

# MAPS AND ATLASES ON HISTORY: SOME SOLUTIONS TO THE COMMON PROBLEMS

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## **Abstract**

The article describes the main reasons why preparation of a map, representing historical data, is so resource consuming. The spatio-temporal information on historical events to be represented in maps requires thorough understanding of it in each particular case, what is not possible without corresponding knowledge. A management-oriented point of view to information handling in thematic cartography can aid to improve an efficiency of work and quality of all the cartographic production, especially when complex maps on historical events and phenomena are concerned. It is based on modern methods of systems engineering which proved to be useful designing cartographic information systems in general. Considering that modern maps practically do not differ from software products, systems engineering approach seems utterly natural. Even for the printed products, these methods perfectly serve the purpose when particular level of complexity is reached. They provide solutions for the most problems incident to the informational complexity.

**Keywords:** cartography, history, map, thematic mapping, mapping paradigms, cartographic design, toponymy.

## **1. INTRODUCTION**

It is difficult to argue that preparation of a map, representing historical data, is often resource consuming out of proportion to the quality of the result. Maps representing different periods of time and historical phenomena extended over time, such as wars, expansion, administrative and political changes, belong to the group of most complex and resource-consuming cartographic products. Unfortunately, maps of this type (maps on history) are rarely analyzed as a separate group of that requires a special attention.

In this paper we try to summarize the main problems that were encountered during different stages of production of different maps on history and share the solutions that have helped to tackle the most of them. It is mainly based on the experience of building information systems for several continuous projects of atlases, such as *Atlas of History of Lithuania* ([1], published in 2001, 70 maps), *Atlas of the world history* ([2], published in 2004, 75 maps), and two map series on Lithuanian Jewish history ([3] and [4], both published in 2004, 34 maps). The represented territories vary from parts of Eastern Europe to the whole world. It took more than five years to prepare the *Atlas of History of Lithuania* and during the process several strategies were developed, on how to tackle different management, data acquisition and representation problems.

## **2. THE PROBLEM OF DATA**

The “island systems” (duplicated data across various databases, duplicated efforts on the part of database developers, difficulties in information access) are very common when we deal with data banks that are used to compile maps on history. Therefore there’s always a higher risk that the data used are incorrect or can’t be harmonized. All data-related problems can be grouped into two large groups:

1. Availability of reference and thematic data;
2. Complexity of data management and database maintenance.

### **2.1 Availability and harmonization problem**

The difficulties to obtain correct, accurate and consistent data, needed for a map on history occur due the following reasons:

- a) various geographic data are needed for a map, that must be dated to a particular dates in the past;
- b) geographic objects change over time;
- c) maps usually cover an interval of time, which can be long enough for the represented objects to have changed up to several times.

The geographic reference data such as shoreline, hydrography, settlements, sometimes also data on relief and forested areas should represent the situation that was at the time represented by the map. Unless it falls within the last several decades, it is very difficult to obtain the data wanted. Diverse data sources have to be used, most of which are not digital databases but printed maps, charts or even textual information sources. Cartographic reference systems of some such sources may be unrecognizable, some information may be missing or distorted, they vary in scale, complexity and accuracy. Therefore the cartographers often have to either sacrifice consistency in accuracy or lose the information which is more precise than the reference data. The first choice has been more common in our practice. Thus inadequate accuracy of some information is typical for historico-geographic databases. However, even the accuracy may be lower in many cases, correct topology (e.g., a settlement being located on the right or left side of a river) is very important. Long hours of manual adjustments are needed to compensate the lack of precise and consistent data for a given period.

Selecting information from such databases for maps that cover longer periods of time we face another common problem – some geographic layers are not available for particular periods, whereas some layers, on the contrary, have several versions within the same period. It is the matter of cartographer’s choice, whether the missing information is to be left out or replaced by one of the available layers and how the changes over the covered period are represented in each case.

Considering these difficulties there’s no wonder that modern reference data are used in so many maps on history, especially in the more popular publications (it is not always so bad, as long as the user is warned about the fact!).

