*Geographic Information Technology Training Alliance (GITTA) presents:*

# Cartographic Data Representation

**Responsible persons: Boris Stern, Helmut Flitter, Lorenz Hurni, Marion Werner, Samuel Wiesmann**

# Table Of Content

# 1. Cartographic Data Representation

Data should always be presented in a clear, accurate, unambiguous, and complete manner. If the map conception phase has not been carefully done, the map will probably be incomprehensible, even giving some false information. So, the objective of this lesson is to help you to structure ideas according to the map user needs, and construct a workflow.

## Learning Objectives

- Be able to produce well conceived maps
- Know the workflow to communicate map information
- Know how important the influence of the map user is on mapmaking

# 1.1. Map Conception

## How to Produce Well Conceived Maps

Cartography is a communicative system in which the cartographer extracts spatial information from the 'real world' and creates a well-defined message that is embodied in the graphical design of the map.
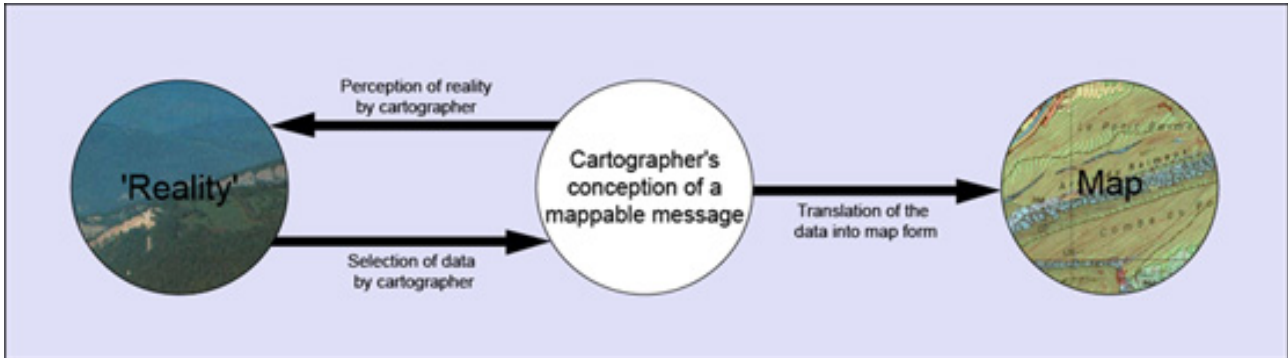


*Simplified model of cartographic communication system. Map Source:* (Spiess 1993)

Over the last 35 years, Cartography has known major technological change, evolving from a discipline based on pen and ink to one based on computer technology. One consequence of this technological change is that map production is no longer the sole province of trained cartographers. This is sometimes very problematic, as there is no guarantee that the resulting maps will be well designed and accurate. Consequently, some essential elements of map conception are often forgotten by such new and"naive" mapmakers. So, in this unit, for which you do not need any prerequisites, you will learn step by step how to build up a map in a correct way.

## 1.1.1. Basic Work Steps to Communicate Map Information

In principle, there is only one main question regarding cartographic communication: HOW we have to say WHAT by which MEANS or EXPRESSIONS to WHOM or to WHAT KIND of MAP USERS obtaining which RESULTS? But in fact, most cartographers would agree that this main question can be replace by sequential steps. Knowing these steps, will be very helpful for good cartography.
The communication model we present to you, consists of a set of five idealised steps:
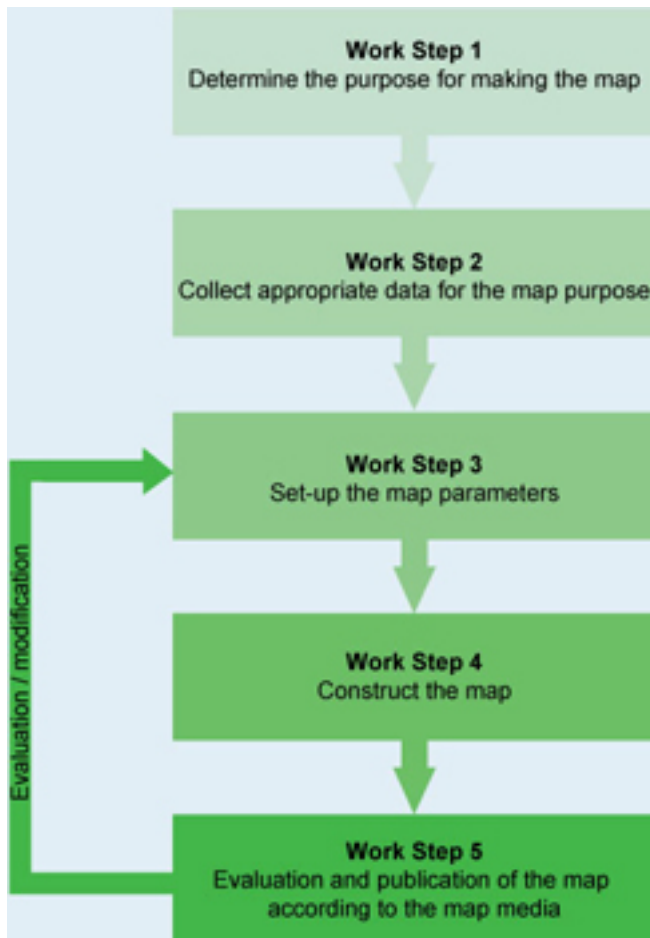
*Five Steps of Cartographic Communication, according to* (Slocum 1999)

