
Communicating Geospatial Information By Means Digital Cartography And GIS

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Abstract

Since ancient times, people have devised cognitive artifacts to extend memory and ease information communication and processing. Among them are graphics, which use elements and the spatial relations among them to represent worlds that are actually or metaphorically spatial. Communicating geospatial information by means digital cartography and GIS through Maps as a decision making tools have improved in the last two decade. Maps schematize the real world in that they are two-dimensional, they omit information, they regularize, they use inconsistent scale and perspective, and they exaggerate, fantasize, and carry messages. The paper reviews the communicating Geographic Data, digital Cartographic Communication Process or model, Map Design, and Cartographic Design Elements as a tool for communication. Collectively, create a good map that successfully communicates geographic information helps the user to interpret for informed decision making.

Keywords: *Geo-visualization; GIS; communication; Geospatial data, cartography*

Introduction

Graphic communication is the surveyor tool in the science of measurement, computing (data processing), analysis and displaying the coordinate values, which have always been the cartographer's raw data for mapping. Cartography is considered as the theory and practice of mapmaking and map use, notably in the context of graphic (spatial information) communication (Burnett and Loos, 2007). The distinction between conventional analogue cartography and digital cartography (computer-based mapping) is contextual. A generalized definition of a map may refer to it (map) as a 2-D graphic representation of the attributes of spatial relationships of geographical features to scale. GIS is a computer-based system for data input, management (storage and retrieval), manipulation and analysis, and displaying of spatial data from the real world (Burnett and Loos, 2007).

Graphic communication in cartography is concerned with representation while GIS is concerned with analysis of spatial relationship (Burnett and Loos, 2007). GIS is a product of the development of computer-assisted cartography, which generated geo-referenced spatial digital databases. The databases became the platform for the creation of data structures that could be linked, processed, analyzed and results displayed in the form of maps, tables and reports. The systems for these functions became known as Geographical Information Systems (GIS). Burnett and Loos, (2007) observes that GIS is often confused with cartographic systems that store maps in automated form. Burnett and Loos, (2007) noted that the main communication in the cartographic system is to generate computer stored maps; the communication of a GIS is to create information by integrating data layers to show the original data in different ways from different perspectives. Graphic communication is the surveyor tool in the science of measurement, computing (data processing), analysis and displaying the coordinate values, which have always been the cartographer's raw data for mapping. The Global Positioning System (GPS), gives the coordinates (as captured by surveyors) in the field. The possibilities today for maps without ethics are compounded by the proliferation of off-shelf computer programs allowing non – cartography trained persons to produce maps that may look good, but are not consistent with any established professional standards or conventions. Geospatial data (Maps) are a great way of communication by displaying and analyzing spatial information.

Communicating geographic data

Map is the medium of communicating spatial information. Spatial arrangement of information communicate (visual communication) it spatial relationships between the elements in each image that provides meaning. The idea of a map (Geospatial data), is an abstraction. Maps are abstractions of the world we live in and phenomena on, within, or above its surface. As abstractions, maps communicate by allowing features in the real world to be represented in digital media, and databases, allowing us to calculate, present, and better understand the relationships that objects in the real world. Cartography view maps in form of visual communication as a special language for describing spatial relationships. In digital Cartography visual resources such as color, shape and pattern are used to communicate information about spatial relationships in computer database. Maps as a symbolic abstractions or representations of real world phenomena are represented with simplified, or generalized, with symbols representing real world. The process of cartographic design revolves around simplifying the situation being depicted and symbolizes the relationships being represented. Digital Cartography and a GIS as a process of abstraction, features of the real world are generalized (simplified) to meet the demands of the theme and audience. Some elements or details have a bearing on the pattern or process being studied and so some are eliminated to draw the reader's attention to those facts that are relevant. A small-scale map of an area must, almost of necessity, be more generalized. Some automated systems now have the ability to provide assistance in the generalization and simplification of features.

