ЗАПРОШУЄМО ДО ДИСКУСІЇ

Від редакції

У цій рубриці представлено роботу В. Чабанюка та О. Дишлика "Реляційна картографія: предмет дослідження", яка є наслідком досліджень авторів у галузі теоретичної картографії. На думку авторів, картографам час звернути увагу на такі сучасні «некласичні» картографічні явища, як гео- і/або карто- платформи епохи Веб 2.0 (OpenStreetMap), просторові інфраструктури (INSPIRE/ELF) та інші. Автори наголошують на необхідності нового виміру теоретичної картографії – Реляційної картографії, що визначається як узгоджені мистецтва, науки і технології виготовлення й використання відношень всередині картографічних систем і між картографічними системами.
Англомовний варіант статті дозволить розширити аудиторію для дискусії.

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RELATIONAL CARTOGRAPHY: RESEARCH SUBJECT

The article studied one of the three basic components of Relational cartography as a new scientific theoretical costruction – research subject. With the usage of such modern phenomena as 1) geo- and/or carto-platforms of Web 2.0 epoch (e.g. OpenStreetMap) and 2) spatial infrastructures (e.g. INSPIRE/ELF), are described examples of Relational cartography relations. The new definition of cartography is proposed. This definition allows including into the research subject of cartography modern cartographic phenomena, described in the article.
Keywords: *relational cartography; geomatic cartography; map- and geo- platforms; geospatial data infrastructure; atlas frameworks and platforms.*

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РЕЛЯЦІЙНА КАРТОГРАФІЯ: ПРЕДМЕТ ДОСЛІДЖЕННЯ
У роботі розглянуто один з трьох основних компонентів Реляційної картографії як нової наукової теоретичної конструкції - предмет дослідження. З використанням таких сучасних явищ, як 1) гео- і/або карто- платформи епохи Веб 2.0 (наприклад, OpenStreetMap) та 2) просторові інфраструктури (наприклад, INSPIRE/ELF), описані приклади відношень Реляційної картографії. Запропоноване нове визначення картографії, що дозволяє включити до предмету її дослідження описані у статті сучасні картографічні явища.
Ключові слова: *реляційна картографія; геоматична картографія; карт- і гео- платформи; інфраструктури геопросторових даних; атласні каркаси і платформи.*

Problem definition

Cartography is (disciple that deals with)[1] art, science and technology of making and using maps (http://icaci.org/mission/, site of ICA - International Cartographic Association, accessed 2016-apr-19). This definition has been recorded in the ICA Strategic Plans for 2003-2011 and assumes its update in 2011-2019. However, ICA President prof. M.-J. Kraak in his opening speeach on the European cartographic ICA Symposium (Vienna, 10-12 November 2015: http://eurocarto.org/, accessed 2016-aug-19) argued that this definition is still 'operational'. Based on years of experience in the atlas cartography, authors formed two groups of practical questions to this cartography definition.

The first group of questions relates to cartographic systems - whether they are the research subject of cartography. Here are some examples that prove otherwise. Under the cartographical system for the present we understand pair (K, R), where K - the set of subjects, which include maps, and R - set of relationships between subjects:

1. Electronic atlases. The most famous monograph of atlas cartography is [15], which provides the following definition: "Atlas - a systematic collection of maps, made according to uniform program as an integral work and published as a book or set of sheets. This is not a simple set of maps under the name, but the system of interrelated and complementary to each other maps". Unfortunately indicated monograph devoted exclusively paper atlases. A more modern books, which would have also studied electronic atlases, we have not found. But modern electronic atlases already reached a level of development that correlate with paper as a computer with a typewriter. In passing, we note that the atlases are a special type cartographic systems.

2. Map- or geo- platforms – for example, such 'phenomenon', as OpenStreetMap (OSM) – causing some significant questions: 1) whether this phenomenon is cartographical, 2) if not, then what the

[1]Refinement in parentheses sometimes omitted.