## 1.1.2. Step 1: Determine the Purpose for Making the Map

In the first work step, you have to think of the purpose of your map. What exactly do you want to show with this map? By answering this question, you will be able to emphasize on the corresponding spatial distribution of a phenomena. It is important that the chosen map presentation reflect the real world as much as possible. Moreover, you should avoid the reader drawing an incorrect conclusion. Therefore, in this first work step, you should be able to answer the following question:

- What does the real-world distribution of the phenomena look like? What would the distribution of the phenomenon or an object look like, if I would view it while travelling across the landscape? This is much more difficult when considering mobile objects (e.g. people), than for natural landscape features. This approach forces the mapmaker to think about different distribution levels and to choose the degree of complexity. Example: Map representation of the landuse and geology of the transverse valley of Moutier. Rollover the following picture to have a cartographic representation of it.

> **Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]**

**A**: Oblique aerial picture from the south of the transverse valley of Moutier.

**B**: Landuse and geology map of the transverse valley of Moutier (1:25,000).

- What is the aim of the map? What is the purpose of your map? What exactly do you want to show with this map? By answering these questions, you will be able to emphasize the corresponding spatial distribution of a phenomenon. It is important that the chosen map presentation reflect the real world as much as possible. Moreover, you should avoid the reader drawing an incorrect conclusion. To know more about this topic read, "How to lie with maps" written by (Monmonier 1996).

- What is the map user group for this map? As shown in the unit Map types, each user or user group brings a particular set of experiences, and use maps in a different way. Therefore, it is important to define well the needs of the potential map users in order not to build too complex or too simple maps.

- What is the publication media for this map? The resolution of computer screens is much lower than the resolution of high quality printing systems, but digital maps offer more colours and animation possibilities. These two examples show that publication media have a very important influence on different map parameters as resolution, size, colours or possible interactivity. Some technical limitations can also be asked for: *imposition* [1](folding) or both sides printing if the publication media is paper, limitation in number of colours for screen maps.

- What are the time and the financial possibilities to finish the map? What is the budget to buy appropriate data, what is the publishing price, for how many copies? When you create a map, you will also have to consider the financial point of view, so without being a financial expert, you have to administer the budget taking account all the spending for the map. For example, creating a high quality dot map will cost more than a surface map, regardless of the technical capabilities available in the printing media. Another important factor you have to take into consideration is time. How long do I have to complete the map?

**Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]**

## 1.1.3. Step 2: Collect Appropriate Data for the Map Purpose

The second work step will consist of the data collection for your map. Spatial data can be collected from primary sources such as field measurements, or from secondary sources like existing GIS datasets. Collection of appropriate data consist of:

- Provide the data
- Analyze the data
- Select the best data

Further information about collecting data can be found in the module Basic Data Capture

---

[1] Imposition means the correct assembly of pages for a layout with, for example, 4,8,16 or 32 pages.

## 1.1.4. Step 3: Set-up the Map Parameters

The essence of cartography has to be considered here: the message which has to be understood by the map user is put in a graphical form. A full consideration of all cartographic criteria for this step is not possible; so we will only analyze the main and essential elements. So, in this step you have to think about the graphical aspect of the map: which elements do you want to present, in which graphical form? By taking into account time and data possibilities, the following criteria must be determined:

- Reverse: If the map media is paper, you must check if the reverse can also be used for printing. Sometimes more information can be put here: tourism information, sponsors, address, diagrams, smaller map, etc. Below is an example the map of the region "Jungfrau" (Switzerland): the front of the map represents the area in winter season, and the back represents the same area in summer. Rollover the map to show the back side.

> **Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]**

- Folding: A map can be folded for two reasons: Roll over the white folding elements to show video of the most used map folding.