Geovisualization is the display of geospatial information to be explored interactively in an effort to facilitate the process of hypothesis formation and knowledge construction (Dodge, McDerby, & Turner, 2008; Dykes, MacEachren, & Kraak, 2005; Kraak & MacEachren, 2005; MacEachren & Kraak, 2001). Data exploration is an individual activity in which unknown spatial patterns are revealed in an interactive environment (Slocum, McMaster, Kessler, & Howard, 2009). A major difference between static cartography and geovisualization is interaction, and with geovisualizations it is possible that some information may go unnoticed without that interaction. Geovisualizations make it possible to provide more than one view (through multimedia, or another map, or tables or graphics). Geovisualizations allow users to interact with data drawing their own conclusions and making them feel like they have made a new discovery.

The digital cartographic communication process or model

Maps used in most activities (from urban planning, through geological exploration or environmental management, to trip planning and navigation), however, are still typically produced by professionals with expertise in mapping or in the phenomena being depicted on the maps.” Cartography has been defined by the International Cartographic Association as “the discipline dealing with the conception, production, dissemination and study of maps.” One useful conceptualization of cartography is as a process that links map makers, map users, the environment mapped, and the map itself. The cartographic process is a cycle that begins with a real or imagined environment. As map makers collect data from the environment (through technology and/or remote sensing), they use their perception to detect patterns and subsequently prepare the data for map creation (i.e., they think about the data and its patterns as well as how to best visualize them on a map). Next, the map maker uses the data and attempts to signify it visually on a map (encoding), applying generalization, symbolization, and production methods that will (hopefully) lead to a depiction that can be interpreted by the map user in the way the map maker intended (its purpose). Next, the map user reads, analyzes, and interprets the map by decoding the symbols and recognizing patterns. Finally, users make decisions and take action based upon what they find in the map. Through their provision of a viewpoint on the world, maps influence our spatial behavior and spatial preferences and shape how we view the environment. In the cartographic process, the fundamental component in generating a map to depict the environment and is itself a process – the process of map abstraction.

Map abstraction

It has become possible to map the world on the head of a pin, or even a smaller space. Even to achieve a screen-sized map of the world on your computer, map abstraction is fundamental to representing entities in a legible manner. The process of map abstraction includes at least five major (interdependent) steps: (a) selection, (b) classification, (c) simplification, (d) exaggeration, and (e) symbolization.

Selection

Depending on a map’s purpose, cartographers (map makers) select what information to include and what information to leave out. For example, in transportation map with aim to help users pick efficient routes by depicting the highways and whether traffic is moving quickly (green) or stalled (red). Other information is kept to a minimum and visually pushed to the background; that extra information is included to provide context for the primary focus (the highways and traffic on them).

Classification

Classification is the grouping of things into categories, or classes. By grouping attributes into a few discernible classes, new visual patterns in the data can emerge and the map becomes more legible. As a preview of some of the things map readers must consider about classification, one must be critical when looking at maps because changing the map classification can change what appears to be true. The challenge of displaying the data in a map is to generalize the data and thus to facilitate the search for spatial patterns (Burnett and Loos, 2007). However, by generalizing and simplifying the data, then map maker may understand data distribution. The map making involves striking a balance between remaining true to the underlying data distribution and generalizing the data sufficiently to reveal intrinsic spatial patterns. Statistical generalization can be applied to data that is to be symbolized by points, lines, and areas, and developed around the mapping of areas in choropleth maps. This is in part because choropleth maps are used so widely, but also because they are difficult to execute effectively. This is because choropleth maps have an inherent weakness--they involve the aggregation of data within a real units that do not correspond exactly with the underlying spatial distribution of data.

Data classification

Data is usually classified - put into some categories or groups – before it can be displayed (Burnett and Loos, 2007). Different ways of classifying data will lead to different patterns on the map. Classification is a form of cartographic generalization which reduces the complexity of a set of thematic data (Burnett and Loos, 2007);

- Classification: start by differentiating between
- categorical (nominal, ordinal) data
- numerical (interval/ratio) data

Categorical (qualitative, nominal) data classifications

In this case you are dealing with nominal (qualitative) data or data that is ordered but without a measurable range (rare as a type of mappable thematic data). There are no absolute rules for this kind of classification, just general guidelines. Features in the same class or category should be more similar than dissimilar and should be similarly symbolized. Features indifferent classes or categories should be more dissimilar than similar and should be symbolized differently (Burnett and

