

Digital information models as geospatial research tools

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Abstract. The list of sectors of the economy that need digital geoinformation support for territories is growing dynamically. The conceptual and semantic apparatus of digital modeling of objects is developing no less dynamically, which often duplicates the essence of the terms used in geodesy and cartography, but uses other, sometimes contradictory, formulations. The problems of discrepancies in names, formats and the lack of well-established transformation algorithms do not allow achieving the maximum synergistic effect in information modeling technology and in practical economic activity. This work is devoted to identifying and systematizing problems based on an analysis of the current regulatory legal acts and trends in digital information modeling. The approaches to digital information modeling of objects at the micro and macro levels are compared. The possibility of creating new knowledge, not amenable to algorithmization, based on associative perception of a three-dimensional visual image of a model, is considered. Discrepancies of essentially identical terms in the conceptual and semantic apparatus of modeling at the micro and macro levels are presented. The necessity of synchronization of definitions and composition of terms has been established. A mechanism for the formation of a classifier of attributes of a micro-level model based on well-established and debugged terms of a developed set of classifiers used in macro-level models is proposed. Using a specific example of urban environment modeling (CIM), the role of the macro-level model as a consolidating basis for the interoperable integration of heterogeneous micro-level models is substantiated. The problem of developing an optimal algorithm for converting normative formats of data representation of micro-level models into formats of macro-level models and vice versa is formulated. Consolidation of BIM and GIS community resources is proposed for the purposeful development of information modeling technologies.

Keywords: BIM, CIM, RIM, TIM, spatial data, digital information model of the territory, digital model, digital twin, 3D model

REFERENCES

1. Karpik, A. P. (2004). *Metodologicheskie i tekhnologicheskie osnovy geoinformatsionnogo obespecheniia territorii [Methodological and technological basis for GIS support of the territories]* (pp. 15–17). Novosibirsk: Siberian State Academy of Geodesy Publ. [in Russian].
2. Khaidukova, D. M., Lerman, Y. V., & Anashkin, P. A. (2021). Possibilities of using Phase One 190MP aerial system aerial survey results during creation of a territory geoinformation space. In *Sbornik materialov Interexpo GEO-Sibir'-2021: Mezhdunarodnoy nauchnoy konferentsii: T. 3, no. 2. Ekonomicheskoe razvitiie Sibiri i Dal'nego Vostoka. Ekonomika prirodopol'zovaniia, zemleustroistvo, lesoustroistvo, upravlenii e nedvizhimost'iu [Proceedings of Interexpo GEO-Siberia-2021: International Scientific Conference: Vol. 3, No. 2. Economic Development of Siberia and the Far East. Environmental Economics, Land Management, Forestry Management and Property Management]* (pp. 221–227). Novosibirsk: SSUGT Publ. [in Russian].
3. Akhmetov, A. R. (n. d.). Information Modeling Technologies: From BIM to CIM. Moscow: GAU "Institute of the General Plan of Moscow" Publ. Retrieved from https://genplanmos.ru/publication/2018_04_12_tehnologii_informacionnogo_modelirovaniya_ot_bim_k_cim/ [in Russian].
4. Khemlani, L. (n. d.). City zenith Smart World for City Information Modeling. Retrieved from <https://www.aecbytes.com/review/2017/CityzenithSmartWorld.html>.
5. Unsere Lösung für 3D-Stadtmodelle baut auf dem offenen Standard CityGML auf 3D. (n. d.). Retrieved from <https://vc.systems/en/solutions/3d-city-models/>.
6. Maxwell, L. (n. d.). From BIM to CIM: why building and city information modelling are essential to smart cities. Retrieved from <https://hub.beesmart.city/en/solutions/from-bim-to-cim-essential-to-smart-cities>
7. Yankelevich, S. S., & Antonov, E. S. (2019). Concept of a new kind of maps on knowledge-based maps. *Vestnik SGUGiT [Vestnik SSUGT]*, 24(4), 188–196 [in Russian].
8. Kudaev, M. R., Bogus, M. B., & Katova, M. K. (2009). Razvitiie verbal'no-logicheskogo myshleniia obuchaemykh v protsesse formirovaniia kognitivnogo ponimaniia teksta (na materiale gumanitarnykh distsiplin) [Development of verbal and logical thinking of students in the process of formation of cognitive understanding of the text (on the material of Humanities)]. Maikop: ASU Publ., 150 p. [in Russian].

