Theory and Applications of Ontology:
Philosophical Perspectives

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Editors

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Preface

After a long period of decline, ontology is back at the forefront of philosophy, science and technology. These days ontology comes in at least two main fashions: the traditional philosophical understanding of ontology has been recently flanked by a new – computer-based – understanding of ontology.

There are scholars from both fields contending that ontology in knowledge engineering and ontology in philosophy are two completely different disciplines. On the one hand there is analysis closely tied to the concrete problems of domain modeling; on the other, difficult and usually very abstract speculations on the world and its most rarified structures. For this reason, it is claimed, those scientists who occupy themselves with ontology in knowledge engineering should not be concerned with what philosophers have to say (and vice-versa).

The thesis defended by *Theory and Applications of Ontology* is exactly the opposite. We shall try to show in this work that – despite their different languages and different points of departure – ontologies in knowledge engineering (let's say: ontology as technology) and ontology in philosophy (let's say: ontology as categorial analysis) have numerous problems in common and that they seek to answer similar questions. And for this reason, engineers and philosophers must devise ways to talk to each other.

The current resurgence of interest in ontological issues displays a number of novel features, both among philosophers and among information technologists. Among philosophers, the revival of a genuine interest in ontology requires the removal of certain prejudices that have profoundly influenced the analytic and the continental camps, both of which have in recent decades systematically delegitimized ontological inquiry in favour of its epistemological transformation (not to say reduction). To this shared error of broadly Kantian (or more properly neo-Kantian) stamp, analytic philosophy has added a linguistic prejudice, and the continental one styles of inquiry and writing that can be described as devoid of methodological rigour.

Behind these obstructions to ontological investigation one perhaps discerns the consequences of another feature common to both camps: the fact that the most influential thinkers of the last 100 years – the reference unquestionably goes back to Wittgenstein and Heidegger, however different their philosophical views may have been – both embraced an a-scientific approach; both, that is, delegitimized alliances,

or at least serious contact, between science and philosophy. In consequence, the revival of interest in ontology also provides an opportunity for renewed discussion of the relationships between science and philosophy.

Science continuously advances, and that which it proves to be valid endures. Problem-oriented thinkers try to follow problems, not to anticipate conclusions or to presuppose an image of the world. This perspective is largely correct. It should, however, be qualified if one is not to commit the ingenuous error of believing that it is only 'solutions' that advance knowledge. Also attempts and failures, in fact, are instructive. For all these reasons we may accept Aristotle's contention that ontology is *philosophia prima* as regards the problems it seeks to resolve, as long as we remember that it can only be *philosophia ultima* as regards the elaboration of results. And it is here that we discern how ontology concretely operates in harness with science, because it 'presupposes the accumulated knowledge of centuries and the methodical experience of all the sciences' (N. Hartmann, *Der Aufbau der realen Welt*, 2nd ed., Meisenheim am Glan, 1949, p. 26).

Besides points of contact, of course, there are also a number of differences, perhaps most notably the fact that ontology in knowledge engineering is a discipline still in its infancy, while ontology in philosophy is as old as philosophy itself. Consequently, the history of philosophy contains ideas, tools and proposals of use for contemporary developments; and it also indicates the options that will lead us into dead ends or nowhere at all. When things are viewed in the light of such a long and articulated history, one knows from the outset that ontology does not permit ingenuous simplifications. For these reasons, philosophical ontology may usefully contribute to ontology in knowledge engineering.

It is true, though, that philosophical ontology addresses questions of a more general nature, ones apparently of no relevance to ontology in knowledge engineering. Consequently, it may appear that certain components of philosophical ontology could be ignored in the passage to ontology as technology. Nevertheless, one should always bear in mind the greater explanatory value and the broader structuring capacity of more general schemes and more comprehensive theories. For this less overt reason, too, philosophical ontology is useful for ontology in knowledge engineering.

The philosophical codification of ontology has often restricted itself to organization of its general architecture, without delving into the details of minute categorization. On the other hand, the concrete, situated practice of ontology as technology may conversely prove useful for the development of philosophical ontology.

For these and other reasons, there is mounting interest in the development of standards, modeling principles, and semantically transparent languages. Ontology thus comes into play as one of the strategies available to developing the semantic web, construct robust data-bases, managing huge amounts of heterogeneous information because ontologically founded knowledge of the objects of the world is able to make codification simpler, more transparent and more natural. The belief is that ontology can give greater robustness to computer-based applications by providing methodological criteria and categories with which to construct and build them, as well as

contexts in which to set and re-categorize different data-bases so that they become more mutually transparent. In this way ontology directly contributes to standardization of the life-cycle model, and can therefore serve as an innovative and possibly unexpected component of software quality assurance.