Numerical data classifications

In this case you have ordered data with a measurable range: i.e. quantitative data. The two big issues involved in the classification of numerical or quantitative data (Burnett and Loos, 2007);

- the number of classes you divide your data into
- the specific way you divide the data into those classes

Quantitative data allows you to create thematic maps called Choropleth Maps. Choropleth maps were introduced in the nineteenth century (Burnett and Loos, 2007). It was used by the Bureau of Census in several statistical atlases in the last half of that century and has been a favorite of professional geographers and cartographers ever since. The name is derived from the Greek words chorus (place) and pleth (value). Choropleth mapping has also been called area or shaded mapping. Choropleth mapping may be thought of as a three-dimensional histogram or stepped statistical surface. Number of classes: Most maps for presentation purposes should have four to six classes (Burnett and Loos, 2007). Environmental research institute (ESRI) proposes six classification methods: Natural Breaks (Jenks), Equal Interval, Defined Interval, Quantile, Standard Deviation, and Manual.

Simplification

Cartographers also need to simplify the features on a map beyond the tasks of feature type selection and feature classification in order to make a map more intelligible. This includes choosing to delete, smooth, typify, and aggregate entities within feature types. In the process of deleting entities, imagine creating a map in the region, then an arbitrary threshold is chosen. Smoothing is the act of eliminating unnecessary elements in the geometry of features, such as the details of a nation's shoreline that can only be seen at a larger, zoomed-in. Simplification processes act on one feature at a time, aggregation combines multiple features into one.

Exaggeration

Exaggeration of map features is often performed in order to allow certain features to be seen. For instance, on a standard paper highway map of interstate highways are printed on A4 paper look small. But, if the width of the printed road relative to the map width was the same as the width of the actual highway, then it would mean that the Interstate width will be wide! This is a typical case of exaggeration to create an abstraction that is useful for travel.

Symbolization

In the final process of creating a map, the cartographer symbolizes the selected features on a map. These features can be symbolized in visually realistic ways, such as a river depicted by a blue color. Map symbols are constructed from "graphic variables, the elements that make up symbols.

Graphic variables

Given the large variety of maps that exist, it might be surprising to learn that the visual appearance of all maps starts from a very small set of display from which all those variations can be constructed. graphic variables represents a "graphic" (visible) feature of a map symbol that can be "varied." They varied for map symbols location, size, shape, orientation, texture, and three components of color – color hue (red, green, blue, etc.), color lightness (how light or dark the color is), color saturation (how pure the color hue is). By convention, each of these "graphic variables" is used to represent particular categories of data variation.

Color schemes

Color is particularly important for map symbolization since so many maps are seen online where color is always available and nearly always used. While most maps you will see use color to depict data (as well as in aesthetic ways), many maps do not use color in the most logical ways in relation to the data being depicted. Well-designed maps use variations in the three color variables in ways that reflect the kinds of variations in the underlying data they represent. Sequential color schemes should be employed when data is arranged from a low to a high data value (e.g., data for mean annual income of country. This sequential scheme aligns colors from light (depicting low data values) to dark (depicting high data values) in a step-wise sequence. Sequential schemes can rely on only color lightness.

Map design

Map design is a complex process that provides many variables and choices to the mappers. Map design and compilation are extremely important to the second transformation of spatial data (Burnett and Loos, 2007). The first transformation is the conversion of data into a statistical summary or thematic story. The second transformation is the conversion of the statistical summary or thematic story into a spatial graphic composition to convey specific spatial knowledge and understanding. Design considerations that are intimately associated with map output addressed lightly here. Map output; this includes incorporating the final medium map that is to be delivered and used in associated map.

Map design as communication

Almost all maps include a "frame" design (titles, color bars, etc.) as well as an actual geographic picture - some may also include narrative text, charts, graphs, etc. use these communication principles to give your "map products" careful design so that they achieve your overall intent (Burnett and Loos, 2007);

Begin by defining your purpose and your audience

All maps are selective - they show what their maker intends. Have a clear objective and message in mind when you go to produce your map. Even if it is very technical, work out what you want the viewer to remember. Be specific about the type and number of people who most matter to your project. Common pitfalls: assuming that your map just shows "data" rather than having a message; or, developing a map for your own taste, rather than understanding what your audience needs.

