
Atlases and Systems Theory within Systematic Cartography

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Abstract:

The paper considers three scientific approaches and outlines a new concept of systematic cartography.

The first approach – systems theory

Systems theory has long been concerned with the study of complex systems (in recent times, complexity theory and complex systems have also been used as names of the field). Complex systems are present in the research of various disciplines, including geosciences, economics, social studies and technology. Recently, complexity has become a natural domain of interest in real-world socio-cognitive systems and emerging systemics research. Complex systems tend to be high-dimensional, non-linear, and challenging to study. Organised complexity is the degree of both the organisation and complexity of a system. When organisation and complexity are not part of the same system they each undoubtedly can occur naturally, but when both organisation and complexity are found in the same system, the odds of their occurring drop considerably, and the more of both that a system has, the less probable it becomes.

It is often useful to consider spatial problems through a general systems approach. A general system is a group of fundamental elements bound together by specific linkages. Systems may be open or closed and may change through time. The earth is an open system in which there are inputs, outputs, and flow-through mechanisms. The linkages, or connections, that bind entities together into a system are paths through which matter, energy, ideas, and people pass from one element to another. General Systems Theory is useful to any approaches describing the earth – cartography is one of them.

Cartography employs systems to develop analytical models with which they seek to understand and explain spatial patterns and interactions. Cartographers use the systems model, for example, to examine human migration patterns, the diffusion of ideas, and the spread of information. Moreover, research about maps relies on understanding the systems in which information and communication processes operate. Cartographers are interested in identifying, explaining, and predicting information flows in maps. They also seek to identify, describe, and explain cycles and patterns in both maps and map collections.

The second approach – atlases

Atlases are, probably, the best known and the most flexible of popular cartographic products. Atlases are used to address different issues and to target different audiences. Historically, atlases have played different roles – from instruments of power, in the Renaissance to a current decision and planning support tools. Atlases are used for general reference, education, research and business. As they evolved, atlases were produced in different ways, from the initial manual compilation to current computer-generated processing. Atlases have experienced many changes in the way they are conceived, produced, disseminated and used.

Many definitions of an atlas exist, and all of them involve words „systematic collection“ or similar expression that an atlas is not a set of map randomly chosen maps and their random arrangement as a book. After a rapid ICT development provides fast map compilations, it seems that atlas cartography is much more comfortable. Various types of atlases can be distinguished by the region, theme, dissemination concept, presentation medium and interaction with users. All these kinds of atlases share the overall objective to communicate geographic knowledge and facilitate new insight into geographic phenomena.

The third approach – Tobler's first law of geography

The Tobler's first law of geography was introduced into the geographical literature in an article that Waldo Tobler (1930-2018) published in the journal Economic Geography in 1970. He described a simulation of population growth in Detroit and invoked the law: “everything is related to everything else, but near things are more related than distant things.”

It considers the following questions for cartographers: Can the Tobler's law be applied in cartography when we replace objects with maps? How can “near” and “distant” be measured in an atlas? Is it right for Euclidean and network space?

A concept of systematic cartography

Systematic cartography is a set of interrelated approaches for visualising a wide range of spatial data sources by various techniques. A traditional field of systematic geovizualisation is the atlas production. At present, advanced display techniques and distributed spatial data sources multiply the possibilities and range of visualization outputs. A theoretical systematic approach plays a crucial role for content, designing, compilation and symbology of any atlas. This calls for the implementation of system theory into an atlas conceptualisation.

Can atlas be described as a system? If a system consists of elements and relationships between them, then an atlas consists of maps and relationships between them. As a system has a structure and behaviour, an atlas has a structure and usage. In the system theory, a system has a language (information is passed through the information channels). In systematic cartography, an atlas passes spatial information through map language. If we describe an atlas as a system we might measure atlas and then to improve it, redesign it, reuse it etc.

If an atlas is a system according to the theory of systems (a system universum A involves maps, symbols, map elements, graphs, texts, etc. and a system characteristics R involves all relationships between them) it make us possible to measure „a rate of systematization“, and make atlas taxonomy better. It will also provide a view into an atlas structure and tools for its imporving. And it is really worth!

Maps in atlases are organized gradually (i) from simple analytical maps (of the main theme components), (ii) to the complex and synthetic maps, (iii) the content of the thematic atlas is arranged like a storybook, (iv) from simple to complex, (v) from basic information to the culmination as the main message in sense of spatial synthesis (typology and regionalization). The relationships relate to map language either in map series, in atlas structure and design and between maps vs. graphs, tables and figures.

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