Finally, historical maps greatly differ in scale and level of detail: from the maps of the world to the schemes of battles; from tiny illustrations for a textbook to large maps for classrooms or exhibitions. This diversity makes it practically impossible to have a single geographic databank for the purpose.

As not much can be done about the lacking information, all the solutions to this problem are only partial. They are related with specific management, development of specific database structures and extended metadata. The management problem is discussed in the chapter 2.3 and general solutions listed there work well for all types of problems. Each continuous project may require its own copy of parts of the geographic databases used, where manual adjustments are made to some layers in order to harmonize these layers with the specific map information. Another option is to use temporary layers and to provide information on storage type (e.g., permanent, periodically or on demand renewable, temporary, archive... etc., data), storage period and relevance to the ongoing projects for each layer. Besides this information the project database must contain another important set of metadata describing which data themes in what context can be used and combined together.

## **2.2 Toponymy problem**

Correct and consistent spelling of place names seems to be one of the major problems to be tackled at least by the Eastern European cartographers. Toponymy problems that complicate efficient preparation of maps on history are created by the need to use old and alternative forms and to reflect the changes of place names over different periods of time on a single map. Sometimes it seems practically impossible to agree on correctness of names of vague, recently small, unimportant or extinct geographic objects, toponymy for vicinity territories (problem of consistency in use of “traditional” transcriptions and original place names) etc. Spelling of the place names has also become one of the major problems for the cartographers of the national Atlas of Lithuania. The new edition will consist of over 600 maps. The Atlas is planned to also include maps on history for different periods of time, including narrowly specialized thematic maps. Cartographers’ work in the field of toponymy has been greatly facilitated by adoption of the regulation on Geodesy and Cartography issued by the National Land Service under the Ministry of Agriculture on 03 02 2004. However, it only concerns general maps. Some toponymy problems persist and greatly complicate efficient preparation of maps:

- Toponymy for the maps on the previous historical periods (unknown forms, old forms, changes of place names over different periods of time, alternative forms);
- Toponymy for specific thematic maps (names of small/unusual geographic objects which have not been in the official toponymy lists);
- Toponymy for the (also multilingual) vicinity territories (problem of consistency in use of “traditional” and original place names).

The specifics of Lithuanian language make the problem even more complex. In order to be used in Lithuanian sentences, foreign place names are added the endings that permit to decline them. On a map, such an ending and transcription often makes the name unrecognizable when it is encountered in original form. There can be several grammatical forms of the same name, use of which is appropriate in particular compounds. The State commission of the national language together with the National Land Service recently have been developing the methodology of use of diverse forms in the maps and issued corresponding regulations. However, it is still only a start. The toponymy data is an essential component of integral national spatial data bank; however, although there's lots of information on place names collected in Lithuania and operative legal acts, there's no overall database available for public usage nor a single institution capable for maintaining such a database, in spite that the attempts to design at least a database for the scale 1:10000 have been made several years ago [5].

Due to complexity of the problem, regardless of how comprehensive toponymy databank is available, a strategy of collection and of use of the place names have to be thoroughly elaborated for every particular project and documented for the future consulting.

Striving to make the toponymy information more systematic, it is necessary to start with developing the toponymy databank, containing recent official and alternative forms as well as historical forms of the place names. Instructions on how different forms are used in different context (including maps) must become an integrated part of such databank. Not only every effort to facilitate collection and preservation of authentic toponymy must be appreciated, but the standard toponymy data must be made available for everyone and free of charge enforcing correct usage, especially in maps and books published for educational and tourist purposes.

A universal historico-geographic toponymy database should be developed in the nearest future. It must be geographically referenced, geographically searchable and free for public access on the Internet. Besides that, all the place names should be approved by the State Commission of Lithuanian Language. It should store historical and alternative forms of the toponymy and the spatio-temporal extent of their use.

### 2.3 Complexity of management

All the discussed above and other specific data-related problems make it difficult to efficiently manage the projects. It mainly manifests in extra time needed for corrections, adjustments and changes, sometimes out of any proportion to the amount of data actually used.