Make your map a story

Design a map product that takes the reader on a journey. Unfold your messages in layers, not all at once. As the viewer looks more closely, additional information beyond your primary message should emerge. Don't force the viewer to read this information when they first see the map. Look at newspaper front pages for examples of how to combine graphic elements in an overall story. Common pitfall: use all the same size and color fonts for title and map labels.

Keep it simple

A map should have one primary message that is instantly clear to most people who see it – show your map to someone who has never seen it and ask them to tell you what it says five seconds after they look at it. Remove all information from the map that is not essential. Common pitfall: drawing attention first to a utility element such as a large or centrally placed scale bar or north arrow, or an overlarge legend; or, hiding the title in small fonts.

Direct the viewer's eye

The frame of a map (title, graphics, legend, etc.) integrates with your map to draw the viewer's eye to your messages in order of importance. Again, the map's intended viewing distance tell you what draws their eye in the first few seconds, then when they look a bit longer, using strongest colors for the most important features. Common pitfall: making lakes and other background water features a very rich and dark royal blue, which will dominate the viewer's perception.

Design for a viewing distance

Every map has an optimal viewing distance. For a page map, it may be only a foot or two; for a large poster it could be 10 feet or more. Place your map at its intended viewing distance and assess its impact.

Principles of map design

The following principles are different from rules such as those for placement of type. Whilst contributing to the design process, rules are not principles." The British Cartographic Society Design Group presented five "Principles of Cartographic Design" on their on November 26, 1999. These principles, and a brief summary of each, are as follows (Campbell and Michael, 2012):

Concept before compilation

Understanding of the concept and purpose of the map must be secured before the actual mapping exercise begins. Furthermore, end-user should be known before information is determined and what to include in a map and in what manner of map will be used. A map should have a purpose.

Hierarchy with harmony

Important map features must appear prominent on the map. The less important features should fade into the background.

Harmony should be created between the primary and secondary representations on the map. This will lead to a quality product that will best suit the needs for which it was developed.

Simplicity from sacrifice

Upon creating a map, adding much information into the graphic view should be as can possibly fit. It is best to leave some stones unturned. Just as the key to good communication is brevity, it can be said that the key to good mapping is simplicity. A map can be considered complete when no other features can be removed.

Maximum information at minimum cost

The purpose of a map is to convey the greatest amount of information with the least amount of interpretive effort by the user. Map design should allow complex spatial relationships to be understood at a glance.

Engage the emotion to engage the understanding

Well-constructed maps are basically works of art. If the viewer does not formulate some basic, emotional response to the map, the message will be lost. According to Buckley (2012), maps communicate geographic information and the five primary design principles for cartography when compiling their maps and constructing page layouts are legibility, visual contrast, figure-ground organization, hierarchical organization, and balance.

i) Visual contrast

Visual contrast relates how map features and page elements contrast with each other and their background. With increase illumination features are distinguish from the background. However, the features will still need to be large enough to be seen and understood so that your mind can detect what your eyes see. A well-designed map with a high degree of visual contrast can result in a crisp, clean, sharp-looking map. The higher the contrast between features, the more some features will stand out. Conversely, a map that has low visual contrast can be used to promote a more subtle impression. Features that have less contrast appear to belong together.

ii) Legibility

Legibility is the ability to be seen and understood. Legibility depends on good decision making when selecting symbols. Choosing symbols that are familiar to the user and appropriate sizes results in symbols that are effortlessly seen and easily understood. Geometric symbols are easier to read at smaller sizes. More complex symbols require more space to be legible. Visual contrast and legibility can also be used to promote the other design principles: figure-ground organization, hierarchical organization, and balance.

iii) Figure-ground organization

Figure-ground organization is the spontaneous separation of the figure from background. Cartographers use this design principle to help map readers focus on a specific area of the map. There are many ways to promote figure-ground organization, such as adding detail to the map, a drop shadow.

