Triune Continuum Paradigm

Andrey Naumenko
Triune Continuum Enterprise, Switzerland

INTRODUCTION

This article reviews the Triune Continuum Paradigm—a logically rigorous theoretical base for organization of conceptual frameworks that are used for system modeling in different contexts (e.g., in software development, in enterprise architecture, in the architecture of financial services, in jurisprudence, etc.). This paradigm is an important contribution to the system modeling domain, because currently none of the prevailing system modeling frameworks has a satisfactory formal theoretical foundation.

The absence of a theoretical foundation for modeling frameworks leads to the practical application experiences where modelers are constrained to be guided by chance and not by a founded reason. This often leads to the inadequate choices of modeling frameworks, that is, to the situations where a chosen modeling framework is not designed to deal with the targeted modeling problems. Possible consequences of such choices include incorrect (e.g., inadequate with regard to the requirements) information systems specifications, contradictory data architectures, incomplete service specifications, and so forth—all of these being the decisive contributions to failures of many projects. The paradigm, which we review in this article, fixes this problem providing missing theoretical foundations for frameworks positioned in the domain of general system modeling.

Many of the existing system modeling frameworks appeared as an integration of the best modeling practices. The reviewed paradigm does not repudiate the practical experience that was gathered by these different frameworks, but fixes its inconsistencies and complements it supporting with logically rigorous theoretical foundations. Therefore the paradigm brings a significant constructive potential to the evolution of modern system modeling frameworks. This potential could be realized if people responsible for the design of modeling frameworks and tools would heed the proposed paradigm.

BACKGROUND

The Cambridge Dictionary of Philosophy (Audi, 1999, p. 641) provides the following definition of the term "paradigm": "Paradigm, as used by Thomas Kuhn (The Structure of Scientific Revolutions, 1962), a set of scientific and metaphysical beliefs that make up a theoretical framework within which scientific theories can be tested, evaluated and if necessary revised."

In practice, a paradigm is usually defined for a collection of sciences. In this context a paradigm introduces and justifies a set of basic assumptions and principles on which any of sciences from the collection can rely as on their foundations. Then, starting from the principles provided by a paradigm, different sciences build their specific frameworks of knowledge. And if some sciences share the same paradigm, then they can bind and synchronize their specific frameworks of knowledge. By doing so they can mutually enrich each other with the knowledge obtained from the different (but consistent with regard to the basic principles) points of view.

The Triune Continuum Paradigm (Naumenko, 2002) is a paradigm for general system modeling. Thus the Triune Continuum Paradigm serves the sciences that have diverse interests in system modeling. As any paradigm, it introduces and justifies a set of principles that provide the sciences with the necessary starting points for building their diverse conceptual frameworks of scientific knowledge, in our case the principles that are necessary for building modeling frameworks.

THREE PRINCIPLES OF THE TRIUNE CONTINUUM PARADIGM

The Triune Continuum Paradigm is composed of three principles.

The first principle is the result of application of Tarski's Theory of Truth (Tarski, 1956) for the case of general system modeling. This application allows defining coherent semantics for the concepts of a modeling framework. This is done by constructing formal descriptions for the relations between the subjects that are interesting to be modeled on one side, and the concepts that have to represent these subjects in the models on the other side. This principle is necessary to assure the *coherency* and *unambiguity* within modeling interpretations performed using a single system modeling framework.

An application of the first principle provided by the Triune Continuum Paradigm results in a system modeling framework that features modeling terms with a coherently defined semantics in the form of Tarski's declarative semantics. The justifications of importance of this principle for the information systems modeling were presented and analyzed in details (Naumenko, Wegmann, & Atkinson, 2003). In particular, it was demonstrated that Tarski's declarative semantics are:

- formally *sufficient* for the definition of the application scope of a modeling language;
- formally *sufficient* for unambiguity in coherency of interpretations within modeling representations; and
- formally *necessary and sufficient* for unambiguity in adequateness of modeling representations.

The second principle of the Triune Continuum Paradigm is the result of application of Russell's theory of types (Russell, 1908) for the case of general system modeling. This application defines the way to categorize concepts of a modeling framework so that in applications of this framework the concepts make up *internally consistent* structures of propositions. Thus this principle is necessary to assure the consistency of descriptions and specifications, which are constructed with the aid of the modeling frameworks.

The importance of this principle is justified by the fact that Russell's theory of types was formulated to resolve Russell's paradox, "the most famous of the logical or set-theoretical paradoxes" (Irvine, 2003). Thus with an application of the second principle of the Triune Continuum Paradigm, the resulting modeling framework in its own applications will produce internally consistent system specifications (i.e., system specifications that are devoid of self-contradictions).

The name of Triune Continuum Paradigm originates from the third theory that was employed for the paradigm definition, from the Theory of Triune Continuum. This theory was defined by Naumenko (2002). This theory allows for the introduction of the abstract ontologies that are formally *necessary and sufficient* to cover the modeling scope of different modeling contexts on the most abstract level.

In particular, the Theory of Triune Continuum was applied in the context of general system modeling (Naumenko, 2002), and this application contributed to the definition of the Triune Continuum Paradigm. The application is the third paradigm principle that allowed introducing and justifying a minimal set of modeling concepts that are necessary and sufficient to cover the representation scope of the general system modeling domain on the most abstract level. This principle is necessary for different system modeling frameworks to justify the existence of their basic modeling concepts.

The Theory of Triune Continuum introduces three continuums that represent in models the scope of general system modeling. The first two continuums are:

- **Spatiotemporal Continuum:** Where subjective space-time metrics are defined to be used in the subjective representations.
- **Constitution Continuum:** Where subjective constitutional metrics are defined to be used in the subjective representations, for example, objects defined in relation with their environments.

These two continuums are introduced in relation with each other as complements within the universal general system modeling scope. In other words, everything in the scope that is not space-time is constitution; and everything in the scope that is not constitution is space-time.

The third continuum is:

- **Information Continuum:** Which emerges from the mutual relations of the first two continuums and contains the corresponding information about these relations, for example, information about objects and their environments being related to the spatiotemporal intervals or to the points in space-time).

Thus the three continuums are *triune*: none of them exist without the others; either the three exist altogether, or they do not exist at all. Indeed, as soon as the first (spatiotemporal) continuum is introduced, everything in the universal scope that does not belong to the first continuum immediately shapes the second (constitution) continuum; and the third (information) continuum immediately emerges as the information about the mutual relations of the first two continuums (e.g., as spatiotemporal information about the constitution).

The third principle of Triune Continuum Paradigm is important for various system modeling frameworks, which are used in diversified domains of human activity (e.g., the frameworks used to analyze, design, and develop coherent structures providing useful functionalities in domains spread from jurisprudence and health care to software engineering and machine-building industries). Using the notion of Triune Continuum it is possible to introduce and justify minimal sets of modeling concepts that are necessary and sufficient for those diversified frameworks to cover their respective representation scopes.

APPLICATIONS OF THE TRIUNE CONTINUUM PARADIGM

The Triune Continuum Paradigm can be applied in practice either to improve an existing system modeling framework or to design a new system modeling framework for a given purpose. Let us mention here three of the existing applications of the paradigm:

- case of the Unified Modeling Language (UML);
- case of the reference model of open distributed processing (RM-ODP); and
- case of the systemic enterprise architecture methodology (SEAM).