Table 1. Three cartographic research paradigms and their research focus [14]

Paradigm	Research focus	
	Map making	Map using
Map as Image (communicative / cognitive tradition)	Visual symbol design, colour use, graphical hierarchy, figure /ground	Reading, visualizing, communicating; metaphor
Map as Model (analytical tradition)	Data structure design, algorithm development	Analytical modeling, hypothesis testing; model
Map as Intent / Social Construction (the critical tradition)	Distortions/biases built in, power relationships, ethical considerations	Power and control, governance, propaganda tool; myth

term ‘map’ does in the name OSM, 3) if so, how this phenomenon agree with the map concept? Note that the platform is also a special kind of cartographical systems.

The second group of questions relates to the term ‘science’ in the definition of cartography. The fact that scientific (and educational) cartographic activity in Ukraine is still under the influence of cartography of K.Salischev. Without going into depth discussion of theoretical constructs as the ‘theory’, ‘paradigm’, ‘conception’, note that cartographical theories in the scientific literature we have not found. Liutyy [10] called existing in moment of writing the his monograph theoretical constructions of cartography, including cartography of K. Salischev, conceptions. Outside of Ukraine the prefered term is ‘paradigm’. Sui and Holt [14] identify three major paradigms, according to three different conceptualizations of the essence of a map (Table 1): 1) the map as image; 2) the map as a model or computational tool; and 3) the map intent or social construction. Among these three paradigms, the research focus – be it map making or map using - is significantly different. Depending on the paradigm in which one is anchored, different aspects of maps related to the cognitive, analytical, and critical dimensions are emphasized.

In all these cartographies (traditions, paradigms, conceptions) research subject is map, and in the singular. Unfortunately, in most countries cartography of K.Salischev is little-known (in particular, it is not included in the Table 1). There is a practical question: what conception or paradigm of cartography should be used in cartographical projects in Ukraine in conditions of integration into the world community? Perhaps best choice is to use several existing cartographies and respond to new paradigms. But how? How to coordinate the different cartographies together?

To solve the above and other contradictions between modern cartographic reality and existed cartography definition, we propose to change the definition of cartography as follows:

- ***Classical cartography*** – arts, sciences and technologies of making and using maps.
- (System or ***Geomatic*** or just) ***cartography*** - coordinated and non-coordinated arts, sciences and technologies of making and using maps and cartographic systems.
- ***Relational cartography*** - coordinated arts, sciences and technologies of making and using of relations in cartographic systems and between cartographic systems.

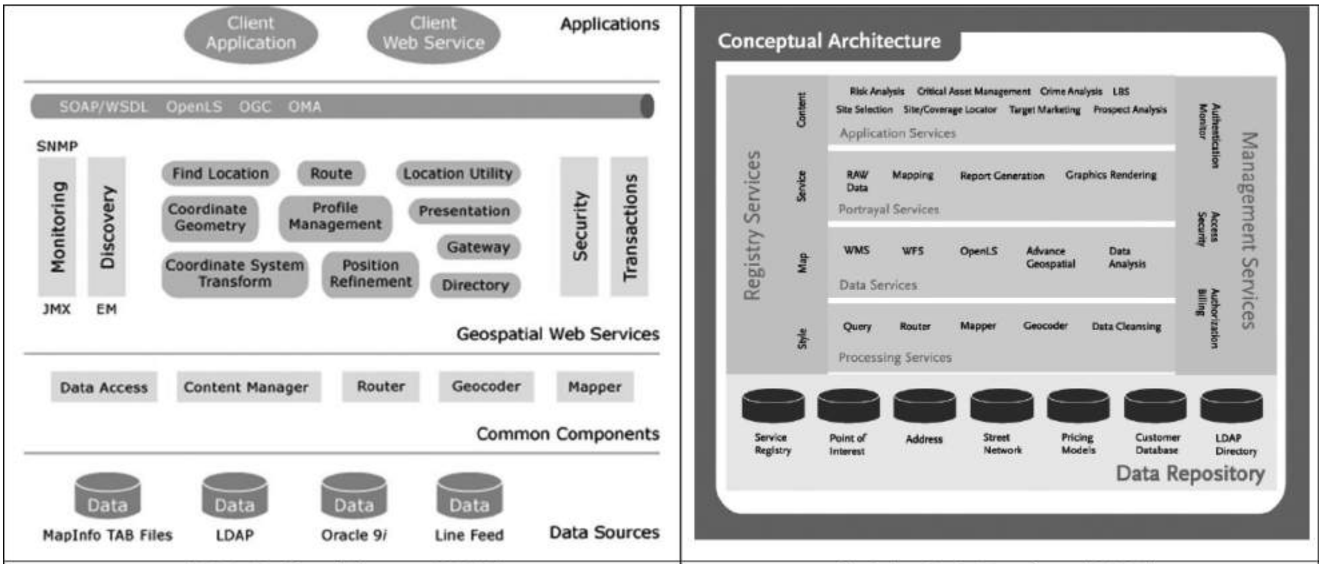
The term ‘science’ is used in plural, to draw attention to the more practically useful theoretical constructs - paradigms and / or conceptions of cartography. These theoretical constructs can be so non-coordinated that it is appropriate to allow an opinion on the existence of several sciences called ‘cartography’. The authors distinguish several classical cartographies. For example, cartography of K.Salischev and analytical cartography of W.Tobler. The term ‘coordinated’ refers primarily to each triad art -science-technology. Cross coordination, such as science1-science2 or art1-science2-technology3 also are possible, but they are much more complex.

