Chapter I

Introduction:
Toward the Intelligent Civilization of Ontological Technology

Today, computers anchored to electronic measuring devices, transducers, and telemetric systems are increasingly transforming into worldwide integrated information processing networks. And ontology science and engineering is getting a long-awaited and fully deserved recognition of a critical factor in the 21st century information and communications technology (ICT); above all, in building knowledge-driven intellectual technologies, meaningful machines and reasoning systems, the engine and driving force of the Global Knowledge Society (Novik, Abdoullaev, 1991).

Providing the unifying modeling schemes and languages for sophisticated information technology, the cornerstone of knowledge societies, ontology is bridging the real world and the information universe, giving the dynamic world modeling fundamentals, principles, constructs, representations, and schemes for building a radically new class of intelligent technologies and knowledge systems, **Ontological Technology**.

What are Ontology and Computing Ontology?

Being a fundamental form of knowledge representation about the world, or any part and domain of it, ontology defines the basic constituents and elements of reality: entity kinds, categories, or classes with their constituent relationships, inherent properties and possible instances. Or, in the fundamental sense, it is an all-comprehensive account of reality and realities and their invariant interrelations; for it concerns with the entity-relation types in the world in the first place.

Mapping the real world features into the mental constructs encoded as objects types (data structures) and procedures in the information systems, ontology comes as the most comprehensive world model and conceptual schema of things. Accordingly, computing ontology is a world knowledge base (realm of abstraction or conceptualization or model) formally defining a domain (universe of discourse, area of knowledge or practice), its constitutive elements and structure, and yielding the rules of reasoning about its organic relationships, presented by machine-processed formal specifications, notations, languages, and codes.

Essentially, about theoretical grand schemes and master plans, ontology affords widely shareable commitments of how to view the world, a single conceptual environment for fundamental intelligent reasoning about the world. Also, it yields a universal language in which intelligent agents, human and machine can represent the world, expressing and communicating their semantic representations and knowledge. Since ontological classes and rules are, metaphorically speaking, the meat and potatoes of human knowledge and reasoning, they constitute an ideal single representation and reasoning platform for various knowledge representation technologies.

If computing is concerned with computable structures and processes, ontology relates to general structures and patterns of relationships permeating the key branches of computer science: knowledge engineering in AI, conceptual modeling in information systems and databases, and type systems and domain modeling in programming languages design. It can be claimed that the most important and breakthrough technological works currently are in ontology research, design, engineering, and large-scale intelligent applications constructing thereof (Abdoullaev, 1989).

Crucially, the computing ontology is promising the developer not only the tools for organizing information (data) but also the generic mechanisms of reasoning over data (strategic rules). In the inherent nature, computing ontology is basically a formal representation of reality and its domains, levels, and complex entities and is used to formulate computable models, causal algorithms, and reasoning strategies about the world, its parts and aspects. Being the heart and soul of diverse coded classification systems, conceptual schemas and reasoning models, it organizes all the things into a hierarchy of entity groupings defined as classes, categories, universals, resources, kinds, or types. The basic unit of the classification system may be taken as a category (as in philosophy), a kind (as in empirical sciences), a set (as in mathematics), a class (as in logic), or a type (as in computer programming).

Today particular domain theories and models, designated as ontologies, are actively used in most basic fields of computer science and technology, namely artificial intelligence, computing networks, informatics, software engineering, programming languages, and computational linguistics. It is increasingly realized that knowledge systems ought to be founded on the real world models involving ontology-controlled syntax (Web content structure, axioms, and rules), semantics (Web content meaning), and pragmatics (agents, attitudes, intentions, values, actions, communication, measurement) replacing the formal representational languages implying the logic-restrained syntax and formal semantics.

So it is essential to differentiate two classes of representational languages and technologies: general and specific. On the one hand, there is Reality (or World) Representation and Reasoning [(RRR) or (WRR)] system describing the universe of things that involves foundation ontology as a content and problem-solving theory providing strategic knowledge and reasoning mechanisms about the world. The RRR system is equivalent to Reality Modeling