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# CARTOGRAPHICAL PATTERNS AS THE MEANS OF BIG DATA HANDLING IN ATLAS MAPPING

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**Key words:** Big Data, Cartographical Patterns, Atlas, GeoSolutions Framework.

**Introduction**

We knew about the phenomenon which called now "Big Data" more than 15 years ago in the projects of the French-German Initiative for Chernobyl (FGI). With the aim of proper information handling connected to the consequences of Chornobyl disaster, two interrelated means were used – Project Solutions Framework (ProSF) and weak integration of projects results and materials with the help of special-purpose portal solution ISGeoTripleNet Software Suite. At the same time, Project Solutions Framework was expanded to the GeoSolutions Framework (GeoSF) which in its turn was proposed as the tool for National Spatial Data Infrastructure (NSDI) creation [Chabanyuk V. S., Dyshlyk O. P., Markov S. Yu., 2005].

The second experience we dealt with the Big Data in the National Atlas of Ukraine (NAU) project which started over 15 years ago. This project is still in progress now, because NAU products require everlasting support, updating and evolution. In order to handle the Big Data for NAU project, specialization of GeoSF – an Atlas Solutions Framework (AtlasSF) – was used [Rudenko L. G., et al., 2007].

Due to the tremendous changes in the IT area for the last 5–10 years, we involved additional information handling means (especially means related to the geosystem models). Therefore, we used Conceptual Framework of electronic atlases and atlas information systems (CF AtIS) and other necessary means.

**Big Data in the projects of "The French-German Initiative For Chernobyl'"**

In July 1997, IPSN (France), GRS (Germany) and the Chornobyl Centre for Nuclear Safety, Radioactive Waste and Radioecology (Ukraine) have signed a co-operation agreement and leaded the so called "The French-German Initiative For Chernobyl" (FGI) activities. The FGI objective was to create a reliable and objective information database on radiation, ecological, and medical consequences of the Chornobyl accident. The FGI consisted of three Projects, implemented in period 1998–2003:

1. Sarcophagus safety (6 Sub-Projects) [Pretzsch G., et al., 2005]. Abbreviation: Project 1 "Shelter".
2. Radioecological consequences of the Chernobyl accident (9 Sub-Projects) [Deville-Cavelin G., et al., 2007]. Abbreviation: Project 2 "Radioecology".
3. Health effects of the Chernobyl accident (10 Sub-Projects) [Tirmarche M., et al., 2006]. Abbreviation: Project 3 "Health effects".

Within the framework of Project 1 "Shelter" the data on the Shelter Object status and its environmental impact have been collected, analyzed and systematized. As a result of Project 2 "Radioecology", a database including ecological overview of the radioactively contaminated areas, data on radioactive waste (RAW) dumps and RAW management strategies, radionuclide transfer, countermeasures for natural and agricultural areas rehabilitation has been created. Implementation of Project 3 "Health effects" allowed collecting and systematizing the data on cancer frequencies among the victims, on infant morbidity and mortality, food practices and nutritional status, and on doses received by the Liquidators.

More than 20 scientific and research institutes and organizations of Ukraine, France, Germany, Russia, and Belarus took part in the database creation. The total number of "thematic" Sub-Projects was 52. The situation was complicated by the fact that relevant databases shall be related to each subject and shall be established by research institutions in Belarus, Ukraine and Russia, each having very different experience in IT development. Moreover, geo-information products were used for all three Projects: ArcView for the Project 1, MapInfo Professional for Projects 2 and 3.

Such situation fully fits to the "three-Vs rule" which characterizes Big Data: Volume, Variety and Velocity. In order to coordinate the development of numerous information products, to control and to keep the obtained results, we have advanced the following ideas:

1. To find or create the set of means which may simplify and universalize the process of products' development for each Sub-Project and ensure the efficient management and coordination both of each Project (i.e. Sub-Projects of the Projects 1, 2, 3) and FGI in general.
2. To apply the notion "weakly integrated information system" to the results and materials of the Projects by interpreting the term "information system" in its broader sense.

Implementation of the 1st idea resulted in the Project Solutions Framework, which model is the following:

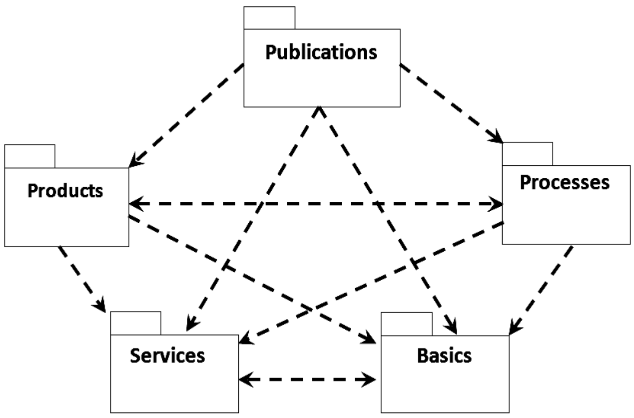


*Fig. 1. ProSF Model. Arrows show usage relations between packages*

In FGI Projects this model had two realizations: 1) in the form of an ordinary operating system catalogues which contain files samples and templates (version 1), 2) file structure of version 1, supplemented by metadata database and specialized portal software ISGeoTriNet, which supported not only development of file structure for organization and description of the results and projects materials, but also relations between them and authorized access for users to the content through the portal. One of possible realizations of ProSF model is described below.