Some solutions on how the performance can be improved are also based on our practical experience.

**Life cycle modelling.** Before starting every new project, it is very important to develop a model, describing what main activities and in what order will be performed during the project, what resources (people, hardware, software, data, knowledge...) will be needed for each of them, and what results (including methodologies, reports, performance statistics, design solutions etc.) will be produced during the project. It is so called life cycle model [6]. Based on such model, an elaborate work plan can be drawn in the later stages. Special stages with corresponding checkpoints have to be planned for more complex projects, such as interviews and feedback sessions with the specialists who possess the information, collecting geographic data from specific sources, integration of viewpoints (see Chapter 3), harmonization of the data, etc.

Normally there are the same major and obligatory stages in all life cycle models (strategy, analysis, modelling, design, implementation), but when they are broken down, more specific phases are planned, in accordance with the adopted paradigm. Three top-down paradigms have been described before in [6] and more are possible.

Special attention has to be paid to the **strategy and analysis stages**. Within the life cycle model an extended strategy stage is essential for projects on maps or atlases on history. Initial phases for three recent projects (strategy planning, analysis and data modelling) took us about 25% of total time allotted for the projects in each case; however, this investment was fully justified by absence of unexpected situations during the implementation and better quality of the results in all aspects. The charts (Figure 1) show the approximate time (man days) spent on the major stages of the last several projects. Even though these estimations are not very precise, they allow noticing that the time spent on the initial stages is compensated by shorter and simpler final stage – planned and unplanned changes. It is obvious, that reduction of corrections and changes is always desirable because the changes often induce other changes thus leading to inconsistency.

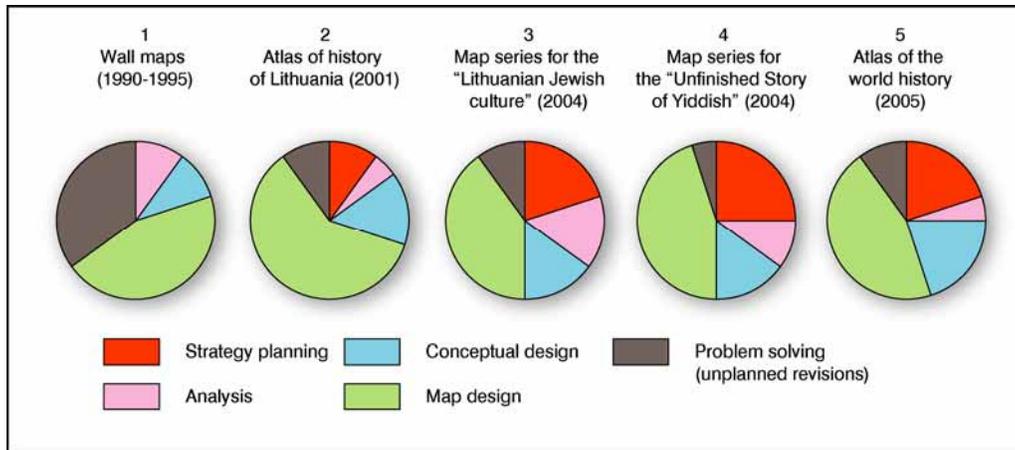


Figure 1: Approximate time allotted for the most important stages of the projects

**Breakdown of data flows** can be done in form of diagrams showing the external and internal information flows at different levels of detail, data sources, filters and management processes. Such diagrams aid to systematize the data, to discover possible lack of information and risks, to assign the responsibilities for data harmonization.

Regardless of which paradigm is chosen, **semantic modelling** of all map information in different stages of the LCM allows to design better database structure as well as the cartographic signs and to avoid semiological errors [7].

**Documentation** is one of activities that have to be upright performed during the whole project. All major methodological and technical solutions have to be stored and made available for use in other activities. Existing reports on problem solving and work statistics from previous projects have proved very useful for planning and risk management for similar projects.