> **Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]**

  - For ergonomic reasons: because a hiker or a car driver cannot use an A0 map continuously, the map has to be folded. In this case, you have to take into consideration the front and back cover: between which map folding will take place. Try also to do in sort, so the map reader reaches the most important information first when he/she unfolds the map.
  - For cutting reasons: If you have to create some pages for a book, or a brochure, you have to take care with the folding, which will be cut afterwards.
- Basemap: Generally, the basemap is made up of territory outlines and borders; but hydrography, orography, landuse, etc. and other elements can also be shown. In this case, the basemap should still be set graphically back from mapped information.
  Inside the global layout of the map, the basemap can be represented in two ways:
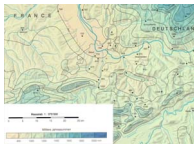  - As a map on which only a selected area is mapped in full; or as a map on which details do not extend over the whole of the area enclosed by the neat line.
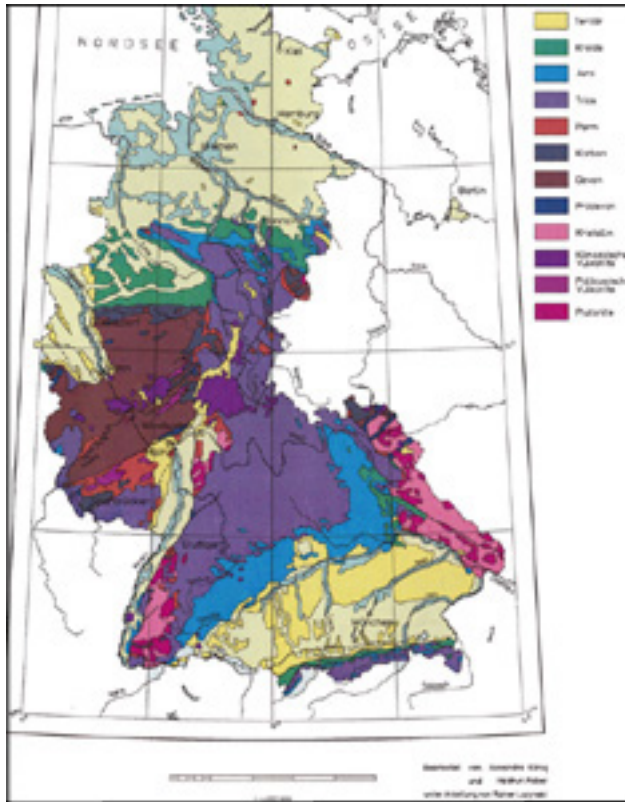
*Map of German geology, student work*

- As a map on which only the details extend over the whole area enclosed by the neat line or by a bleeding edge



*Map of the rainfall in the region of Basel, student work IKA*

- Projection system: Determine a projection system. Further information can be found in the module Basic Data Capture.
- Represented elements of the basemap: Determine which elements should be present: relief, shading, etc. depends of the user group, the aim, etc. Further information can be found in the lesson, Thematic Data Presentation of the Intermediate Presentation Module.
- Format, working and publication scale: Determine a working and publication scale. Further information can be found in the unit Map Size and Scale
- Generalisation: Define the degree of generalisation. Further information can be found in the Lesson Generalisation of map data.
- Map elements: Define the map elements: map symbols, font, colour-range, etc. Further information can be found at the lesson Thematic Data Presentation of the Intermediate Presentation Module.
- Design: Determine a global graphic design outline. Further information can be found in the Lesson Layout Design.

 **REMARK:**

The order of these criteria can be significant, so take this into consideration when determining your map parameters. In addition, like the other steps, you should still avoid the reader drawing an incorrect conclusion. For example, a hastily made map was used in the invasion of Grenada by USA (1983): a psychiatric hospital was bombed because of wrong information on these maps. The following right map shows an incorrect presentation of Grenada Island used in the lesson. Left shows the correct map presentation.



*Incorrect presentation of Grenada Island* (Monmonier 1996)

You have to produce a new map of the hiking paths in Switzerland. The appropriate data for the map are already collected, and the map format will be A0. Choose in which chronological order you will set-up the map parameters by draging and dropping them next to the chronological numbers.

**Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]**

## 1.1.5. Step 4: Building the Map

After the long and rather theoretical map conception phase began the concrete map construction phase. As cartography is almost digital nowadays, you can find further information about digital map construction in the Intermediate Lesson Instruments of digital Cartography.

The following points have to be taken into consideration when you build up the map.

- Positioning of symbols, lines, and typographic elements: In order to facilitate communication, you have to arrange the different map symbols in a correct manner. To acquire knowledge on the structure and presentation of map symbols have a look at the lesson Thematic Data Presentation of the Intermediate Presentation Module. For the positioning of topographic elements read the unit Typographic Design.