iv) Hierarchical organization

Visual layering of information within the map and on the page helps readers focus on what is important and lets them identify patterns. The hierarchical organization of reference maps (those that show the location of a variety of physical and cultural features, such as terrain, roads, boundaries, and settlements) works differently than for thematic maps (those that concentrate on the distribution of a single attribute or the relationship among several attributes). For reference maps, many features should be no more important than one another and so—visually—they should lie on essentially the same visual plane. In reference maps, hierarchy is usually more subtle and the map reader brings elements to the forefront by focusing attention on them. For thematic maps, the theme is more important than the base that provides geographic context.

v) Balance

Balance involves the organization of the map and other elements on the page. A well-balanced map page results in an impression of equilibrium and harmony. You can also use balance in different ways to promote edginess or tension or create an impression that is more organic. Balance results from two primary factors: visual weight and visual direction. If you imagine that the center of your map page is balancing on a fulcrum, the factors that will tip the map in a particular direction include the relative location, shape, size, and subject matter of the elements on the page.

Map design and visualization from a GIS viewpoint

Map creation and the visualizations of spatial information are bound to the purpose which the map/visualization will serve. Burnett and Loos (2007) suggested five (5) general steps in the map making process, and maps as used in GIS workflow. At each workflow step there is a generalization of map creation. Data purpose (needs assessment: in terms of information or data flow), determine medium of presentation, Data collection and manipulation (often to reconcile data) is usually the least rewarding of the map production tasks and design. Design is the magical step where the understanding brought together in the needs assessment and the constraints of the medium are weighed and the cartographer lays out the information. There are many conventions that can be adopted, and many tools to assist with rapid map production and deployment. Deployment is the release of the map. Printing continues to be a challenging part of good cartographic production.

Rules of cartographic representation

The contents of the map has to be adapted according to the target audience and the purpose of the map!

Map size

There is need to optimize the map so that it contain less information than the original map.

Simplification and generalization

Map usage, need to simplify and generalize to certain features present forexample instead of using symbols to show all the details on the ground, picking the *dominant* features and those that are included on the map. Also

- ❖ Distances between map elements and minimum sizes should be chosen so that features can be differentiated.
- ❖ The information density should be adapted according to the enlargement of the symbolization.
- ❖ The geometry of map elements must be generalized for legibility.
- ❖ The point density of lines must be reduced as well as text labels have to be adapted

Minimum dimensions

Unnecessary dimensions on a map should not be included as they compete with the map details. Also focus on line widths, minimum sizes for point symbols and minimum distances between graphical elements.

Fonts

A font must be easily legible and should also be optically pleasing. A font for maps should respect legibility at small sizes, and little space requirements. Colors Use colors that give hierarchical organization.

Cartographic design elements

Cartographic design is the visual representation of geographic and spatial information on a map. The purpose of Cartographic Design is to create a map that is visually appealing and effectively communicates pertinent information to the audience. Cartographic design consists of planning and layout. During preliminary designing phases, the cartographer determines the elements that will enhance the maps. As a mapmaker begins composition of maps, the basic elements need to be worked on, such as the subject area, the title, the legend, the scale indicator, color schemes, the north arrow, labeling/supplementary text, frame/border, and insets. A map does not always contain all of these elements. Cartographic design is subjective to the cartographer's idea of a "good" map.

Despite cartographic design's inherent subjectivity, there are at least 6 definable elements that make a good map:

- a) **Clarity** (eliminating unimportant elements),
- b) **Order** (in what order the viewer sees the map's elements including the Map Title, Map legend, and so on),
- c) **balance** (appropriate use of space)
- d) **contrast** (important elements stand out clearly against less important ones),
- e) **unity** ("the map appears to be a single unit, not a collection of unrelated bits and pieces")
- f) **harmony**(the elements all seem to fit together naturally).