### 3. THE PROBLEM OF DIFFERENT VIEWPOINTS

Diversity of historical data sources, none of which may be fully comprehensive or reliable, and incompatibility of different viewpoints, so common in interpretations of historical information, causes another problem. Disagreements of specialists, who rarely able to geographically relate their knowledge, on exact locations, real or hypothetic boundaries, names etc., is a part of daily work of the compilers of maps on history. In addition to overall complexity of the task, necessity to find a solution, satisfactory for all sides cause lots of cartographer's extra work

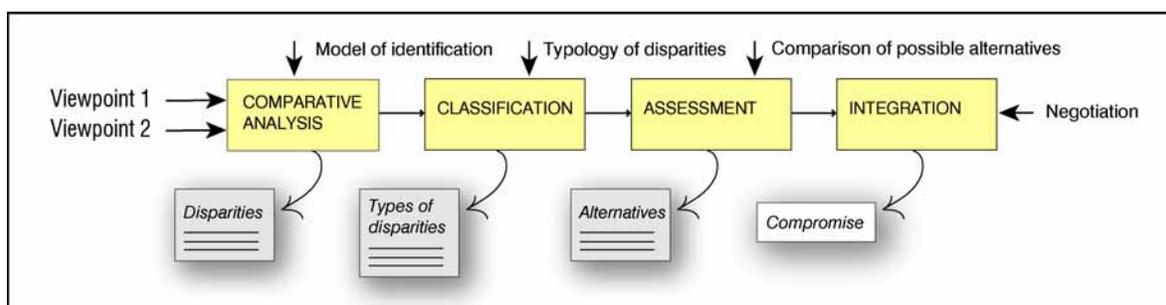


Figure 2: The scheme of viewpoint integration [6]

It is natural that designing every map we seek for maximal degree of adequacy with the requirements specified – accuracy and correctness of information in all aspects. Incompatibility of viewpoints on, for example, which of several sources of data can be trusted, what aspects of the same phenomenon should or should not be represented etc., can arise when different contexts and persons are involved. In that case it is essential to not rely on a single opinion or source of information. To integrate different viewpoints, a viewpoint analysis and integration stage must be given special attention in the analysis phase. The result of integration is usually a compromise, which is not fully acceptable for either of opponents. Still, it largely allows avoiding subjectivity and related problems in the future. On the other hand, differing opinions usually

complement one another, thus neither of them should be disposed of lightly. A possible schema for integrating two different viewpoints is presented in Figure 2 and an example of the result of integration is shown (Figure 2). Of course, it requires additional factographic analysis, but also helps to concentrate on integration instead of vain polemic.

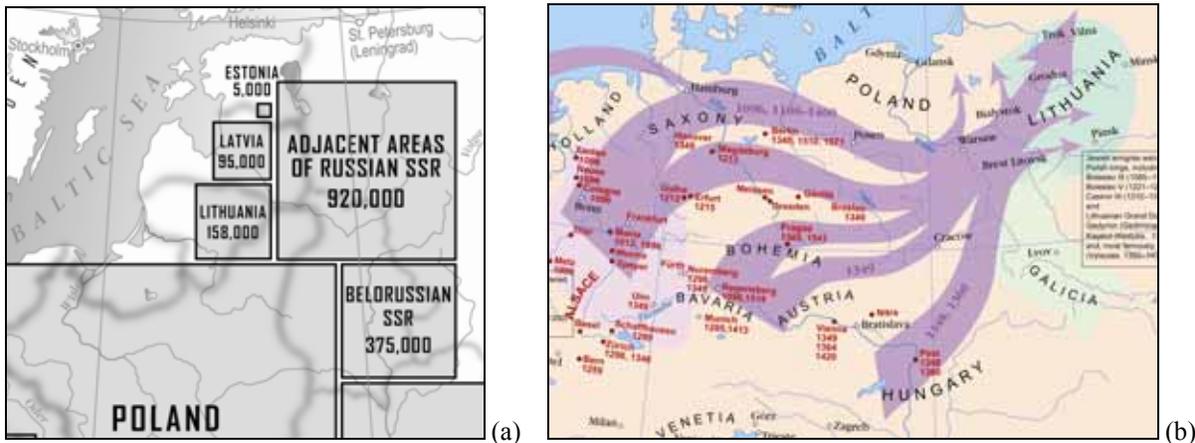


Figure 3: Examples of fortunate design solutions developed integrating different viewpoints – topological chart laid over geographic boundaries of the represented states (a, [4]) and expressively represented migration of Ashkenazi Jews in Europe (b, [3])

