Chapter 13

Modularising the Complex Meta-Models in Enterprise Systems Using Conceptual Structures

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ABSTRACT

The development of meta-models in Enterprise Modelling, Enterprise Engineering, and Enterprise Architecture enables an enterprise to add value and meet its obligations to its stakeholders. This value is however undermined by the complexity in the meta-models which have become difficult to visualise thus deterring the human-driven process. These experiences have driven the development of layers and levels in the modular meta-model. Conceptual Structures (CS), described as “Information Processing in Mind and Machine”, align the way computers work with how humans think. Using the Enterprise Information Meta-model Architecture (EIMA) as an exemplar, two forms of CS known as Conceptual Graphs (CGs) and Formal Concept Analysis (FCA) are brought together through the CGtoFCA algorithm, thereby mathematically evaluating the effectiveness of the layers and levels in these meta-models. The work reveals the useful contribution that this approach brings in actualising the modularising of complex meta-models in enterprise systems using conceptual structures.

DOI: 10.4018/978-1-5225-3686-4.ch013
INTRODUCTION

The development of meta-models in Enterprise Modelling, Enterprise Engineering, and Enterprise Architecture provide insight into the complexity of business organizations (Bork et al., 2015; von Rosing and von Scheel, 2016). These meta-models are extensible across whole industries, individual businesses, their sub-organisations (e.g. departments) and individual workplaces where the actual activity takes place. Thus, a business enterprise’s myriad resources (e.g. physical assets, human resources and IT systems) can be aligned with its purpose and strategy (‘vision and mission’). The meta-models thereby facilitate enterprises to develop a conceptual model that creates the right context. These meta-models thereby enable enterprises to add value and reduce unnecessary cost and risk in meeting its obligations to its stakeholders (e.g. shareholders, employees, regulatory bodies and the wider environment).

Computer science has over its history contributed to the expressibility in these meta-models through its advances in ontology and semantics; together they capture the objects and relations that describe the interplay and effects of business in a formal, computable model (Floyd, 1967; Gruber, 1995; Oberle, 2013; von Rosing and Laurier, 2015). Computer productivity is thus brought to bear on the creativity of human endeavour, which identifies and sustains enterprise opportunities. Enterprise Architecture and modelling tools are predicated on formally conceptualized meta-models, and this success is already evident (Mayall & Carter, 2015; Bork et al., 2015; von Rosing et al., 2015; von Rosing, 2016).

The meta-models themselves however have become large, unwieldy and error-prone. Whilst the size of these models does not initially present a computational hurdle and the software can reveal errors and gaps that surface to human modellers (e.g. enterprise architects) and end-users (e.g. business decision-makers), the readability of the original meta-models have become illegible thus unreviewable by the human modellers. This aspect is pertinent; given the models are instigated by humans they should be re-viewable by them.

To support this review, there needs to be a consistency of concepts and their relations in these meta-models. The objects, their subtypes, descriptions, semantic relations and how they are viewed that collectively make up the meta-models must be consistently interrelated including the level at which they relate and how they could or should interconnect. For example, enterprise strategy permeates across all the areas of an enterprise; it should not just be captured as a disjointed function. Added to these mistakes are the uneven levels of composition and decomposition of the objects and relations. Put simply, the objects are wrongly thrown together at arbitrary levels, in what apparently are obvious connections but emerge to be much more complex. The meta-model ends up undermining rather than elucidating the effectiveness of the enterprise.

LAYERS AND LEVELS IN ENTERPRISE META-MODELS

To rebalance human creativity with computational execution, meta-models have been broken down into components then coupled together by interfaces analogous to the software engineering principles found in object-oriented design. Like programming-in-the-large, this approach has enabled ‘metamodelling-in-the-large’ (Zivkovic and Karagiannis, 2015). In Enterprise Architecture, the meta-models have been modularised into layers and levels that collectively describe how a business works. A study describes the benefits of this approach (Bork, 2015). The outcome is a matrix structure that is superficially akin to