These problems are dramatically magnified by the fact that unlike all the societies of the past, modern societies are no longer afflicted by a lack of information. If anything they suffer from its excess, from having to cope with too much unused and unusable information. It becomes increasingly difficult, in fact, to find the information that one needs, when one needs it, to the extent that one needs it and in the appropriate form. Although the information may be stored somewhere, all too often one does not know where; and even when one is aware of how to find the information, it is often accompanied by further information irrelevant to one's purposes. And when information is available, it is often forthcoming in the wrong form, or else its meaning is not explicitly apparent.

However broad the range of information already gathered may be, a great deal more has still to be assembled and codified. And this inevitably complicates still further the problem of the functional, flexible, efficient and semantically transparent codification of information.

Broadly speaking, the two research communities of philosophers and engineers have still not found a way to relate to each other systematically. While philosophers tend unilaterally to emphasize the need for a conceptual complexity that matches the complexity of the subject-matter, engineers tend equally unilaterally to stress the drawbacks of the tools available and the presence of insuperable computational problems. One side is perhaps too theoretical, the other too pragmatic. In short, taken as they stand, the two views seem difficult to reconcile.

However, in dynamic terms, one easily foresees mounting social and institutional pressure for the development of tools able to model fragments of reality in terms that are both adequate and efficient. And from this point of view, we are all at fault. Those colleagues who concern themselves with technologies seemingly pay closer attention to manipulation than to knowledge. Likewise, those who concern themselves with philosophy suffer from the reverse problem, that of navigating in a sea of theories for which the rationale is sometimes unclear.

For our part, we have grown increasingly convinced that the same problems will force engineers to address theories, and philosophers to address the limitations of our current capabilities. Provided, however, that both sides have the will, the ability, the desire and the courage to do so. If they decide to tackle these problems, it will become reasonable to identify and systematically develop those areas of convergence and contact now existing.

In this sense, the two volumes of *Theory and Applications of Ontology* may play a role in paving the way for a better mutual understanding between engineers and philosophers. Since the two communities are still very different as to their own languages, conceptual tools and problem-sets, we thought that collecting papers within one single volume would have been too constraining. We therefore devised two different volumes, one dedicated to the philosophical understanding of ontology and

one to the computer-based understanding of ontologies. Both volumes contain both papers describing the state of the art in their respective topics and papers addressing forefront, innovative and possibly controversial topics.

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Introduction

After two centuries of mainstream denial, ontology is back again. In fact, the past two or three decades have seen the slow resurgence of ontology as a progressively accepted and even respected field of philosophical inquiry. Ontology has come back in many different flavours. To mention but a couple of cases ontology has come back as the effort to establish the basic categorial grid of being, or the effort to dig deeper into the intricacies of specific groups of entities, such as organisms or minds. Furthermore, recent events in information technology have led to a new manifestation of the philosophical field of ontology. In this new manifestation, ontology is also a technological discipline. The development of knowledge-based systems has lead to computer applications written to manage knowledge expressed in symbolic form, in a variety of domains such as diagnostics and manufacturing engineering and in a variety of programming languages. The use of different rules, languages and terminologies, however, makes interoperability difficult if not intractable. The philosophical notion of ontology suggests a possible solution in the form of a system-neutral repository of abstract knowledge which can be refined to specify system rules and artifacts in the domains to be modeled, accompanied by automated translators mediating between each knowledge system and the repository.

The two volumes of Theory and Applications of Ontology (TAO) are intended to inform the scholar in philosophy or the researcher in the sciences, information technology, or engineering, of the present state of the art in philosophical ontology and the systems available for the study, development, and application of ontology as technology. While Volume 2 addresses the recent flowering of ontology as an all-encompassing field of study and application, which provides a declarative semantic framework for mutual understanding and interoperability between technological system components, models and processes, Volume 1 addresses philosophical ontology. The present volume, Volume 1 is intended as a snapshot of much, although not all, of the work in progress on ontology in philosophy. Nevertheless, each of the two volumes is self-contained and can be studied independently.