Application of this scheme has proved really efficient in cases when there were more than two authors from different institutions providing data for the same map and actively participating in the revisions later. It is difficult to estimate the time saved for discussions in each case and in average, but it is obvious that the summarized information (typology of disparities) and a simple scheme of finding alternative solutions presented to all sides during the revision sessions has helped to at least not to make them endless.

#### 4. THE PROBLEM OF COMMUNICATION

The maps on history usually are strongly purpose-oriented. Most often they serve as

- *Educational materials* (school atlases, wall maps, maps in textbooks). Providing **correct, systematic and easily understandable** geographic information is the main accent in this case;
- *Information resources for general public* (maps in studies on history in all possible fields, maps in mass media or general atlases). Maps on history of this type are often designed to **represent or accentuate one specific point of view** to a particular phenomenon, e.g., war, geopolitical situation of a country, importance of a city etc.;
- *Artworks* (maps in representative monographs or albums on history of a country, city or another historically significant place, postcards, souvenirs etc.). Due to their decorativeness maps have often been used as artworks. **Aesthetics, distinctiveness and emotional impact** are the most important for such maps if the tradition is to be followed.

Many maps on history have to combine all above mentioned functions. They require that the message conveyed by the map is clearly expressed and does not leave much space for possible misinterpretation (e.g., showing dependence of a region to one or another sphere of influence, representing fuzziness of a boundary, clearly showing that some common information, like hydrographical network, is backdated etc.). The signs on such maps have to be easily memorizable, i.e., they should be neither abstract nor simple, but still understandable). Use of multiple signs, colours, textures, need to represent various static and dynamic processes (movement, split, interaction, duration) on one map make the problem of efficient cartographic communication a challenge in this field.

Thus the rules of semiotics become especially important. Considering the complexity of information and the scope of technical work, there is a risk that they may be overlooked unless semiotic analysis is planned as a special stage in the life cycle model. However, as it is shown in Figure 4, it is not enough to carefully design the signs and obey the rules of semiotics. When many different signs are placed on the map, together with the colors used for the background they may cluster into groups which may be unreadable or create a false impression.

Human work will be always necessary to complete the design – in particular for clarity in the first two cases and for distinctiveness in the third. We estimate that such additional works as revisions and corrections of the design solutions take at least 10% of the total preparation time of a map of average complexity. Besides that, it is a work that demands skills and competence in cartographic design.