Package Publications contains samples and templates of: Web-site, presentation, paper publication, demo version of project result (product). It is intended for communication with the external environment of the project.

Package Products contains samples and templates of: database, map, software, report; their descriptions and metadata; operational documentation. It is intended for the developers of project products.

Package Processes contains samples and templates of project business-processes: requirements management, planning, supervision, quality control and configuration management. It is intended for the project management.

Package Services contains specialized portal software ISGeoTriNet, ProSF operational documentation, and samples and templates of: training materials, meta-database, elements of products design, electronic and paper storage of project results and materials. It is intended for the administrator, documenter and/or user trainer.

Package Basics contains global information resources of the project: glossary, data dictionaries, classifiers, base map, geoobjects database. It is intended for (elementwise) all project participants. It is supported by the architect and project management.

Application of described ProSF realization gave an opportunity to organize the results and materials into the information system in its broader sense[1] and weak integrated information system in desktop and portal versions. The portal information systems are characterized by meta-database that describes portal content and helps to work on portal content through Web interface. In the portal version the approach to the data integration was “enhanced” comparing to the desktop version. For this purpose Digital Dashboards, Web Parts and Portlets (predefined combinations of Web Parts) tools as addition to database tools were used.

REDAC3W – RadioEcological Database After Chernobyl, version 3, Weak integration of Project 2 results and materials, HEDAC – Health Database After Chernobyl, weak integration of Project 3 results and materials. ChIIS-FGI2 – Chernobyl Internet/Intranet Information System, version 2, weak integration of FGI Projects 1-3 results and materials.

Project Solutions Framework was also used in the Joint Swedish-Ukrainian project “Capacity Building for the Implementation of a National Geospatial Data Infrastructure in Ukraine”. ProSF was expanded to the GeoSF which was used for the creation of NSDI prototype in Ukraine. There are two important differences between these frameworks:

1. GeoSF consists of two frameworks: ProSF and ComSF (Company Solutions Framework). GeoSF.ComSF is aimed at the improvement of the enterprise architectures of the organizations that produce, supply and consume geoinformation products and services.

2. GeoSF.ProSF was adapted to the usage in the projects dedicated to spatial databases and electronic maps development.

Each framework that forms GeoSF fully corresponds to the ProSF model (see fig. 1). Therefore, such model is called also as the GeoSF Model [Chabanyuk V.S., Dyshlyk O.P., Markov S.Yu., 2005].

**Big Data in the Electronic Version of the National Atlas of Ukraine**

DVD version of the National Atlas of Ukraine (hereinafter – ElNAU2007, see [Rudenko L.G., et al., 2007] may not fall under the category of Big Data, because its total capacity on DVD is less than 3 GB. However, after the date of ElNAU 2007 edition its developers faced some problems which may be solved with the help of Big Data handling means.

The most frequent problem which occurs while maintaining electronic atlases is associated with the maintenance of the following software versions of the previous file format. For example, Adobe Flash Player OCX Control 10 is not compatible with the Version 9 and SWF format being used for the many of ElNAU2007 maps and their visualization.

Such problem may be characterized as the problem related to the breakdown of a separate function. For example, malfunction of the content tree in the ElNAU pilot version due to the changes in syncURL of the hhctrl.ocx in Windows 7 (hereinafter – ElNAU2000, see [Bochkovska A.I., et al., 2000]). Such problems may be solved through refactoring[2], if we control: 1) Atlas dataware, 2) The whole atlas as the information system (including architecture, software, dataware and documents).

The structure and content are controlled through GeoSF specialization for atlas cartography known as Atlas Solutions Framework (AtlasSF), which Products package consists of eight patterns and one framework: 1) User Interface; 2) Content/solution Tree; 3) Cartographic Component; 4) Thematic Map; 5) Document Template (for example, HTML documents or photography); 6) Base Map; 7) Atlas Search; 8) Atlas Presentation (Workspace); 9) Atlas Architecture Framework which unites patterns 1–8.

Such approach facilitates the execution of the tasks such as refactoring (fault resolution) and designing of other atlases being similar to the ElNAU2007. These similar atlases are known also as classic atlases.

By using AtlasSF, some other classic atlases were created, for example, Atlas of Radioactive Contamination of Ukraine , which was released on CD in 2002 (Version 1.0, hereinafter – RadAtlas2002) and in 2008 (Version 2.0, hereinafter – RadAtlas2008).

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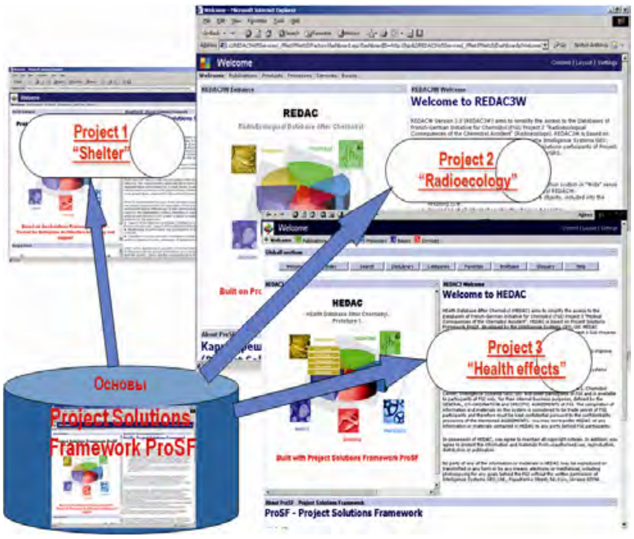
[1] Information System in the broader sense (ISb): The totality of all formal and informal data representation and processing activity whithin an organization, including the associated communication, both internally and with the outside world [Falkenberg E. D., Lindgreen P., Eds., 1987].

