

Cartography: Sciences, Art and Technology

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Abstract

This research was conducted because of the different views on cartography, both from the point of view of benefits as well as the disciplines that cover it. Cartography paradigm shift that cartography is not a rigid work that is only understood by certain circles but as an attractive and communicative map that is understood by the community.: to describe modern cartography with a blend of science, art and technology. using a literature review, with a qualitative research approach. Modern cartography is a map produced from careful observation and analysis, using methods according to the right rules, presented in an attractive manner for the long-term interest, by utilizing the latest technology, serving and focusing on user needs. Today, most agree that maps are said to be good if they follow civilization, can provide broad benefits and are not a rigid result, but can be a source of information that can be used by individuals and organizations.

Keywords

Cartography; modern cartography; sciences; art; technology



I. Introduction

The growing popularity of cartography today, provides different assumptions about cartography. In the past, cartography was a science that paid attention to fundamental theories and cartographic methods (Gartner & Wien, 2019), currently cartography is prioritized to meet user needs. How cartography is manifested in maps as a medium for communicating more expressive spatial information based on applications on the internet and cellular phones. Today it is referred to as digital cartography. Some of the available devices, such as hardware: multitouch and navigation devices are applications that have the potential to make cartography more attractive, then the emergence of mobile devices that provide easy access to the web, navigation and location-based services, making digital cartography shift to a new paradigm, is cartography that service-oriented, by distributing digital maps according to individual requests. Communication is the process of delivering messages by someone to other people to tell, change attitudes, opinions or behavior either directly orally or indirectly through the media. In this communication requires a reciprocal relationship between the delivery of messages and recipients namely communicators and communicants (Hasbullah, et al: 2018).

Cartography evolved into effective communication. Even in everyday conversation, there are often words, "share loc please". What does it mean? There are different paradigms about cartography. Topographic maps of Europe are made by showing the strength of a special cartographic style that uses a very strong scientific basis (Kent, 2017), while in other countries it presents maps as a form or result of cartography that can be easily understood by the reader (Kent, 2013). The similarity of these two paradigms is that cartography is a communication medium that is processed based on scientific investigation, science, observation, measurement and not just from imagination. If the community is very close to cartography, because this location visualization (mapping) is widely used as a

support to strengthen the position of digital-based businesses. When we order taxis online, order food online, create websites for our business, there is even an obligation to share locations for ASN in certain areas in Indonesia when there is a ban on going home on Eid Al-Fitr in 2020 and 2021.

The concept of cartographic modeling is still considered in a narrow sense, which is considered an Algebra Map (Gotlib, Olszewski, & Gartner, 2021), but cartography in ISO 19101 is broadly defined as a mapping activity where objects and phenomena are presented as materials for analyzing existing spatial relationships. , and many researchers have developed cartography on a broader concept (Gotlib, Olszewski, & Gartner, 2021); (Reichenbacher, 2003). Cartography in practice is a combination of art, science and technology (Griffin, Robinson, & Roth, 2017), making it difficult to bring up the ethics of cartography as a scientific discipline. When it is said to be obedient to the method, art here is more dominant. Obedient means far from being creative, while cartography must be presented attractively through visualization and brief explanations. This is the basis of this study, how to present cartography as an effective communication tool by prioritizing the ethics of art, science and technology. In essence, when cartography is presented based on valid raw data sources, explains the method well, and conveys the reasons for using a particular design (Kent, 2017), it is certain that the end result will be appreciated (Tyner, 2005). It will be difficult to always be rigid in accordance with the method, because basically a map cannot be called good, if it does not try to understand the world and communicate it for the wider use of the community.