The chapters in this first volume of TAO are grouped in three parts. We consider this grouping necessary, in order to help the reader deal with the large volume of knowledge contained in the book. Of course, this grouping does not mean that the chapters are not related or interrelated; in fact, the reader will discover references from chapters that present seemingly different aspects of ontologies to common

concepts and entities, which constitutes a proof of the universal application of ontologies. The chapters in the first part of the book present aspects of general ontology. Those in the second part of the book discuss domain or regional ontologies. The final part contributes chapters that shed light into the history of twentieth century ontology.

As we already mentioned, the first part in Volume 1 contains the chapters that provide an overview of various aspects of general ontology. Poli presents an overview of the most general structures than ontology may require. After distinguishing descriptive, categorial and formalized ontologies, Poli notes that most philosophers seem to have adopted one form or another of oversimplified theories of substance, and proposes a general framework for better addressing the nature of substance. Continuing, Seibt investigates notions of particularity, starting from the distinction between *foundational* and *target* particularism. Herre surveys mereological systems, an area of research that is today one of the core topics of ontology. Petersen discusses causation: Despite the undeniable importance of causation, its correct understanding remains subject to considerable controversy. She then presents the two main clusters of proposals in the literature, namely the view that sees causation essentially as a *relation* between facts or events, and the view that focus on the ontology of the *processes* by which causes are connected to their effects. Petersen discusses the most influential varieties of both views and underlines their main difficulties. Cocchiarella analyses the difference between being and existence. The simplest account of the distinction between being and existence is that between actualism and possibilism, where by existence he means physical existence, i.e., existence as some type of physical object; and by being he means possible physical existence, i.e., physical existence in some possible world. According to possibilism, there are objects that do not now exist but could exist in the physical universe, and hence being is not the same as existence. On the other hand, in actualism being is the same as existence. Cocchiarella then clarifies their differences by formally modeling different aspects of actualism and possibilism within a suitable system of formal ontology. Busck Gundersen overviews some of the central issues about dispositions and response-dependence theories. Finally, Nef discusses the difference between concepts, predicates and properties.

The second part groups five chapters that discuss specific domain ontologies, namely biology, perception, language, interactive knowing, law and economics. After a general survey of the most prominent ontological questions lying behind biology, Ramellini studies the case of biological boundaries. The problem is that the various boundaries distinguished by biologists (perceptual, compositional, epithelial, cellular and *sensu lato* processual boundaries) appear to be flawed by theoretical inconsistencies. Ramellini introduces then a new concept of organismic boundary and discusses some of its merits. Albertazzi analyses in details the psychological acts in which visual objects are presented and shows some of their intricacies. She proposes to consider acts of presentation as an irreducible level of the ontology of mind. Addressing the lack of consensus among cognitive scientists about the role of logic and ontology in relating language to the world, Sowa reviews the ongoing research, relates it to the historical developments in logic and philosophy, and

proposes a synthesis that can accommodate the full range of language use from casual conversation to precise technical nomenclature. Bickhard defends the idea that a process framework is needed for understanding the emergence of normative function and representation. Mommers discusses the nature and classification of a varying set of ontology models focusing on legal domains, their environments, legal argumentation and other legal and legally relevant phenomena. Potts explores the vast ontological complexity of the economic world. The economic world in fact is an emergent (and massively parallel) process of socially-coordinated individual knowledge. In turn, the organizations and institutions that coordinate economic behavior are themselves subject to self-organization and evolution, showing that the economic world is ontologically complex in a profound way.

The third part includes four chapters dedicated to the reconstruction of the main trends within twentieth century ontology. The two chapters by Ales Bello and Ghigi reconstruct phenomenological ontology. Ales Bello presents Husserl and some of his pupils, notably Reinach, Hering, Conrad-Martius and Stein. Ghigi discusses in some depth the ontological proposals of Ingarden and Hartmann. Symons presents an articulated sketch of the history and methodology of ontology in the analytic tradition. Dahlstrom, finally, offers a vision of hermeneutic ontology, focuses on Heidegger and Gadamer.

The three parts of this volume aim at providing comprehensive coverage of the current status of ontology. They have been structured in a way that guides the reader from overviews of contemporary discussion in ontology to new proposals and suggested developments. This structure reflects the editors' choice of most profitable studying path. However, each part is independent from the others and will equip the reader with updated and complete knowledge under a specific perspective in ontology. Each chapter has been authored by distinguished scholars in the various applications of ontologies. Let them guide you, the reader, in a path of knowledge discovery that we, the volume editors, find to be the most fascinating.