[2] Refactoring is the process of changing a software system in such a way that it does not alter the external behavior of the code yet improves its internal structure [Fowler M., Beck K., Brant J., et al., 1999].

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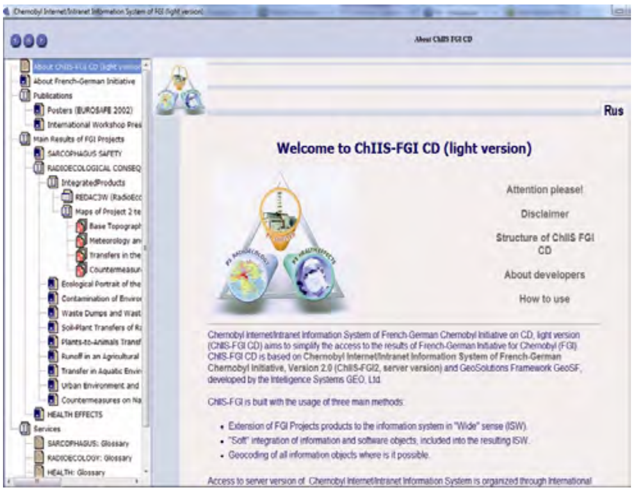


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*Fig. 2. Results of the ProSF application for the Projects 1–3 of the FGI: a – REDAC3W, HEDAC and ChIIS-FGI2 portals; b – ChIIS-FGI CD (light version)*

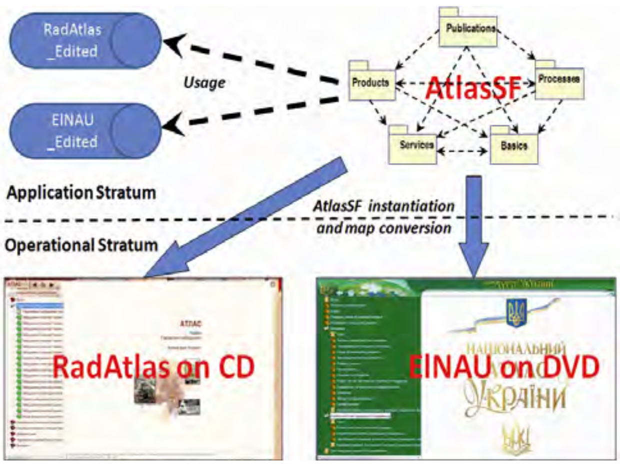


*Fig. 3. Principle of AtlasSF usage for classic atlas creation*

It should be noted that classic atlases ElNAU2000, RadAtlas2002, ElNAU2007, RadAtlas2008 were designed with the account of dominance of Windows operating system and Internet Explorer browser. Internet Explorer maintains user interface through HTML pages rendering and operating as the ActiveX objects that deal with the content tree and the map. Nowadays, only small percentage of users browses through the Internet Explorer. Even those users who have Windows installed use such browsers as Chrome, Firefox, Opera etc. Moreover, popularity of mobile devices with Android or iOS operating systems is considered to be the revolution changes in IT world. Therefore, it is more than enough to illustrate the impossibility to provide the reliable performance of the classic atlases within significant time period.

It is also important to note about another problem which is fundamental, namely the problem regarding development of new modern atlases. To resolve described problems we have performed re-engineering[3] of the whole project. The main result of such re-engineering is the ElNAU Conceptual Framework (CF) [Chabanyuk V.S., Dyshlyk O.P., 2014]. ElNAU CF is correct for every classic atlas, including RadAtlases of both versions. This work demonstrates the framework only and necessary comments upon it. As classic atlases are known also as Web 1.0 atlases, we use this term for fig. 4 to mark the classic atlases.

In consideration of the foregoing, it is better to use the term "Classic atlas information system" (CAtIS) instead of "Classic atlas" and instead of ElNAU CF we should use CAtIS CF. Both CAtIS CF and ElNAU CF define the conceptual structure of ElNAU ISb, which was created through combination of ElNAU2000, ElNAU2007, ElNAU2010 editions and ISb known as ElNAU Infrastructure[4].

ElNAU2000, ElNAU2007 and ElNAU2010 atlases create the Operational stratum of ElNAU ISb. ElNAU Infrastructure creates Application, Conceptual and General strata of ElNAU ISb. This ElNAU ISb fits into category of the Big Data. AtlasSF, mentioned above, is also known as Atlas Solutions Application Framework Web 1.0 αAtlasSF1.0. It is belongs to Application stratum. ElNAU2000, ElNAU2007, ElNAU2010 dataware are also belong to this stratum and is used for creation of the Operational stratum maps and documents. Moreover, Application stratum includes the atlas known as ElNAU_Edited. This atlas presents the maps in MapInfo Professional and Adobe Illustrator formats which enables their editing. There is also Web 1.0 AtlasSF of the Conceptual stratum which is marked as βAtlasSF1.0.