The essence of cartography is still a matter of debate. Depends on the meaning of the map and its purpose (Gotlib, Olszewski, & Gartner, 2021). If the map is only a visual representation that strives to appear very close to the original, then the map is defined only as a graphic representation of reality. However, if the map aims to provide information about geographic space using voice, text then the map can develop in new directions in line with the latest technological developments. In practice, the concept of maps is very broad, not only in the context of visualization, but how maps are called innovative cartographic products (contemporary maps), which provide social benefits, while still being presented according to the rules. Cartography should be defined as a unique facility for the creation and manipulation of visual (or virtual) representations of geospace for the purposes of exploration, analysis, understanding and communication (Wood, 2003), the principles of cartography do not change, what matters is the map as an abstraction of the resulting reality of data mining techniques (Gartner & Wien, 2019). Cartographic mapping is a process that associates one set of spatially related data with another set called a representation while maintaining spatial arrangement by simplifying details (Lapaine, 2019).

If we look at the opinions that have been conveyed by several experts, there is a contradiction that maps as a result of cartography must prioritize rules and methods on the one hand, but on the other hand maps are very close to the community for social and economic interests so they must be adaptive and follow technological developments. Map as a communication medium that provides information, so it must be packaged in a simple and attractive way. Maps can no longer only be read by experts such as geographers, historians, but with their appearance, maps can be widely understood by the public. Thus, this study aims to provide an overview of the extent to which cartography has developed not only as a medium that visualizes appearances to approach the original using scales and methods, but also increases the usefulness of maps as a result of cartography, which is a communication medium to convey information to individuals according to their needs. This study is considered important, because of the growing needs of the community.

Shifting tertiary needs into basic needs. For example traveling, before the Covid-19 pandemic, traveling activities increased, along with the increasing need for people to unwind, relieve stress by taking a vacation. Maps are one of the communication tools used to guide the journey. Seeing the distance of restaurants in online applications for ordering food, sharing the location where someone is, are some of the activities that prove that cartography is very close to human daily activities. So, in this study, it will be discussed whether it is still important to debate the essence of cartography while the benefits of cartography have grown far to touch the sides of people's lives.

II. Research Method

This study was conducted by applying a literature review, which used a qualitative method. Delivered by describing it in a narrative, it is hoped that it can explain the model and provide suggestions for further researchers. To avoid bias, narrative explanations follow systematic guidelines (Levy & Ellis, 2006), i.e. starting with searching and identifying, aggregating or combining and grouping the identification results, the last step is analyzing and determining the closest fit to theory and empirical review.

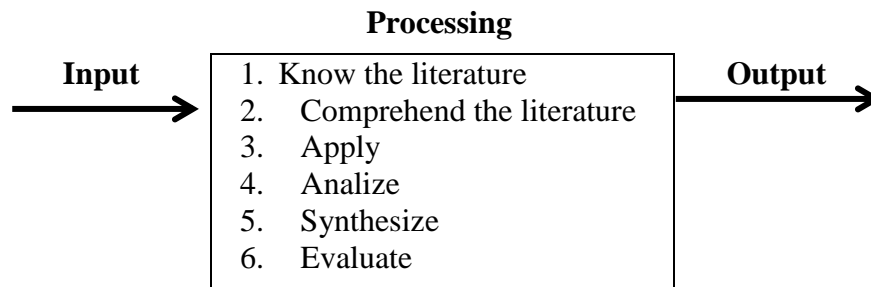


Figure 1. Analysis Steps (Levy&Ellis, 2006)

III. Result and Discussion

3.1 Cartography: Sciences Perspective

The German cartographer Max Eckert is considered the creator of cartography as a science in 1907, i.e., initiated a series of elaborations dedicated to defining and systematizing research on cartography. The main purpose of cartography, according to Eckert, is to study the process of making maps and to analyze their essence, structure, and possible uses. He emphasized that the science of maps is indispensable for the science of geography, by applying research methods including:

1. Observation (topographic image);
2. Survey (map is the result of survey);
3. The use of logic (certain objects are combined into a map image), deduction (from a general idea to a single object) and fiction, for example the fictitious lighting of an area in the shading method. (Ostrowski, 2008)

In the 50s, initiated by A. Robinson who established an important chapter for the graphic design of maps according to the principle of visual perception. In this period, cartography and geography became inseparable sciences. Then the development of cartography continued in the 70s, with the birth of the theory of map graphics, which cartography aimed at perfecting the cartographic image of the earth. It does not stop here, that cartography must also serve other disciplines, not only geography, because cartography needs to express ideas about space, landscape, appearance, and based on the

results of discussions at the International Cartographic Association Forum, cartography as knowledge must fulfill three basic concepts, are: cartology (cartographic communication), cognition, and map semiotics.