This paper addresses the first of three basic components of Relational cartography as a new scientific theoretical construct - 1) domain of inquiry (or subject of research). The other two components are: 2) body of knowledge regarding the domain; 3) methodology (a coherent collection of methods) for the acquisition of new knowledge within the domain as well as utilization of the knowledge for dealing with problems relevant to the domain.

More specifically, we are interested in the relations of Relational cartography (hereinafter - RCrelations), which are existed in or are associated with the following phenomena:

- geo- and/or map- platforms of Web 2.0 epoch, such as OSM;
- spatial infrastructures such as INSPIRE / ELF.

In other words, in this paper we focus on RCrelations, existing between the cartographic systems, since all listed above phenomena are integrated cartographic systems. RCrelations, existing in cartographic systems, are considered in [7]. Wherever it is possible we use examples from the activity of ‘making and using’ electronic atlases. This is done due to the fact that atlases have needed for us dualism. On the one hand, atlases are cartographic products that are well



a) MapInfo miAware (2003) b) MapInfo Envinsa (2006)

Figure 1. Geo-Platforms of MapInfo Corp. (following of Corporation materials)

known by cartographic community. On the other hand, atlases are systems. Therefore they can be considered as a kind of bridge between classical and non-classical cartographies: Relational and Geomatic. The Web 2.0 epoch of Internet selected as the most advanced in our time.

RCrelations of geo- and map- platforms of Web 2.0 epoch

Tim O'Reilly points out that the platform and collective intelligence are the two main characteristics of Web 2.0 [12]: "Web 2.0 is the business revolution in the computer industry caused by the move to the internet as platform, and an attempt to understand the rules for success on that new platform. Chief among those rules is this: Build applications that harness network effects to get better the more people use them. (This is what I've elsewhere called 'harnessing collective intelligence.')"

"Platform is a system that can be reprog-rammed and therefore customized by outside developers - users - and in that way, adapted to countless needs and niches that the platform's original developers could not have possibly contemp-lated, much less had time to accommodate" [3].

Geo- and/or map- platforms exist in the geoinformational industry for a long time. As an example, we present architecture of geo-platforms of MapInfo Corp. (now Pitney Bowes Inc.) (Fig. 1).

The most important part of these platforms in terms of RCrelations are service layers that are located between the data (below) and applications (above). Shown software architecture is known as service-oriented (SOA). Most spatial services (such as WMS, WFS, OpenLS services group in Envinsa and their predecessors in miAware) are standardized by Open GIS Consortium. Web services are allowing to set a large number of quite random and almost independent from software manufacturer relations between spatial resources and client applications. In fact, they can transform the geo- and map- information systems into the so-called geo- and carto- possible distributed systems opposed to geo- and carto- centered systems. Last ruled before SOA.