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[3] Reengineering, also known as both renovation and reclamation, is the examination and alteration of a subject system to re constitute it in a new form and the subsequent implementation of the new form [Chikofsky E., Cross J., 1990].

[4] Infrastructure (lat.*Infra* – "lower" and *Structura* – construction) of the ElNAU is defined as the complex of interrelated structures that comprise and/or provide the basis for the task execution: operability support, update and development of ElNAU2000, ElNAU2007, ElNAU2010 Atlases and design of the new ElNAU versions.

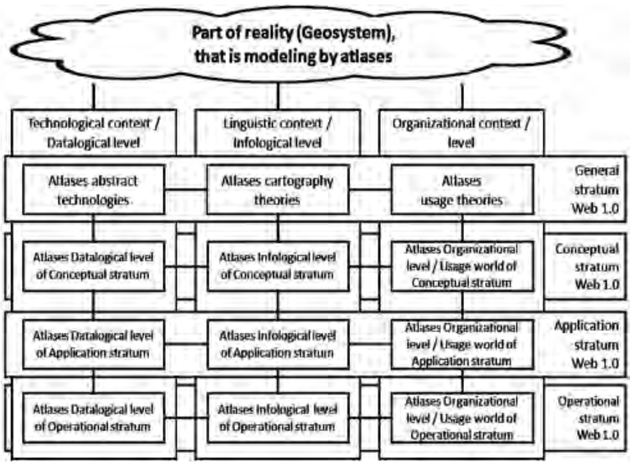



*Fig. 4. Conceptual Framework of ElNAU and other classic atlases*

In [Chabanyuk V. S., Dyshlyk O. P., 2014] CAtIS CF was received through so-called abductive inference. In other words, we have started from the practical methods. At the same time, both levels and strata are well known and quite frequent in use in IT area. For example, a monograph [Olive A., 2007] analyzes a well-known standard ISO/TR 9007:1987 “Concepts and terminology for conceptual schema and the information base”, which defines the object of Infological level – conceptual scheme – and also defines its interrelation with the object of Datalogical level – an information base. [Olive A., 2007] deals also with the Meta-information system (MIS) and its relation to the Information System (IS). According to the CAtIS CF, MIS belongs to the Conceptual stratum, while IS belongs to the Application stratum. Therefore, CAtIS CF may be received with the help of more formal methods, like deductive inference.

It is also important to define the meaning of the term “Information system”. According to the [Olive, 2007], Information system is the system designed for the collection, storing, handling and distribution of information about the state of a domain. To make this definition more useful, there are defined the following functions of IS: 1) to remember: to maintain the domain state; 2) to inform: to provide information on the domain state; 3) to be active: to perform any actions being necessary for changes of the domain state.

It should be noted that according to this definition, classic atlases of Operational stratum (for example, DVD version of ElNAU), do not support the function of domain state change, while classic atlases of Application stratum (ElNAU_Edited), may perform such changes. This is the main difference between the Operational and Application strata.

CAtIS CF (Figure 4) illustrates the structure of electronic classic atlases. However, nowadays we can see the atlases which can be called as the neoclassic atlases. Therefore, the atlas systems connected thereto shall be marked as the NAtIS. It means that AtIS CF has third dimension which may be called as formations. We distinguish the following formations: Web 1.0, Web 1.0x1.0, Web 2.0 and Web 3.0.

We adhere to the definitions of the terms Web 1.0 and Web 2.0 set by [O’Reilly T., 2005]. Web 3.0 shall be deemed as the oncoming formation which is now unattainable and may not be taken into consideration. Web 1.0x1.0 formation is known as the formation which differs from the Web 1.0 by its ability to change the atlas elements by the “user”. Moreover, Web 1.0x1.0 uses HTML5 instead of HTML4. Finally, Web 1.0x1.0 is used for the mobile powered atlases without Internet connection, which, however, may be connected to the Internet and perform server swapping.

**Patterns of the Big Data Cartography: To Be or Not to Be**

For the purposes of this research, the pattern is defined as a common solution to a common problem in a given context, while the framework is defined as an architectural pattern that provides an extensible template for applications within a domain [Booch G., Rumbaugh J., Jacobson I., 2005].

The patterns are widely used for creation of the information systems over the last 20 years from the publication of the monograph [Gamma E. et al., 1995]. In addition to the patterns usage as the software elements (design patterns in [Gamma E. et al., 1995]), we can observe the popularity of patterns usage for other IS elements. Thus, a monograph [Blaha M., 2010] describes the patterns usage as the dataware elements. The other monograph [Ackerman L., Gonzalez C., 2011] also exemplifies the patterns usage for IS development processes as addition to their usage for the products (IS software or dataware elements). According to the AtIS CF, such patterns shall be included to the strata that are placed above the Operational. In general, the issue regarding usage of patterns in information systems has been discussed in numerous studies – for example, there are more than 100 monographs dedicated thereto.

Electronic atlases are information systems. It also should be noted that paper atlases shall also fall under the category of information systems and even shall be classified as the classic atlases. The vast majority of other cartographic systems shall also thought to be the information systems. Therefore, it looks quite unusual why usage of patterns in modern cartography is so unpopular today. The works that deal with the cartographic patterns are not very numerous. Thus, only Chapter 12 of the [Karimi H.A., Ed., 2014] deals with the patterns as the means of Big Data handling. Cartographical patterns are described in the monograph [O’Sullivan D., Perry G. L. W., 2013].