Cartology, from the perspective of cartography's function as a source of information, is a system in cartographic theory and as a structure in cartographic practice. Cognition, the perception of the map as a model of a particular reality and the process of its creation and use as a cartographic model. In the cartographic modeling process, the object-specific space and phenomena of objective reality and their changes from time to time will be known. In addition, cartography is described as the science of presenting, researching and distributing objects and the reciprocal relationship between nature and society by means of a picture sign model (cartographic presentation).

The three main characteristics of maps, are precise mathematical construction, use of signs and generalizations, which consist of three main methods of cognition: formalization, symbolization and abstraction. Map semiotics, maps are a product of civilization, which is formulated empirically, developed in socio-historical practice, and passed down from one generation to the next.

3.2 Cartography: Art Perspective

The intersection between cartography and art is very close, because map making is closely related to cultural, social and political factors (Ribeiro & Caquard, 2018). Generally this slice is because: cartography is always correlated with artistry; Maps are the result of artistic practice; Cartography as a combination of art and a place. Wood (2010) reveals a new approach called map art, which is a map designed by an artist that challenges conventional cartographic practices, which is presented by revealing political conditions in a poetic way. Maps are not just pictures, they contain political and cultural elements, which seek to understand the deep relationship between individuals/communities and a place (Cosgrove, 2005). Art has a long tradition of influencing the practice of cartography. Cartographers are trained to become artists, who must master the techniques of painting, carving (Brotton, 2014). Some examples of cartographic practices influenced by art, are:

1. London Underground Map by engineer Henry Beck. This map was driven by modernism and the avant-garde artistic movement. This technique based on straight lines and points, which describe the accurate location of a station within a city, influenced the design of subway maps around the world (Field & Cartwright, 2014).
2. Panorama maps. Panoramic maps are a style that combines ancient European painting traditions with modern cartography (Troyer, 2002) to show landscapes from an angled perspective. This style, which emphasizes the beauty of landscapes, has been heavily influenced by panoramic maps designed by the artist Heinrich Berann in the 1930s (Demaj & Field, 2012). This style is still widely used for tourist city maps as well as for maps of national parks in the U.S.
3. The earth from space. This world-famous map is made up of more than 10,000 satellite images, but which is recolored and stitched. This map produces what looks like a perfect image of the earth taken from space, and was further developed by Google, with the advent of Google Maps and Google Earth.

3.3 Cartography: Technology Perspective

Cartography has developed rapidly along with the development of technology. Starting with Google Maps and Google Earth, now there are more navigation options featuring mapping applications. Web-based mapping applications, have grown dramatically. Initially a web-based mapping application as a tool that allows institutions

and individuals to publish maps with user options limited to browsing, zooming, panning, and turning in/off (Kent, 2017). Today, web mapping applications introduce a wider range of functionality, including what traditional desktop GIS has provided but are expanding beyond that to include evolving application requirements, with the advantage of being able to share content and analyze map data on the web (Kent, 2017). Web-based mapping applications have occupied people's hearts and are now becoming valuable. Technology makes maps see the world in a wider range, not only around us, maps have been made far to have a function that is more than just mapping locations/places, but can capture our emotional responses (Nold, 2009), using other senses (McLean, 2016) thereby extending the graphic performance of space and place cartography.

Cartography by utilizing technology is more about how cartography provides services to individuals/organizations to meet their needs, where cartography is positioned as a medium for providing information. The emergence of the information society, maps are not only understood as a description of the surrounding space. However, there may be changes that can be predicted, analyzed, evaluated as a basis for making decisions. Technological advances make maps not only read by humans, but also by machines and robots. From the perspective of cartographic theory, this poses a new methodological challenge. For this, the map must be able to: (1) map as par-computing; (2) Maps as unique sensors; (3) and maps as data structures that co-exist both in the cloud and on the dock.