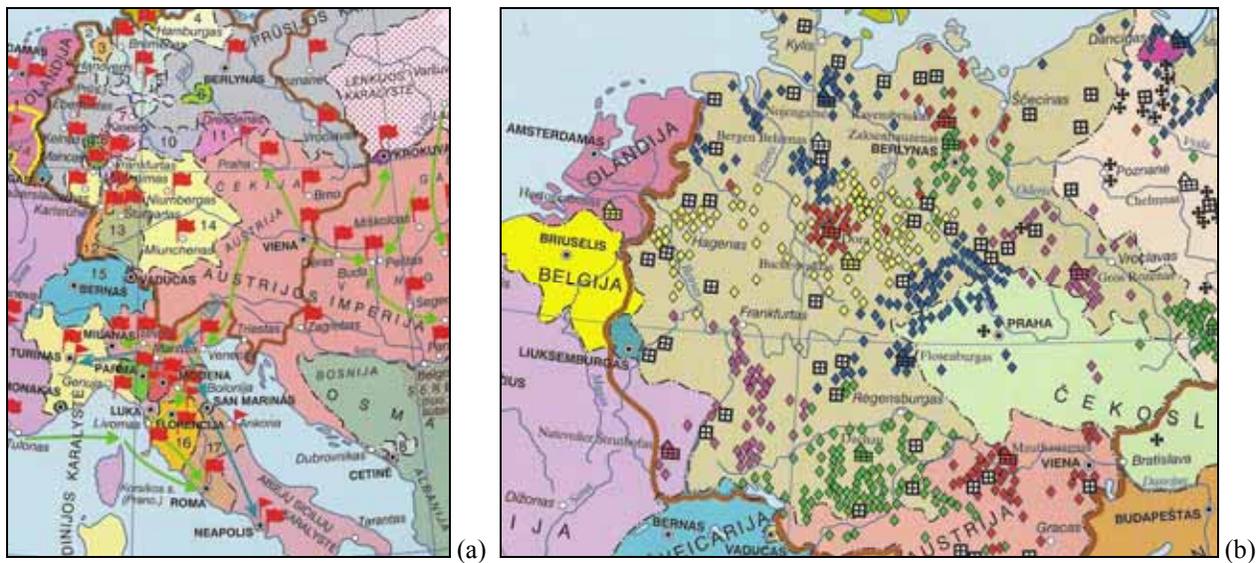


Figure 4: Two fragments of maps [2] demonstrate how difficult it is to choose perfect cartographic signs. In the first case (a), some areas of the map become almost unreadable. The second case is more subtle: even though the signs are clear and pleasant to look at, they create a general “happy” feeling that does not fit to the represented objects (concentration camps).

Often the non-cartographers involved in the process (e.g., authors of different map information and consultants) can also help to find better design solutions when the possibilities of representation are presented to them and discussion encouraged (see examples in Figure 3, which were designed with active participation of the author of the information).

Speaking about maps as artworks, the concept of **style** becomes very important. Style is a systematic consistency, unity of expression tools, specifics that make map unique. Not only original, graphically interesting and attractive cartographic signs and unconventional colour schemes must be used to achieve that, but all their elements must be designed to form a consistent whole in terms of historical and cultural associations, which are intended to be evoked. Additional graphic elements (pictures) have been used for this purpose since long ago. Nowadays, use of them is greatly facilitated by graphic processing technology.

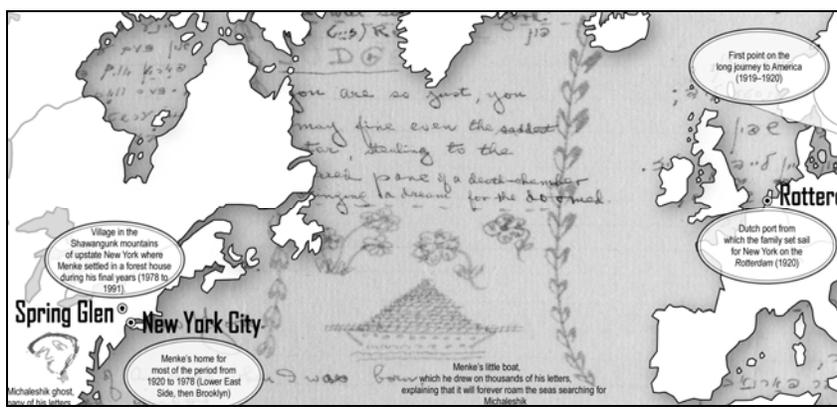


Figure 5: A fragment of a map designed to represent biographic facts of Jewish poet Menke Katz [8]. Authentic letters, drawings and different graphic effects were used to create an adequate feeling about this black-and-white map.

Style also allows recognizing the map author, group or the company. Map stylistics is worth of separate study that could investigate into the style-forming elements, their relationship with cartographic semiology, functional styles of modern electronic maps, hierarchy of styles and other issues.

## 5. CONCLUSIONS

The major groups of problems that cartographers deal with when they compile maps on history are:

- a) data-related problems: data acquisition and management;
- b) the problem of different interpretations of the same raw data (viewpoints) and corresponding cartographic representations;
- c) problems of cartographic communication.