Legend

A Legend (also referred to as a map key) is a small box used to explain unclear symbology on the map. They do this by describing each symbol (point, line or polygon) exactly the way it appears on the map (size, orientation, color, etc.). Because map symbols' meanings vary from region to region, a clear and concise legend is critical for conveying the distinctive characteristics of the map. Not all symbols are included in the legend; Symbols that are intuitive do not need to be defined in the legend. Any symbols that are not central to the map's theme can also be omitted from the legend. When designing a legend for a map it should be approached the same way that you would approach designing a map or any other kind of graphical representation. The only difference is that it is related to the information on the map it is connected to. Therefore it is important to remember the layout design concepts such as harmony, visual balance, clarity, visual logic, logical groupings, and unambiguous references to create a legend that is effective in relationship to the map. Creating a well laid out legend will only enhance the overall map's visual appearance. Often times a well-designed map can appear bad because of a poorly designed legend. It is important for map makers to keep an open and creative mind when designing the legend, and to make sure that it connects well to the map. The appearance of a legend should be simple. A subtle border and definition next to each symbol in the legend make it useful and aesthetically pleasing. The symbols inside the legend should be identical to the corresponding symbols on the map in size, shape, color, etc.

The position of a legend depends largely on the open space available in the map. It should be centered in an area of open space. It should be large enough to be easily legible but small enough to keep from drawing too much attention away from the map.

Representing scale

There are three common ways to represent scale on a map: Scale Bar, Representative Fraction, and Verbal Scale. Maps are smaller than the part of the earth's surface they depict. Cartographic scale expresses this relationship, traditionally in one of three ways. A verbal scale statement expresses the amount of distance on the map that represents a particular distance on the earth's surface in words, e.g., 'one inch equals a mile.' The representative fraction (RF) expresses scale as a numerical ratio of map distance to earth distance, e.g., '1:63,360.' The RF has the advantage of being a unit-less measure. Finally, a graphic scale bar uses a line of particular length drawn on the map and annotated to show how much earth distance it represents. A graphic scale bar has the advantage that it changes size appropriately when the map is enlarged or reduced. Alternatively, all three expressions of scale may refer to areal measurements rather than linear measurement.

A scale bar

Also called a bar scale, linear scale, graphic scale, or graphical scale, is a means of visually showing the scale of a map, nautical chart, engineering drawing, or architectural drawing.

Representative fraction

(often times referred to as RF) is a simple ratio that represents the scale on a map, usually written in this way 1:25000. A scale of this amount would mean that one unit on the printed map would equal 25,000 of the same units in the real world. A disadvantage of this type of representation is that it can be difficult to visualize.

A Verbal Scale or a word scale

Is when the scale is written out in a sentence or an equation, such as "1 inch = 16 miles", or "1 inch represents 16 miles". When using a verbal scale, numbers are often rounded to get a more desirable result.

Inset

An inset map is a smaller map featured on the same page as the main map. Traditionally, inset maps are shown at a larger scale (smaller area) than the main map. In this, they differ from locator maps, which show the primary map at a smaller scale (larger area) in the context of a region. Inset maps are used by cartographers to highlight information that would be difficult to perceive at the scale of the main map. This highlighted information may include symbols or points of interest that add to the purpose of the map and address its audience. This technique should be done for a highlighted area of significance, as the viewer will attach greater importance to the inset map. An effective inset map follows the same design principles as any map, even though it is featured in a smaller frame. The inset should be placed away from the visual center of the map but in a balanced location where the viewer will be able to clearly see it and recognize it is not an extension of the main map (this may be done with a border or text distinction). A good inset should include use similar colors and text as the main map, and should include a legend and scale bar unless the cartographer makes these two clear in some other way. Reasons for including an inset map within the main map can be to clarify a certain subject within the map, enlarge or focus on a small area of the map, or to provide a reference for an area presumed to be unfamiliar to the reader. Another reason for using inset maps is to show irregular shapes that don't easily fit into a given format. Inset maps are a great asset to cartographic design, but if overused will create a choppy, cluttered appearance and the design will not appear unified.