The sources mentioned above are dedicated to the patterns usage as the means of specific geographical things research. Therefore, it is better to name them as the “things” cartographical patterns. The patterns being the subject of our research shall be named as the “relational” cartographical patterns according to the following definitions.

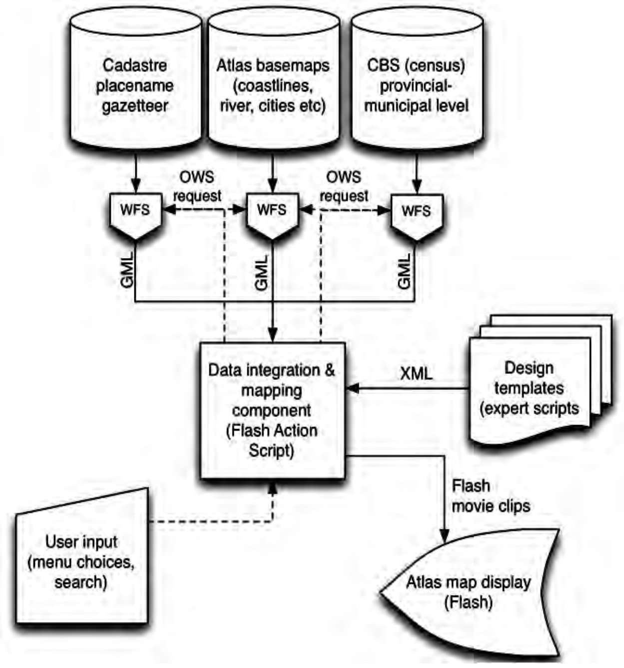
A geographical system (geosystem) is an ordered pair (A, R), where A denotes a set of relevant things, some of which are geographical, and R denotes a relation among the things in set A. To make such a conception of a system pragmatically useful, it has to be refined in the sense that specific classes of ordered pairs (A, R), relevant to recognized problems, must be introduced. Such classes can basically be introduced by one of two fundamentally different criteria: a) by a restriction to systems which are based on certain kinds of things; b) by a restriction to systems which are based on certain kinds of relations. Classification criteria (a) and (b) can be viewed as orthogonal. The term “relation” is used here in a broad sense to encompass the whole set of kindred terms such as “constraint”, “structure”, “information”, “organization”, “cohesion”, “interaction”, “coupling”, “linkage”, “interconnection”, “dependence”, “correlation”, “pattern”, and the like. This definition is the adaptation of the relevant definition from [Klir G. J., 1985].

Cartographical system is the model of a geographical system, where geographical things (phenomena) are represented in the form of maps. As the patterns being the subject of our research are aimed at the investigation of relations between the cartographical systems’ objects, it is necessary to use the adjective “relational” with the term “cartographical pattern”.

Does it mean that absence of relational cartographical patterns in cartography is the sign that we are doing something wrong? Does it mean that our approach to the Big Data handling is not of considerable importance? We cannot give the final answer now. We can observe both pros and cons.

GeoSF Model has been implemented twice: as the portal system GeoSF and as the AtlasSF. Portal system GeoSF was used for the creation of FGI weak integrated information systems also as for the National atlas portal prototyping (see [Rudenko L. G., et al., 2007]). Some classic national and thematic atlases (or Web 1.0 atlases) were created with the help of AtlasSF. Apart from the final user’s production (for example, DVD version of the ElNAU), each atlas has its own infrastructure used for support and evolution. Such infrastructure of each Atlas on the Application stratum has its own structure very similar to the GeoSF Model. The process of thematic maps’ construction is also very important. If we limit to the Datalogical level, we can say that there is the technology that let us construct various thematic maps. If we look into the Infological level, we have to admit that methodology of thematic maps construction requires further research. Conceptual stratum has been studied less than the Application one. But it is should be noted that Conceptual stratum contains such objects as basic map and geoobjects database, including the description of administrative-territorial division of Ukraine.

The worthiness of our approach may be evidenced by the works of the Dutch atlas school (see [Kraak M.-J., et al., 2009], [Köbben B., 2013] and others). We use the AtIS CF for analysis of the Electronic version of the National Atlas of Netherlands (hereinafter – ElNAN). For this purpose, let us represent the conceptual structure of ElNAN (fig. 5).

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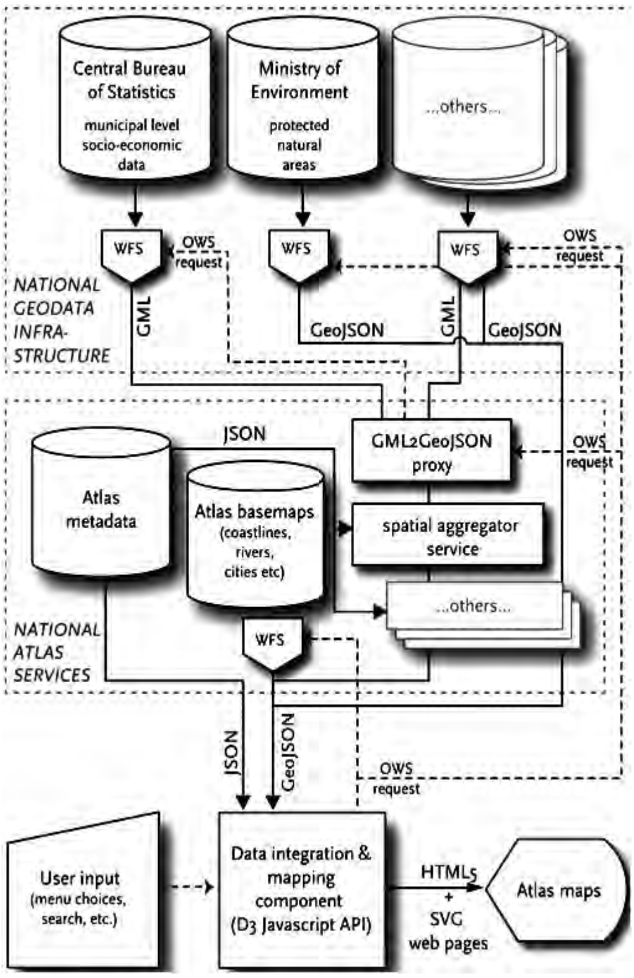