Representation of the generally known and that is very important - open - map-platform OSM gives Fig. 2. Three of the five shown in Fig. 2 blocks are implementing or supporting RCrelations: Editing, Rendering, Visualization. Please pay attention to the term 'slippy map', which is defined as:

"Tile web-map (slippy map in terms of OpenStreetMap) or tile raster map displayed in the browser, which easily connect dozens of other image files over the Internet. Currently, the most popular way to display and navigation maps, to replace previous methods such as WMS, which usually reflect one large image that can navigate using the arrow buttons. Google Maps was one of the first major cartographical sites that have used this technique. Web map tiles in turn can be substituted vector tiles as standard". (Https://en.wikipedia.org/wiki/Tiled_web_map, accessed 2016-aug-19). Because of these maps field (layer) approach to modeling of spatial information [13] currently is more common than the object. At that object approach is promising, but difficult. It is implemented by vector formats unlike the raster formats, which are implemented by 'slippy' map.

Vector platform (e.g., Envinsa) we often call geo-platform, meaning that they can construct 'object' geoinformation systems. Raster platform (e.g., OSM) we often call map-platform as they are best suited for the construction of 'field' cartographic systems.

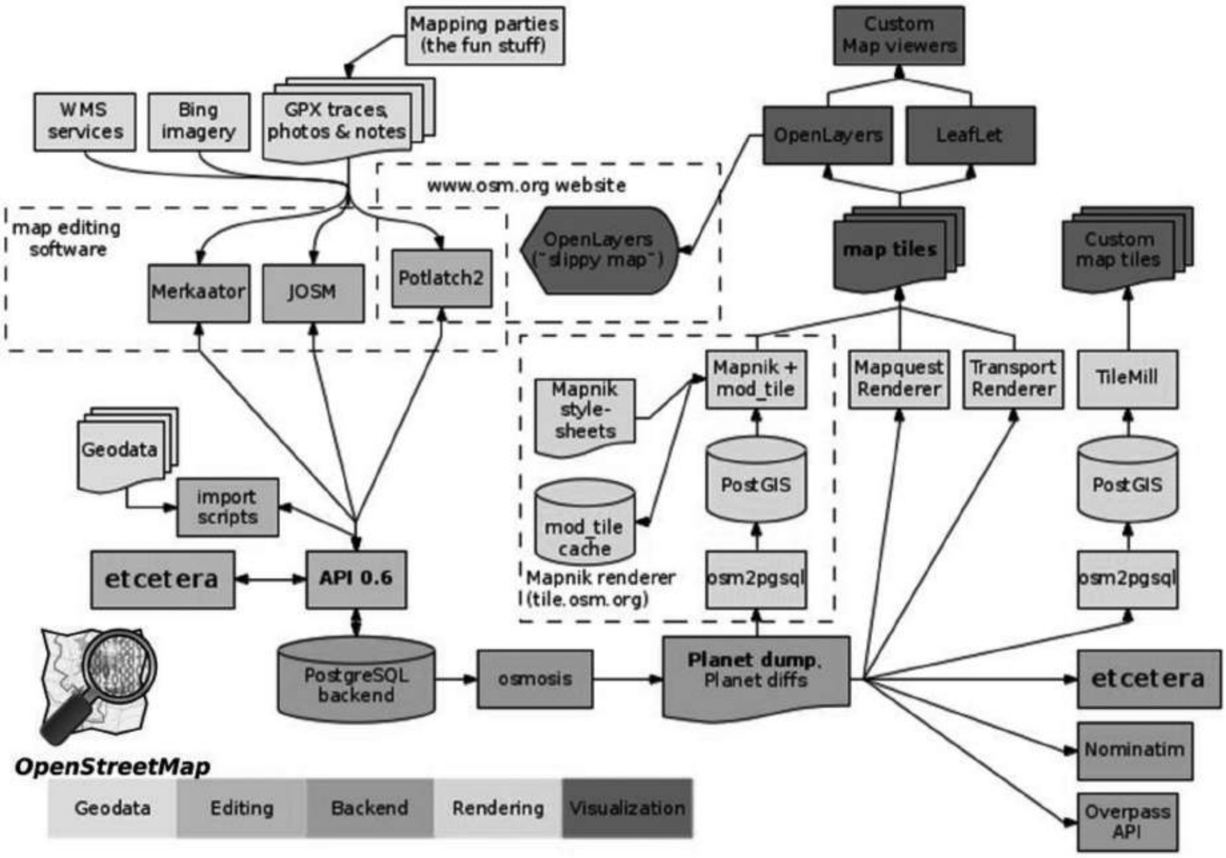


Figure 2. Components of OSM: http://wiki.openstreetmap.org/wiki/Component_overview, accessed 2016-aug-19