Balance

Balance within cartography creates an overall stability. Applying correct balancing technique can greatly enhance the clarity of the map. An essential part of correctly balancing a map knows how different map features are weighted. A weight is applied based on how quickly an element draws the reader's attention. Heavier elements tend to be dark, brightly colored, and larger. Lighter map features are generally dull colors, small, and lighter. When balance is poor, map readers might be distracted. When balance is achieved, map readers will focus on the content of the map. Visual balance results from two major factors: weight and direction.

- ❑ Visual weight depends on location: Elements at the center of a composition pull less weight than those lying on the tracks of the structural net; on the other hand an object in the upper part of a composition is heavier than one in the lower part.
- ❑ Regarding direction objects on the right of the composition appear heavier than those on the left and the weight of an object increases in proportion to its distance from the center of the composition.

Negative space

Negative space is the space around and between the subjects of an image. Negative space may be most evident when the space around a subject, and not the subject itself, forms an interesting or artistically relevant shape. Negative space in maps is useful in drawing attention to places where you want your audience to look. Oceans and other large bodies of water are good examples of negative space because they can either draw attention away from the purpose of the map if done incorrectly or they can be represented without taking over the visual hierarchy. Using negative space properly will greatly affect the balance and aesthetic value of an image. By working with negative space in the image instead of positive space, one may find that they are better able to accurately portray the subject or positive space in a visually pleasing and complete manner. One way to understand the negative space in an image is to represent the subject in white and the rest of the image with black. This allows you to creatively work with space in order to find the right balance between negative and positive space.

Aesthetics

Aesthetics deals with beauty or artistic appeal. In cartography, the aesthetic aspects of a work influence the overall quality of that work. It is important for cartographic works to have aesthetic features because the aesthetic quality of a work has a significant impact on the overall quality and user friendliness of that work. When choosing between two similar maps, one usually chooses the map that has more aesthetic appeal. Aesthetics in cartography can take one of two forms:

- ❖ Responses to the map itself as an aesthetic object. This can be accomplished through details the cartographer chooses to put emphasis on, the color or combination of colors included in the map, or artistic form the map takes.
- ❖ The subject of the map symbolized. An example of this would be the cartographer creating an expression of terrain which forms an imagined visual experience.

With these two forms in mind, a cartographer must always be aware of the audience the map is to be created for. Just as important as the audience is the theme of the map. Cartographers make aesthetic judgments when designing maps to ensure that the content forms a clear expression of the theme(s).

Lettering - labeling point features

Cartographers should avoid overprinting underlying graphics, which is to place a label on top of a map feature. Labels for points should not be placed directly to the right or the left of the point. The preferred position of labels for points is to the upper right of the point.

The second best location is to the lower right. Labeling on the left side in a like manner is also acceptable, but less preferred. Do not allow other map features to come between the point and its label because this may cause confusion for the map reader. Consider using a mask or a halo if the preferred locations of the point label don't work. Use leader lines if a mask or halo doesn't suit the point. Leader lines should be thin and should not touch the point or its label. Multiple line labels should be centered and placed in the preferred location of point labels.

Summary

To summarize this paper, in Communicating Geographic Data, Map is the medium of communicating spatial information. Maps are abstractions of the real world created through systematic selection, classification, simplification, exaggeration, and symbolization. They are products of the cartographic process, a cyclic process involving data as inputs, the final map as an output, as well as the map maker and map user as the creator and consumer of the map. Maps help reveal geographic patterns that are hard or impossible to find in lists of numbers that data are typically presented in. Graphic variables and color schemes form the building blocks for thematic map construction. Furthermore, different types of maps are used to represent different types of data, both categorical and numerical. Some data, for instance, are conventionally portrayed with symbols that are distinct from the statistical areas they represent, because counts are independent of the sizes of those areas. Rates and densities, on the other hand, are often portrayed as choropleth maps, in which the statistical areas themselves serve as symbols whose color lightness is varied with the magnitude of the attribute data they represent. Attribute data shown on choropleth maps are usually classified, and classification schemes that facilitate comparison of map series. Map design is a complex process that provides many variables and choices to the mappers. Map Design is a means of communicating the principles of map design. Cartographic design elements are the visual representation of geographic and spatial information on a map. Map creation and the visualizations of spatial information are bound to communicate the purpose which the map/visualization will serve.

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