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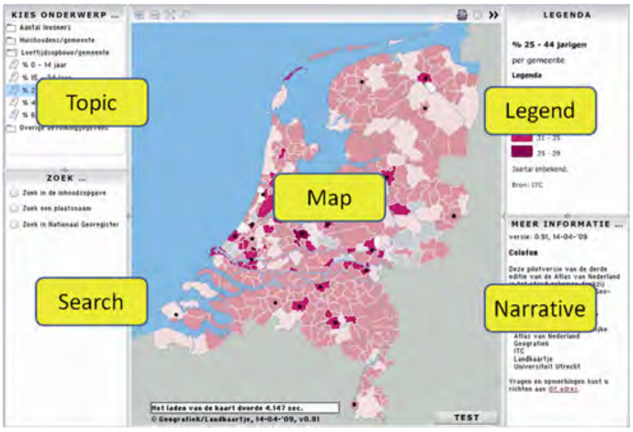
*Fig. 5. Conceptual structure of the National Atlas of Netherlands according to: a – [Kraak M.-J., et al., 2009]; b – [KöbbenB., 2013]*

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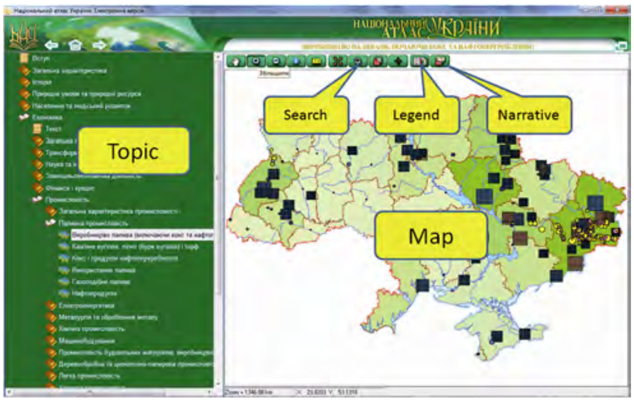


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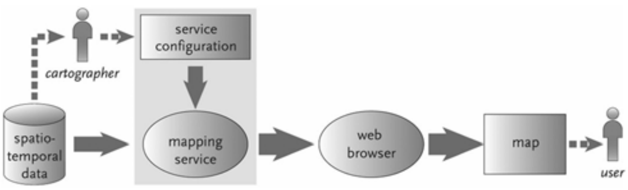
*Fig. 6. Comparison of National atlases interfaces: a – the Netherlands [Kraak M.-J., Ormeling F., Köbben B. etal., 2009]; b – Ukraine*

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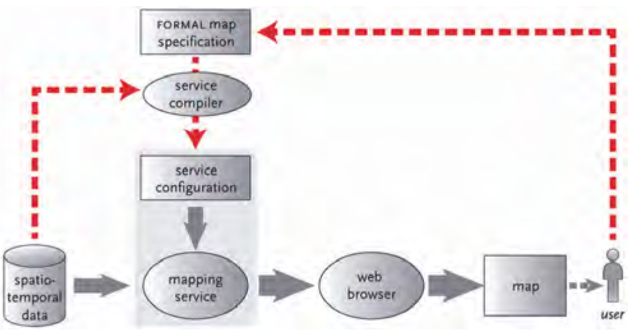


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*Fig. 7. a – General principle of current practice in dissemination of maps in a Service-Oriented Environment; b – Possible set-up of dissemination of maps in a Service Oriented environment with a fully automated service configuration [Köbben B., 2013]*

