

Chapter 7

Theory of Ontology and Meta-Modeling and the Standard

An Enabler for Semantic Interoperability

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ABSTRACT

With the continuous development and rapid progress of information techniques, complexity and scale of information systems are expanding increasingly, which consequently brings our research focus on how to ensure the effective exchange of information and efficient interconnection between each part of a information system. However, different modeling paradigm, languages and platforms cause grammatical and semantic diversity to the existing information resources, a challenging approach to information resources management is needed to promote deep sharing of those information resources and implement rapid integration based on them. To realize semantic interoperation between diverse information systems and resources, the authors combine meta-modeling methodology in software engineering and ontology from philosophy to exploit a novel methodology named Theory of Ontology & Meta-modeling. Based on the methodology, the authors contributed to an international standard project ISO/IEC 19763-3: Metamodel for ontology registration since 2003, which was officially published as an international standard in Dec, 2007. Furthermore, we developed a Management and Service platform for Semantic Interoperability on Manufacturing Informationalization Software Component Repository (SCR). It can support ontology-based software component attributes classification, registration and management using

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ISO/IEC 19763-3 standard, and implement semantic (ontology) based software component query and retrieval. Based on above mentioned techniques, this platform can facilitate the management of semantic interoperability, which provides the reliable infrastructure for the reusing and sharing of heterogeneous software component resources.

1. CHALLENGE IN SOFTWARE ENGINEERING: SEMANTIC INTEROPERABILITY

With the continuous development of information techniques, information systems are now merging into our life and even becoming an essential and indispensable part in the social infrastructure. From general computing system to complex database management system and Enterprise Resource Planning (ERP) system, various kinds of information systems are scattered in different application domains and areas so that they can be typically deemed as distributed systems. Meanwhile, rapid progress of information techniques drives the evolution of software development paradigm. More specifically, with the shifting from object-oriented techniques to component based development method, not only the granularity of software modular grows bigger, but also the middle-ware technologies and component-based development become the main and popular techniques for software development. Furthermore, the raising of web services (Curbera, 2001; Newcomer E., 2002), service-oriented architecture(SOA) (Thomas, 2004; Newcomer, 2005), and semantic web (Berners-Lee, 2001; Daconta, 2003) cause great changes in both ingredient and development method of web-based information systems. On one hand, web services and semantic web services with greater granularity and more complicated structure are now regarded as the unit of current information systems; on the other hand, it is recommended to create information systems by dynamically linking and integrating existing information resources and service resources on the web. This situation leads to the fact that complexity and scale of information systems are expanding increasingly, which

consequently brings our research focus on how to ensure efficient interconnection, intercommunication and interoperation between each part of a common information system.

In the realm of software engineering, when the studied objects take radical changes in the scale, the essential problem of our research will change correspondingly. Considering a single information system, the primary task is to achieve the given functionality of it. Otherwise, if the whole functionality of a system will be realized through several information resources or other systems, this kind of system will be created by linking and integrating specified resources. Here, the key issue of developing current information system is how to organize and manage varied information resources systemically, enhance accessible rate of them, and finally promote knowledge sharing and interchange between them. However, different development methods and platforms make information resources differ in syntax and semantics, which might hamper the understanding and interacting between them. Therefore, effective solutions should be taken as a bridge to connect information resources and implement interoperation between them.

Generally speaking, interoperability is the ability to communicate and share data across programming languages and platforms(ISO, 1993). On information domain, interoperability will be defined as “the ability of two or more systems or components to exchange information and to use the information that has been exchanged (IEEE, 1990)” or “the ability of a collection of communicating entities to (a) share specified information and (b) operate on that information according to an agreed operational semantics(Lisa, 2004)”. While we talk about interoperation between information

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