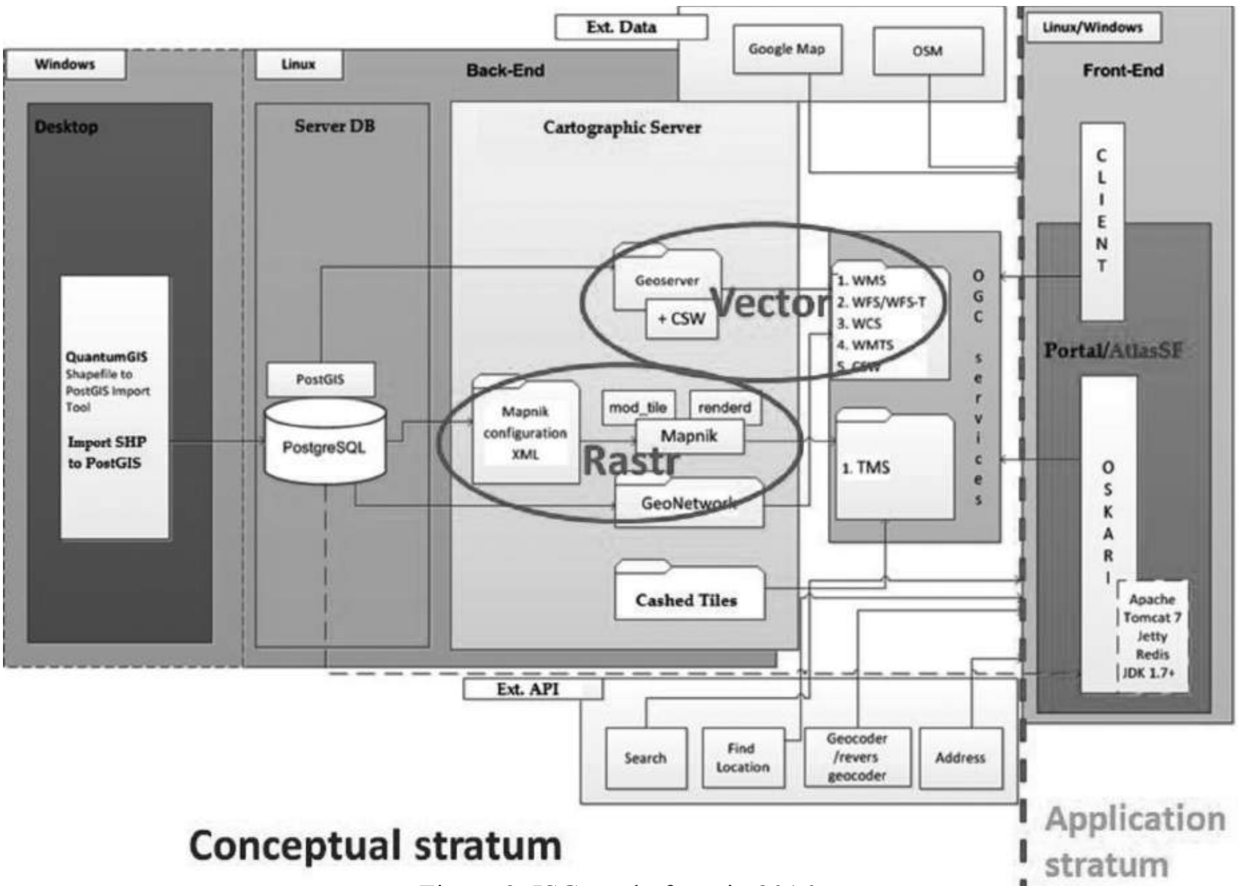
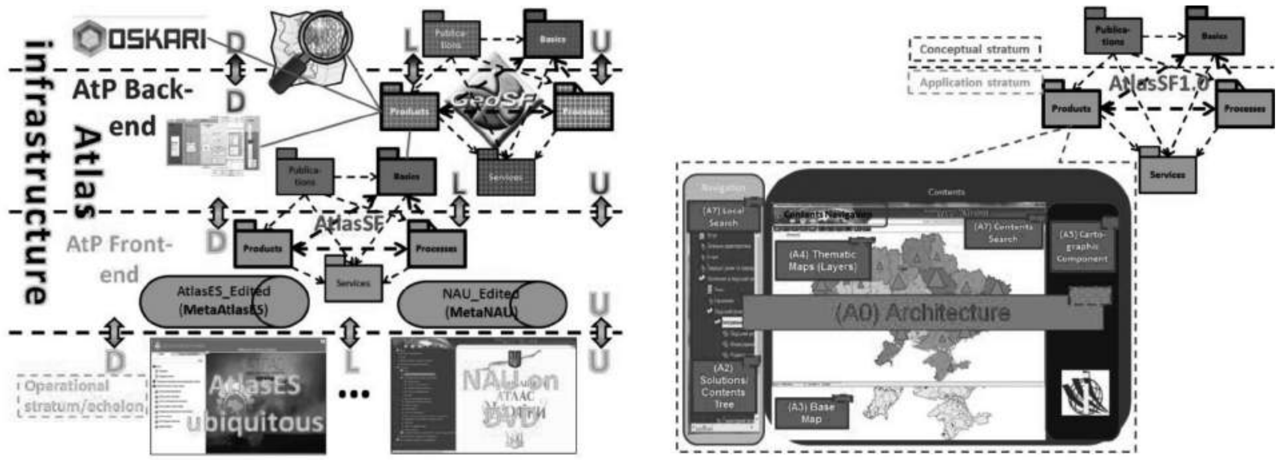


