



Chapter II

Two Meta-Models for Object-Role Modeling

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ABSTRACT

For conceptual information analysis, the object-role modeling (ORM) approach is arguably more suitable than entity-relationship modeling and the class modeling technique within the Unified Modeling Language. Although ORM has been used for three decades and now has industrial modeling tool support, it has no official, standard meta-model. Because of its extensive capability for expressing business rules, ORM is currently being considered as a possible standard for business rules expression within the Object Management Group (OMG), and for use in ontology standards. To support these initiatives and the interchange of ORM model data between different software tools, this chapter discusses recent research by the authors to pave the way for a standard ORM meta-model that employs a standard interchange format. Two different ways of meta-modeling ORM features are presented, design trade-offs are examined, and extensions to ORM are proposed. As proof of concept, a working prototype that is compliant with the OMG's Meta-Object Facility is also discussed.

INTRODUCTION

The analysis phase of information systems development employs a conceptual schema of the application domain to enable the information structures and business rules to be easily validated by domain experts. A validated conceptual schema can then be mapped to logical/physical/external schemas using automated and/or manual processes. For the persistent (database) and transient (in-memory) structures, the high-level data modeling is often performed using entity-relationship (ER) modeling (Chen, 1976) and the Unified Modeling Language (UML) (OMG UML RTF, 2003), respectively. Recently, the fact-oriented approach exemplified by object-role modeling (ORM) (Halpin, 1998) is becoming a popular alternative to ER and UML at the conceptual analysis phase.

Because of its attribute-free approach, ORM models are inherently more stable than ER models or UML class models. The ORM graphical language can formally capture many more business rules than the diagram notations supported by industrial ER tools or UML. ORM textual languages enable business rules to be expressed naturally using mixfix predicates of any arity (unary, binary, ternary, etc.). Moreover, ORM's constraint primitives are orthogonal, and they work properly with n-ary associations. In contrast, industrial ER is confined to binary associations, while UML forbids unary associations, fails to support value-based identification schemes, and its main constraint primitive (multiplicity) fails to scale properly to n-ary associations (Halpin, 2001a). Moreover, ORM models can be automatically transformed to ER and UML class models when desired.

For such reasons, ORM is being considered as a possible standard for business rules expression at the computation independent model (CIM) level within the Business Rules Special Interest Group recently formed within the Object Management Group (OMG). In addition, ORM is being investigated as a possible foundation for ontology specification (Demey, Jarrar, & Meersman, 2002; Spyns, Meersman, & Jarrar, 2002). Although ORM has been used productively in industry for three decades and now has industrial modeling tool support, it has no official, standard meta-model. If ORM is to be used as a standard for business rule or ontology specification, a standard meta-model for ORM is essential. Such a meta-model would also facilitate the interchange of ORM model data between different software tools.

Historically, the fact-oriented modeling approach exemplified by ORM has been known under different names, including Natural Information Analysis Method (NIAM) (Wintraecken, 1990), Predicate-Set Model (PSM) (ter Hofstede, Proper, & Weide, 1993), Natural Object Relationship Method (NORM) (De Troyer & Meersman, 1995), and Fully Communication Oriented Information Modeling (FCO-IM) (Bakema, Zwart, & van der Lek, 1994). Although many publications exist on the fact-oriented approach, to our knowledge the only

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