3.4 Realizing Cartography as a Combination of Sciences, Art and Technology

Modern cartography must be relevant, attractive and modern (Gartner & Wien, 2019). In accordance with the previous explanation that the end users of cartography are not only humans, but also robots and machines, as well as cartography that is serving by providing information widely to the public not only to certain experts, modern cartography must fulfill several things as follows:

1. Focus on user needs, while promoting awareness of geospatial understanding.
2. Using renewable information technology (open source, crowd sourcing, cloud).
3. Provides various access options for searching data and free for charge.
4. Ensuring the quality of geospatial information is up-to-date and conveyed in an authoritative manner.
5. Ensure the quality of geospatial information based on ethical values and boundaries.
6. Ensure the quality of geospatial information by considering technological developments in cellular phones and other devices.

Meanwhile, if viewed from its orientation, modern cartography which is a combination of science, art and technology, is cartography oriented as an artifact and providing services. That is, the map as an artifact has a beautiful appearance and is well designed, to retain important information for a long period of time. It turns out that apart from being an artifact, modern maps are also a communication tool that gives people access to find information (Gartner & Wien, 2019). That's why a modern cartographer needs an interdisciplinary professional. For a map maker, it is very important to know about computer science methods and techniques, as well as GIS, data acquisition methods, design, art, data modeling and analysis techniques. A map maker must be able to adopt new technologies as well as be able to handle the latest available media. All of these areas influence the cartographer's final product, which is shaped by science, art and technology. The modern cartographer is somewhere in between these three disciplines. He is skilled, trained and able to deal with the latest geodata, design principles and technologies. A modern cartographer must master competencies in data handling, media use, and artifact

design skills to make cartography of service value, focusing clearly on the role of cartography in conveying communication to users.

The application of ethics is more difficult for cartographers because their work is closer to that of an artist (Kent, 2013), especially when creative personal design solutions are needed. Cartographic languages allow different ways of expressing the same thing. If the feeling of being an artist is more dominant in making cartography (Crouch, 2010), then tension will arise. This critical problem with cartography could best be addressed by seeking more openness about how maps are made. This could include stating more complementary information about the source material (and/or providing a link to the raw data), disclosing data classification methods, including notes to justify why certain design decisions were made. Cartography is rooted in pragmatism which involves the application of art, science and technology to communicate spatial relationships. In essence, all cartography must involve a critical appraisal of its methods, and science must involve closer engagement and integration with mapping producers.

By transferring more power to the author as a cartographer, taking into account the long-term interests of establishing ethical principles if cartography is to develop as a discipline (Griffin, Robinson, & Roth, 2017). Any ethical guidelines in cartography, need to be rigidly pragmatic to succeed and incorporate the values of accuracy, openness and creativity. Cartography makers, must defend the future of this discipline and their belief in their profession.

IV. Conclusion

Today, with increasing possibilities of interaction on the web, the cartography encourages an increasing number of people to use their cartographic potentials to the full extent. They become users of cartography, and not just users of maps others have created (Wood D 2010). There is no future without cartography (Frančula, 2005). He argues that an important characteristic of contemporary cartography is the importance of maps having a fundamental role as one of the pillars of civilization.

Academic cartographers who place more emphasis on cartography as a science, most now accept that map communication models no longer adequately explain how maps work. The role of geovisualization expands the emphasis on delivery of information also includes exploration. Consequently, mapping is no longer in the hands of experts. Collaborative work is needed to make cartography a real product that combines science, art and technology. Most human activities related to space are hard to realise without adequate cartographic representations. Some of them are land use planning, property ownership, weather forecasting, road construction, location analysis, emergency response, forest management, mineral prospecting, navigation, etc. In essence, today's cartography refers to the choice of a new world, a new society.

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