Figure 3. ISGeo-platform in 2016



a) Symbolized structure of AtSw

Figure 4.

b) Product package of AtlasSF1.0 (NAU)

Explanations to Fig. 4:

1. Atlas infrastructure elements are elements and relations of three stratums / echelons that are shown above the Operational stratum/echelon. Stratums and relations between them were considered in some of our works, particularly in [5, 6, 8]. Strata notions are used when you want to focus on the hierarchy of AtSw elements (artifacts). Strata notions agreed with echelons notions. Echelons are used when you want to focus on the organizational aspects of the system (users)[2].
2. For designation of relations between neighboring strata / echelons is used three vertical arrows, differentiated by letters D (Datalogics), L (Language), U (Usage). So we specify that there are relations in three levels/contexts: Datalogical/ Technological, Infolological/Language, Organizational/ Usage World. Between levels/contexts are also exist relations, but they are not considered here as they are intersystem. These relations exist for each element-system, eg, for NAU on DVD end user AtS.
3. Fig. 4a shows two Solutions frameworks: application Atlas solution framework AtlasSF and conceptual GeoSolutions Framework GeoSF. The term and concept of 'Solutions framework' is introduced in [9]. It also describes GeoSF and its possible application to build a national spatial data infrastructure (NSDI). 'The main triad' (in bold) of each Solutions framework are Products, Processes, Basics packages of elements and relations between them.
4. AtlasSF is used to build various end user AtS. At that performed similar actions described in the package Processes. Required actions are usually performed with the corresponding MetaAtS (e.g., MetaNAU). MetaAtS is also called editable variant of AtS (e.g., NAU_Edited). The Products package of the classical version of AtlasSF is shown in Fig. 4b. It consists of eight patterns (A1) - (A8), which are shown shaded in red by badges of UML (Unified Modeling Language) parameterized templates with an appropriate label. Patterns are united in a package (A0) by Architecture. Patterns (A1) User interface and (A8) View in Fig. 4b are not marked.
5. AtlasSF is an important element of front-end of Atlas Platform (AtP) and GeoSF – of Back-end of AtP. The concept of AtP introduced us to streamline all elements and attitudes that are constantly repeated. Recall that the platform is a system. Therefore, we can assume that we actually evolve and apply our AtP system. Please pay attention to the relation, shown in blue between GeoSF and: 1) ISGeo-platform 2016 2) OSM, 3) AtlasSF.Basics. ISGeo-platform 2016 is used to solve not only the atlas tasks, but it is almost entirely included into GeoSF. OSM is used by GeoSF, AtlasSF.Basics fully included into GeoSF Products.