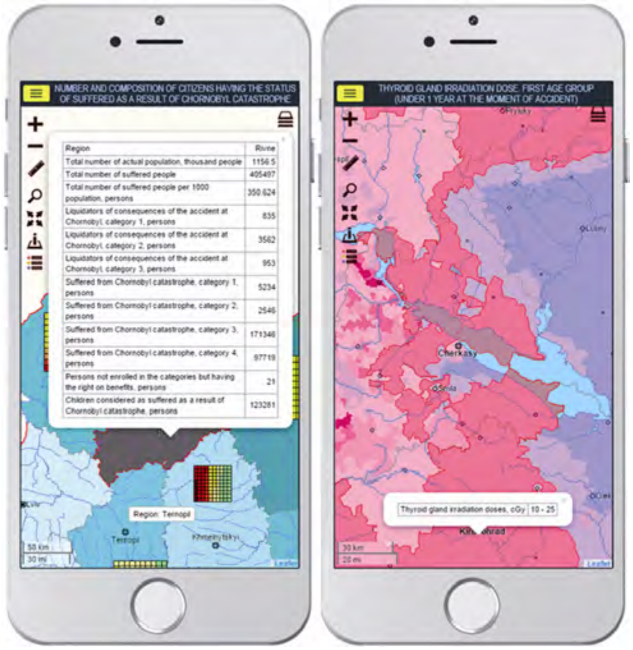

*Fig. 8. Mobile (Web 1.0×1.0) version of the RadAtlas2014*

Results of comparison between ElNAN and ElNAU user interfaces are represented on the Figure 6, which may conclude that “operational” atlases are quite similar. The differences in implementing (ElNAU is HTML4 document, ElNAN was Flash document (2009), but now it works as the HTML5 document (2013)) are not significant, because both programs operate as the Web 1.0 programs. Changes in content in both cases occurred on the Application stratum. Therefore, an average user deals with the similar cartographic systems on the Operational stratum. Moreover, we took into consideration the fact that ElNAU publication on the Internet is not very difficult, because we have used ElNAU cartographic software, which is quite similar to the pair MapInfo MapX and MapXtreme, for Web projects.

In our opinion, National Atlas Services, which are demonstrated on the Figure 5b belong to the Application stratum. We would describe only two differences.

1. Manipulation with the Application stratum objects is performed manually in case of ElNAU ISb, while objects of ElNAN ISb are manipulated automatically.

2. The process “Data integration & mapping component (D3 JavaScript API)” is performed manually for ElNAU ISb on the Application stratum, while similar tasks for ElNAN ISb are manipulated automatically beyond the National Atlas Services.

Let us investigate the second difference. According to the Data integration & mapping component description from [Köbben B., 2013], the Figure 5b does not illustrate a very important object which serve as an analog to the “Design template (expert scripts)” object (fig. 5, a). See fig. 7, a instead.

According to the Figure 7a “…(D3 JavaScript API)” object is the automatic part of the Datalogical level only. Cartographers here shall perform important “infological” operations manually. [Chabanyuk V.S., Dyshlyk O.P., 2014] describe several infological concepts of the Application level, which are used by the qualified cartographers: 1) hierarchic thematic structuring of the modeled reality, 2) organization of the cartographic dataware into the layers with accentuation of the base map layers according to the hierarchic thematic structure; 3) semantic (thematic) cartographic modeling of specific "themes" of reality; 4) variability of the atlas dataware depending on the cartographer's preferences. It is hardly impossible to automatize such concepts, therefore, it is not important for us where the datalogical integration takes part – either at the client or on the server. In other words, "Data integration & mapping component (D3 JavaScript API)+" belongs to the Application stratum of the Web 1.0 formation.

According to the AtIS CF, National GeoData Infrastructure belongs to the Conceptual stratum. Thus, ElNAU and ElNAN structures are very similar in the context of strata. For example, the data of the National Statistics Services of Ukraine were used for the maps of ElNAU "Population and Human Development" and "Economy" blocks by cartographers, which is quite similar to the Central Bureau of Statistics in Netherlands. It is important to note the "migration" of the base map between Conceptual (Figure 5a) and Application (Figure 5b) strata. Such discrepancy may be explained by the differences between implementation of the base map on these two strata.

To conclude our analysis regarding usage of the ElNAU CF for the National Atlas of The Netherlands, see the Figure 7b of [Köbben B., 2013]. In our opinion, implementation of this scheme is seriously limited by the following factors:

1. The classic cartography proposes no theory that may resolve the problem of the formal map specifications. In our opinion formal map specification is impossible without suitable theory.

2. According to the AtIS CF, Organizational level of the Conceptual and General strata require strong background knowledge, which may not be possessed by an average atlas user (who serves as an object of the Operational stratum). It is needed to define which "user" is shown on Figure 7b.

3. Notwithstanding the results of application of HTML5 or service-oriented architectures by ElNAN [Kraak M.-J., et al., 2009], [Köbben B., 2013], such prototype may not be considered as the member of more advanced Web 1.0x1.0 or Web 2.0 formations. It is also should be noted that latest ElNAN publications exclude the "third" world, which was studied in 2009 – Virtual Globes (see [Köbben B., Graham M., 2009]). In our opinion, Conceptual and General strata and Language and Organizational contexts of Web 1.0x1.0 and Web 2.0 formations require further studies.

Due to the capacity limitations, we cannot prove the applicability of the AtIS CF to the studies being performed within the scope of Cybercartography. We would like to point only the parallels between AtIS CF and Cybercartography model constructions (see, for example [Taylor D. R. F., Ed., 2005; Chapter 3, pp. 35–61] also as between GeoSF, AtlasSF and Cybercartographic Atlas Framework (see, for example, [Taylor D. R. F., Ed., 2014; Chapter 9, pp. 129–140] and http://nunaliit.org/, accessed 09-nov-2014.

**Conclusion**

In both abovementioned experiences with the Big Data handling we had to build (dealt with) multilevel hierarchical Atlas information systems in a broader sense – AtIS. Recent studies of the authors [Chabanyuk V. S., Dyshlyk O. P., 2014] show that the structure of these systems corresponds to the specific Conceptual framework AtIS. This framework also corresponds to the union of the National Atlas prototype and NSDI of the Netherlands and also to the Radioecological GeoInformation System (RGIS). RGIS is not described in this work. It integrates other Big Data – large number of information products, created by the authors and their colleagues in the works on liquidation of consequences of the Chornobyl accident. The consequences of the Chornobyl accident can be understood as a large thematic geosystem. RGIS Operational stratum subsystem is the Atlas of Radioactive Contamination of Ukraine.