The main ways to tackle these problems related to the specifics of the maps on historical phenomena are

- a) developing specific strategy and project life cycle model for every new project as long as it promises to be enough complex as to require additional information analysis, viewpoint integration, purpose-oriented visualization and semiotic verification;
- b) paying special attention to the initial stages (strategy planning, analysis and data modelling) and some particular phases (interviews with the professionals of particular fields, feedback sessions and viewpoint integration) of the life cycle model, presuming that such model is always applied;
- c) choosing the most appropriate paradigm for thematic map design and upholding it during the whole life cycle and obeying the relevant general principles of system design;
- d) consulting all the involved specialists even about the decisions that are traditionally made by cartographers alone;
- e) a broader understanding of map design and style issues.

The experience of compiling historical atlases of Lithuania and of the world at Vilnius University allows asserting that popular methods of systems engineering, such as life cycle modelling, paradigms of thematic map design based on different life cycle models and some general principles of design comprise an effective method to minimize the design costs and improve the quality of the final product. Nevertheless, the process will never be formalized in this case. Many hours of qualified professionals' work will always be needed to achieve sufficient quality of maps on history.

Due to the space limitation we have touched upon the question of project management success factors, basically leaving aside the problem of product quality, which is, nevertheless, also relevant to the methods of management. In the light of this experience, a general framework for map design can be proposed, that allows better control over the map design process and quality assurance in terms of cartosemiotics.

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## **BIOGRAPHY**

**Giedre Beconyte** is an associate professor in the Centre for Cartography at Vilnius University. She studied in Vilnius University (Geography and Informatics) in 1989–1996. Since 1994 she has been employed as a senior cartographer, then as a head of Theory and History sector of the Centre for Cartography until 2000. The theme of her PhD dissertation defended on July 3, 2000 was “Methodology of Information System Design for Thematic Cartography”.

In 1997–2001 she took part in projects of business re-engineering and computerization of the Centre for Cartography, preparation of the Atlas of Eastern Lithuania and the National Atlas of Lithuania, cartography for the National Encyclopaedia of Lithuania, and numerous other thematic cartography projects such as atlases and series of thematic maps for schools. She was a member of the team, which outlined the program of modern MSc Cartography studies at Vilnius University. In 1997–2005 she published over 20 papers addressing information engineering methods and theoretical cartography, took part in national and international conferences, seminars and other scientific activities. She is a corresponding member of the Commission of Theoretical Cartography at the International Cartographic Association, since 2003 the Executive secretary of the Lithuanian Cartographic society.

Research interests: thematic cartography, semiotics, mathematical modelling and analysis of socio-cultural phenomena; system analysis and engineering; graphic design; web design.

The introductions of the country, dependency and region entries are in the native languages and in English. The other introductions are in English. This section holds a short summary of the history of the area of present-day Europe, illustrated with maps, including historical maps of former countries and empires that included present-day Europe. Caution: this map is highly inaccurate in some regions and borders, see its talk page.}} The map of reality is not reality. Even the best maps are imperfect. That's because they are reductions of what they represent. If a map were to represent the territory with perfect fidelity, it would no longer be a reduction and thus would no longer be useful to us.Â To the non-technical reader, most of the paper reads like an abstruse argument on the relationship of mathematics to human language, and of both to physical reality. Important stuff certainly, but not necessarily immediately useful for the layperson. However, in his string of arguments on the structure of language, Korzybski introduced and popularized the idea that the map is not the territory. In other words, the description of the thing is not the thing itself. The model is not reality. Normally, the resource problem is either considered a solely environmental or a purely economic issue. We have purposefully put it as a single item to emphasise its planetary twofold value as both an environmental and economic (social) issue at the same time.Â The global resource problem is that people consume without any limitation, and deplete the reserves of natural elements of the planetary ecosystem, the components of organic and non-organic life, and the conditions for the existence of the biosphere including people and society. Meanwhile, Earth's resources are not unlimited, they are exhaustible; increased wasteful use of natural resources on a regular basis leads to their depletion, and does not allow them to renew.