

Atlas GeoInformation System and Model. Introduction

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Keywords: model, system, metamodel, modeling

Abstract:

This work is the introductory part of a monograph dedicated to a new class of special spatial information systems, called Atlas Geoinformation Systems (AGIS). Instances of this class, in a certain sense, are best models of the complex spatial phenomena of reality/actuality, such as management of large territories, activities to preserve cultural heritage (CH) and phenomenon of sustainable development of the country. All of them are possible to represent by the so called actuality systems (AS). The relation between AS and AGIS is called modeling.

In the "classic" variant, AGIS is a hierarchy composed from bottom to top by: Electronic Atlases, Atlas Information Systems, and GeoInformation Systems. Hierarchical integration is epistemological. Between the components, "vertically adjacent" in the hierarchy, there are "meta-" relations. They often detailed by two-way relations defined in computer science, such as "instantiation" and "classification". However, the main one is the "conformity" relation, which is horizontal-vertical. A system is defined as a set of different elements connected or linked in such a way as to perform a unique function that cannot be performed by individual elements. Systems of Systems occur when the constituent elements are useful systems in themselves and retain some degree of operational and managerial independence in addition to participating in a larger collection. AGIS is a System of Systems.

Considerable attention is paid to models conformed to AGIS. They called Atlas GeoInformation Models (AGIM). Among such AGIM, preference given to patterns. System patterns AGIS Conceptual Framework and AGIS Solutions Framework introduced in Relational Cartography for Atlas Information Systems (AtIS) in the broader/extended sense (AtISb) are used. Both frameworks characterized by "product-process" dualisms. Their use for AGIS modeling leads to processes, among which are creation processes. Such system patterns are both AGIS meta-models and AGIS creation methods. The application of system patterns implements the conformity relation between AGIS and AGIM, which is a type of metamodeling. In addition, the relation between the constituent components is important in system patterns. In Relational Cartography, transformational, epistemological and evolutionary relations defined.

In practical usage, the relations between AS and AGIS, AGIS and AGIM, and, finally, between AS and AGIM, are modeling relations, so a methodology that could "connect" the listed subjects and the relations between them is of interest. This is the methodology of Model-Based System Engineering (MBSE). The work pays considerable attention to the relations of AGIS and AGIM with MBSE.

The first section provides an overview of such basic concepts as "model", "modeling", "meta-model", "meta-modeling". To review the first three concepts, sources intended for non-specialists in MBSE selected. In particular, the "Reference Conceptual Map for the model" was adapted for work needs. The same made for introduction of metamodeling. Meta-modeling primarily understood as the Epistemology of System Science.

The material of the first section allows formulate a clear **goal** and **subject**. The **goal** of the work is to propose the introductory information on AGIM, useful for creation a special spatial information system – AGIS. AGIS would be, in a certain sense, the BEST representation of spatial AS. The **subject** of the work is introductory information on modeling systems from the AGIS and AGIM classes, as well as on the modeling relations between them and reality/actuality.

The most important clarifications: 1) AGIS should be the simplest possible, but still able to model the Sustainable Development system; 2) AGIS is purposeful on CH, which makes it practically feasible; 3) AGIM should be a pattern, due to which the main system method used to create AGIS is determined, 4) due to the presence of pattern-based AGIM, we can talk about exceeding the normative approach to creating AGIS before the declarative one.

The second section consists of subsections dedicated to the overview of methods, processes and methodology involved in the definition of MBSE methodology. The exception is the "tool" element, included in definition but the least prioritized in this work.

AGIS research and design are using AGIS system methods - patterns/frameworks. The AGIS Conceptual Framework is using for AGIS modeling as a whole, and the AGIS Solutions Framework is using for modeling the products of individual AGIS strata. In addition to defining research products, methods - system patterns - characterized by the "product-process" duality.

Modeling processes are considering in a separate subsection. On the example of AGIS-CH, shown that for such systems advisable to use a known but specific life cycle model - Vee.

One of the most important results of the work is the consideration of modeling methodology usage example of the bottom-up extension of the AtIS "lowest" component through AGIS-CH to the desired AGIS of sustainable development.