The gathered experience and its comprehension allow us to make a conclusion that attempts to simulate large national or thematic geosystems inevitably lead to the information systems with abovementioned AtIS structure. Such AtIS has described above context (level), stratum and formation hierarchies. The following sentences are true for them:

– Consistent vertical order of the subsystems that build the entire system (vertical decomposition).

– The priority of action or the right of intervention of the top-hierarchy subsystems. The dependence of the action of the top-hierarchy subsystems from the actual performance of the lower hierarchies subsystems of their functions.

– Understanding of the system increases with successive transition between contexts, stratums and formations: the lower we descend in the hierarchy, the more detailed becomes explanation; the higher we raise the clearer the meaning and significance of the entire system.

In more detail:

1. The patterns ProSF, GeoSF, AtlasSF and especially AtIS CF are useful means of Big Data handling.

2. Architectural pattern AtIS CF may be useful in the process of Big Data national and thematic geosystems modeling. In order to develop modern National Atlases and Spatial Data Infrastructures, it is very important to take into consideration all hierarchical relations between AtIS strata, levels and formations, taking into account the specific geosystem context.

3. The obvious tendency for Big Data approaches to concentrate on the Technological context may not bring significant results, if designers will neglect the objects from and relations with Language and Organizational contexts.

4. ProSF, GeoSF and AtlasSF may help designers to find and use the most reusable solutions for typical tasks.

Web 1.0×1.0 and Web 2.0 formations deserve individual attention. From the viewpoint of modern cartographic systems, these formations are outside the classic cartography and classic atlases such as the National Atlases of the Ukraine and the Netherlands. Created atlases correspond to the vision of the "classic" cartographers about the cartographical models of geosystems. "Neoclassic" cartographers create non-classic cartographical models of geosystems in the formations of the Web 1.0×1.0 and Web 2.0. AtIS CF draws attention to the fact that there are relations between of the Web 1.0 formation on the one hand, and the Web 1.0×1.0 and Web 2.0 formations on the other hand. According to authors' opinion, the search of these relations is one of the most important tasks of modern cartography.

Researches on the creation of electronic atlases of the Web 1.0×1.0 and Web 2.0 formations are conducted in the Institute of Geography of National Academy of Sciences of Ukraine within the framework of the project "Atlas of natural, man-caused and social risks in Ukraine". First results are shown on the Figure 8. Additional information about the results of this and other our projects can be found on the Web-site http://geo-popularization.com.

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**Картографічні каркаси як засіб оперування великими даними в атласному картографуванні**

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Описано можливості створення електронних атласів та/або атласних інформаційних систем за допомогою картографічних каркасів у процесі обробки великих даних. Автори проаналізували попередній досвід щодо поводження з великими даними, напрацьований під час виконання проектів у межах франко-німецької ініціативи та інших проектів, зокрема проект створення цифрової версії Національного атласу України. Увагу зосереджено на реляційних (архітектурних) каркасах, а саме ProSF, GeoSF, AtlasSF і AtIS CF (концептуальний каркас атласної інформаційної системи). Крім того, AtIS CF використано для аналізу прототипу Національного атласу Нідерландів, щоб довести схожість між двома підходами. Представлено авторську думку щодо каркасів, які можуть бути ефективним засобом опрацювання великих даних у сучасній картографії.

**Картографические каркасы как способ оперирования большими данными в атласном картографировании**

В. Чабанюк, А. Дышлык

Описано возможности создания электронных атласов и/или атласных информационных систем с помощью картографических каркасов в процессе обработки больших данных. Авторы проанализировали предыдущий опыт по обращению с большими данными, который был получен при выполнении проектов в рамках франко-германской инициативы и других проектов, в том числе проект создания цифровой версии Национального атласа Украины. Внимание сосредоточено на реляционных (архитектурных) каркасах, а именно ProSF, GeoSF, AtlasSF и AtIS CF (концептуальный каркас атласной информационной системы). Кроме того, AtIS CF использован для анализа прототипа Национального атласа Нидерландов, чтобы доказать подобие между двумя подходами. Выводы представляют авторскую мысль о каркасах как эффективном средстве обработки больших данных в современной картографии.

**Cartographical Patterns as the Means of Big Data Handling in Atlas Mapping**

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This article describes the possibilities of designing of electronic atlases and/or atlas information systems with the help of cartographical patterns in the process of Big Data handling. The authors have analyzed the previous experience regarding Big Data handling which was performed as the part of the French-German Initiative and other projects dedicated thereto, including the project dedicated to the National Atlas of Ukraine. The article focuses upon the relational (architectural) patterns, namely ProSF (Project Solutions Framework), GeoSF (GeoSolutions Framework), AtlasSF (Atlas Solutions Framework) and AtIS CF (Atlas Information Systems Conceptual Framework). Furthermore, AtIS CF is used for the analysis of the National atlas of Netherlands prototype to prove similarity between two approaches. Conclusions are representing authors opinion concerning the patterns as the means of Big Data handling in the modern cartography.