9. BIM-technologies (market of Russia). Information modeling of buildings and structures. (April 01, 2021). Tadviser website. Retrieved from <https://www.tadviser.ru/index.php/> Article: BIM-technologies (market of Russia) [in Russian].
10. Order of the Federal Agency for Technical Regulation and Metrology of 05 June 2019 No. 279-st. On approval of the national standard. Retrieved from ConsultantPlus online database [in Russian].
11. Order of the Federal Agency for Technical Regulation and Metrology of 05 June 2019 No. 281-st. On approval of the national standard. Retrieved from ConsultantPlus online database [in Russian].
12. Order of the Federal Agency for Technical Regulation and Metrology of May 02, 2020 No. 30. About cancellation of standards of the Russian Federation. Retrieved from ConsultantPlus online database [in Russian].
13. Serov, A. V. (2009). Spatial information and its properties. Spheres of application of data models. *Prostranstvennyye dannye [Spatial data]*, 2. Retrieved from <http://www.gisa.ru/54694.html> [in Russian].
14. Order of the Ministry of Construction of Russia of September 18, 2017 No.1227/pr. SP 333.1325800-2017. On approval of the set of rules "Information modeling in construction. Rules for the formation of an information model of objects at various stages of the life cycle". Retrieved from ConsultantPlus online database [in Russian].
15. Order of the Ministry of Construction of Russia of December 31, 2020 No. 928/pr. On approval of SP 333.1325800-2020 "Information modeling in construction. Rules for the formation of an information model of objects at various stages of the life cycle". Retrieved from ConsultantPlus online database [in Russian].
16. Decree of the Government of the Russian Federation of September 12, 2020 No. 1416. On approval of the Rules for the formation and maintenance of the building information classifier. Retrieved from ConsultantPlus online database [in Russian].
17. Decree of the Government of the Russian Federation of September 28, 2020 No.1558. On the state information system for ensuring the town-planning activities of the Russian Federation. Retrieved from ConsultantPlus online database [in Russian].
18. Decree of the Government of the Russian Federation of August 21, 2006 No. 1157-r. About the concept of creation and development of infrastructure of spatial data of the Russian Federation. Retrieved from ConsultantPlus online database [in Russian].
19. Order of the Ministry of Economic Development of Russia of December 24, 2008 No. 467. On approval of the requirements for the composition, structure, procedure for maintaining and using a unified electronic cartographic basis of federal, regional and municipal significance. Retrieved from ConsultantPlus online database [in Russian].
20. Federal Law of December 30, 2015 No. 431-FZ. On geodesy, cartography and spatial data and on amendments to certain legislative acts of the Russian Federation. Retrieved from ConsultantPlus online database [in Russian].
21. Order of the Ministry of Economic Development of Russia of March 29, 2017 No. 142. On establishing requirements for information about spatial data (spatial metadata). Retrieved from ConsultantPlus online database [in Russian].
22. Order of the Ministry of Economic Development of Russia of June 06, 2017 No. 271 (as amended on November 12, 2017). On approval of requirements for state topographic maps and state topographic plans, including requirements for the composition of the information displayed on them, for the symbols of this information, requirements for the accuracy of state topographic maps and state topographic plans, for the format of their presentation in electronic form, requirements for the content of topographic maps, including relief maps. Retrieved from ConsultantPlus online database [in Russian].
23. Anashkin, P. A. (2021). Organizational and regulatory problems of spatial data regional infrastructure functioning. In *Sbornik materialov Interekspo GEO-Sibir'-2021: Mezhdunarodnoy nauchnoy konferentsii: T. 3, no. 2. Ekonomicheskoe razvitie Sibiri i Dal'nego Vostoka. Ekonomika prirodopol'zovaniia, zemleustroistvo, lesoustroistvo, upravlenii e nedvizhimost'iu [Proceedings of Interexpo GEO-Siberia-2021: International Scientific Conference: Vol. 3, No. 2. Economic Development of Siberia and the Far East. Environmental Economics, Land Management, Forestry Management and Property Management]* (pp. 12–21). Novosibirsk: SSUGT Publ. [in Russian].
24. PARB.00046-03 99 02. Software product geoinformation system "Map 2005 version 12" GIS "Panorama x64". Data formats and specifications. Vector format SXF. Data structure in binary form. Published by JSC CB "Panorama" [in Russian].
25. Classifiers. (n. d.). Site of JSC CB "Panorama". Retrieved from <https://gisinfo.ru/classifiers/classifiers.htm>.

26. Building Information Modeling. Information modeling of buildings and structures. (n. d.). Tadviser website. Retrieved from https://www.tadviser.ru/index.php/BIM-Information_modeling_of_buildings_and_structures [in Russian].
27. Levin, D. Ya. (July 1, 2021). Fractal BIM. Review of industry news for June 2021. Isicad website. Retrieved from http://isicad.ru/ru/articles.php?article_num=21931 [in Russian].
28. NANOCAD. Smart design. (n. d.) Site of Nano-soft company. Retrieved from <https://www.nanocad.ru> [in Russian].
29. Renga. Making BIM accessible. (n. d.). Renga website. Retrieved from <https://rengabim.com/application> [in Russian].
30. Order of the Ministry of Construction of Russia of September 18, 2017 No. 1230/pr. SP 331.1325800-2017. On approval of the set of rules "Information modeling in construction. Rules for the exchange between information models of objects and models used in software systems". Retrieved from ConsultantPlus online database [in Russian].
31. Nizhny Novgorod. Application of CIM (City Information Modeling) technology at the facilities of Russian cities: a brief overview. (n. d.). NPK Integral website. Retrieved from <http://integral-russia.ru/2021/05/14> [in Russian].
32. Order of the Ministry of Construction of Russia of March 1, 2021 No. 99/pr (as amended on May 20, 2021). On approval of the Plan for the development and approval of codes of practice and updating previously approved building codes and regulations, codes of practice for 2021. Retrieved from ConsultantPlus online database [in Russian].
33. Amendments No. 1 to SP 48.13330.2019 "SNIP 12-01-2004 Organization of construction". [Electronic resource]: Draft changes (prepared by the Ministry of Construction of Russia). Retrieved from <https://www.normacs.info/discussions/7520> [in Russian].

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