Definitive choice of the platform name (geo- or map-) depends on the definitions of cartographic and geoinformation systems.In the development of modern atlas systems necessary to use raster-vector geo- platform. Fig. 3 shows ISGeo-platform 2016, some of which (called the Back-end of Atlas platform) used by us at the Institute of Geography to create such atlas systems like the Atlas of Emergency Situations (AtlasES) and Atlas of Ukraine's population and its cultural and natural heritage. We draw attention to complementing of raster platform similar to OSM, by vector platform that is based on GeoServer.

RCrelations of spatial infrastructures

In work [5] introduced the notion of spatial infrastructure, called Atlas infrastructure and determined as a set of interconnected service structures that form and / or provide a basis for solving the tasks of creation, performance support and update of Atlas systems (AtS)[3] of operational phase. All AtS in some extended sense (AtSw) are integrated hierarchical cartographic systems, consisting of end user AtS (or atlas systems of operational phase) and the same type organized atlas infrastructures. The term 'atlas system' (AtS) in this paper is used to refer to the end user systems of three types: paper atlases, electronic atlases, Atlas Information Systems.

Generalized structure of AtSw that established, operated and evolved by us, shows the fairly saturated (although simplified) Fig. 4. As examples of end

[2] 'Strata' and 'echelons' are introduced following [11].

[3] In original was 'atlases'

user AtS are selected National Atlas of Ukraine (NAU) and AtlasES. They are shown below, on Operational stratum.

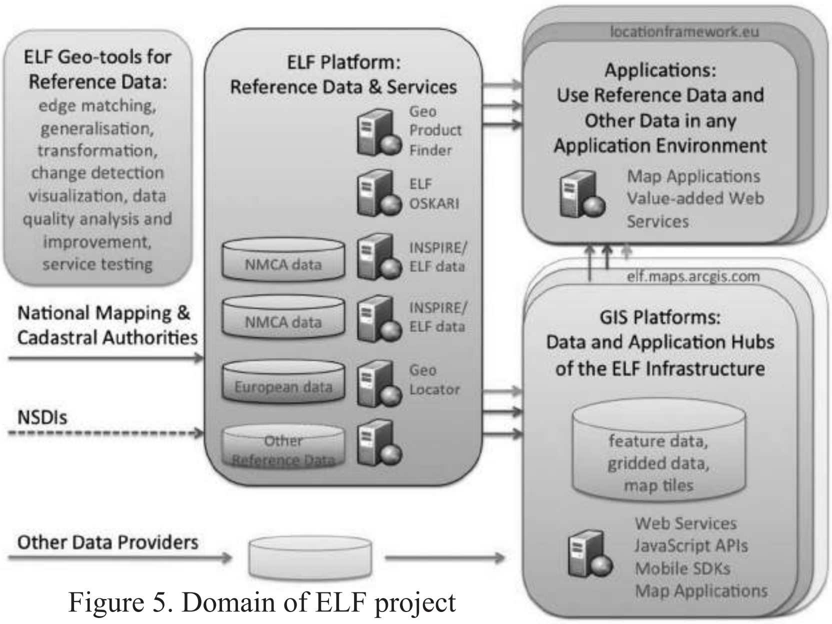


Figure 5. Domain of ELF project
(Source: ELF project; our caption)

Important note

From our point of view a platform and infrastructure are systems. But between them there are serious differences. We mention two of them:

1) The platform must have a system of repetitive elements and relations, and infrastructure can include arbitrary elements and relations;

2) in terms of levels/contexts platforms inherent clearly defined technological context. Infrastructures are not necessarily focused only on technology.

