaches based on different theoretical foundations and their consequences for model driven information systems.

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