For example, the Usage World or Organizational level of infrastructure is no less important. In the case of spatial data infrastructure (SDI, see below) it is even more important than Technological context.

Currently, the world has a large number of SDI. Consider in more detail SDI Infrastructure for Spatial Information in the European Community (INSPIRE) which is designed "to support EU policies on the environment and the policies and activities that may affect the environment". The practical implementation of the INSPIRE is made in European Location Framework (ELF) project. "ELF platform (http://locationframework.eu/) is the basis of technical architecture of ELF. It includes data sets provided by Mational Mapping and Cadastral Authorities (NMCA), and in the future - other data providers" (from page http://www.elfproject.eu/documentation, accessed 2016-aug-22). Using ELF geo-tools NMCA will produce data sets that will meet the requirements of INSPIRE.

ELF platform provides viewing data and other service interfaces for ELF users. The concept of 'users' includes end users, application developers using ELF services and data in their applications, and developers that provide ELF data on other platforms.

Structure of ELF project domain is shown in Fig. 5. It is taken from the page of project documentation. Fig. 5 originally had no caption. By our caption we try to partially remove the contradictions that inevitably arise in such projects, if not use the concept of specialized cartographic system, relations of which are repeated in 'infrastructure' contexts. The contradiction we called improper use on a single figure of the terms 'infrastructure', 'framework' and 'platform'. To explain our statements, we give further information from [4], where the main ELF technical elements called:

a) ELF Infrastructure – ELF Data, ELF Services and ELF applications.

b) ELF Data - geospatial reference data in accordance with one or more ELF specifications and made available through ELF. Initially ELF covers following INSPIRE themes administrative units, hydrography (land), geographical names, transport network, elevation, buildings, cadastral parcels, addresses.

c) ELF Services - spatial data services operating on ELF data, these will be available through ELF platform (operated by NMCAs and other data providers) and ELF-affiliated platform (operated by third party).

d) ELF Platform – an open source platform based on OSKARI, developed by the National Land Survey of Finland, to offer view, download and web mapping services.

e) ...

Also in [4] states that "ELF is not only technical. It is a business oriented operational framework establishing common licensing terms, while still respecting the need for individual NMCAs to set their own pricing levels".

Pay attention to some contradictions:

1. Why "ELF Platform: Reference Data & Services" (see. Fig. 5), instead of "ELF Infrastructure - ELF Data, ELF Services" (see (a))?

2. Why open source platform based on OSKARI called ELF Platform (see (d)), although the latter term has been used for a wider concept?

3. What is "Data and Applications Hubs of the ELF Infrastructure" (see. Fig. 5)? In the glossary there is the definition (see http://elfproject.eu/documentation/glossary, accessed 2016-aug-22): "ELF - The European Location Framework, a technical infrastructure which delivers authoritative,

interoperable geospatial reference data from all over Europe for analysing and understanding information connected to places and features".

4. There is no direct definition "ELF Infrastructure" in the glossary. The definition of ELF as a technical infrastructure contradicts the claim (a).

Of course, the presented contradictions can be simply design mistakes. However, despite the fact that the results were already operational in 2015 but has not yet completed (the term was extended until the end of 2016), developers are faced with significant problems.

Moreover, these problems are not only problems of the project domain. It is clear that the ELF project domain overlaps with the research subject of Relational cartography. By this work we prove the need to develop a theoretical construction that we call Relational cartography and which is the second dimension of Geomatic (or system) cartography. This theoretical construction (preferably that it was the theory) would help to solve the problems of projects similar to ELF.

In conclusion, we recall some definitions. ***Pattern*** – it is proved practically best known solution of a recurring problem in a given context [1]. Architectural pattern – it is common, reusable solution that is found everywhere in the architecture of cartographical system in a given context. ***Framework*** – it is architectural pattern for the whole cartographical system or some of its logical parts. Pattern is a special kind relation, since "each pattern is a three-way rule that reflects the relation between a certain context, a problem and a solution" [2, p. 247].

In sum, we want to emphasize that research of patterns is the essence of Relational cartography. For example, patterns are essential relations of the Application, Conceptual and even the General (theoretical, highest stratum on Fig. 4a) strata.

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