- Development and construction of the legend: After deciding on the elements to be mapped in the previous step, you must now organize them into a legend. Some interesting information for the appropriate design of the legend can be found in the unit Readability Rules and in the lesson Thematic Data Presentation of the Intermediate Presentation Module.

- Organize the map elements: For symbols, you have to arrange the map elements into a functional and aesthetic composition. Some good tips about map organization can be found in the unit Definition and organization of the map elements (Internal Link).

## 1.1.6. Step 5: Evaluation and Publication of the Map According the Map Media

- Evaluation of the map: One of the most important points in mapmaking is to know that you are designing the map for others, not for yourself. Therefore, when your map is more or less finished you have to determine whether users find it useful and informative. So, show the map to your circle (colleagues, friends, etc.) and ask them about the design, colours, etc.

  If the feedback analysis reveals that the map is not useful and informative enough, then the map may have to be reconstructed in an other way (step 4), and at the very worst, you have to set-up the map parameters once again (step 3).

- Publication of the map: Once the map has its definitive aspect, the publication phase can begin. Nowadays, personal computers are more and more involved as publishing systems: web mapping, laser printer, plotter systems etc. If you want to learn more about the different publication media, some information can be found in the lesson "Solutions for Digital Mapping" of the Intermediate Presentation Module.

## 1.1.7. Map Brainstorm

Come together in a group of 2 or 3 students for an online whiteboard discussion.
For the discussion, please keep the following aspects in mind:

- After welcoming each other, make an agreement on who is loading the attached file into your workspace.
- Take a minute to get a first impression of the topic's content.
- Then start to clarify each other's impressions. Allow at least 10 minutes for this communication part. Keep objective!

You have to make a map of the population's density in Europe for the year 2002. This map will be included in a schoolbook for 9-10 year old children. Find an answer to the following questions:

- What exactly do you want to show with this map, and by which means?
- What are the sequential steps you will follow?
- Optional question: Draw a very simple preliminary sketch of your map.

Your course leader will give you further information about the exercise presentation and the according time/ deadline.

## 1.1.8. Summary

To build up a map in a correct way, follow the complete workflow you learned here. Never skip or miss out a step to be faster with map production, without which the quality of the map will suffer from.

# 1.2. Map User Needs

## The Influence of the Map User on Mapmaking

Because it is essential to include only those objects of specific relevance to the context of the map's message, the map user needs are a very important factor in the transfer of knowledge between map author and users. Therefore, in this unit you will learn how to interpret the requirements of the map user in order to make an appropriate map and be successful in map communication.

Necessary prerequisites are knowledge of map types and map communication. This content was dealt within the previous unit where you may need to have a look first to get the new aspects in the right sense.

## 1.2.1. Map User's Feedback

Map user's feedback is helpful to the map author in that it allows him to alter the design by incorporating changes suggested by the map user. Unfortunately, most cartographic designers are separated from users by time and space, so it is difficult to make use of such feedback.

User should also describe how the map will be used. Legibility requirements for road maps to be used in a moving car must be higher than for a map to be viewed in stable conditions. Maps to be used at night in boats, ships, and aircrafts must be usable in dim conditions so that night vision will not be greatly affected by bright illumination. A map on a wall being viewed by an audience seated at desks will require a different treatment of graphic character than a map of the same sort in a textbook on the desk. If you are not sure about the "map user feedback"a good question which is necessary to be answered before continuing is: "have I well understood the needs of the map user"? If the answer is negative, you should discuss the map user again, or have a look back at the unit "map types" to get more information about the different map types.

☞ It is also still necessary to pay attention to ethical questions regarding map making. Indeed, a map should never contain purposeful errors (lies) or poor judgement, even if the map client asks for it.

As an example of map user's feedback, look at the two following school maps showing the African continent. The first map on the left is designed for children between 5 and 9 years. The map designer takes the small capacity of comprehension of young children into consideration to design this very uncomplicated and attractive map: few colours, pleasing children symbols, little thematic information. The more detailed map on the right is designed for children between 10 and 15 years. This map is much more complex than the first, but still simple: only relief information, border, toponimy information and sea names are represented.

*Map for children between 5 and 9 years* (Michel et al. 1998)



*Map for children between 10 and 15 years* (Klett-Perthes 1993)

## 1.2.2. Map User and Map Communication

Each map user group may vary from another in terms of its familiarity with graphic and symbolic conventions, its geographical knowledge, and its perceptual limitations in general. Therefore, when you design a map, you should only include map information that is meaningful for a specific type of user group.

The perceptual limits of the map user may sometimes be a significant element for map design. For example, older people have more difficulty perceiving small types and must hold visual material closer. An extreme example is provided by the problems of making maps for blind people, which attention must be paid to things such as tactile symbols. More information to design colour maps for partially sighted user, can be found at the unit "Colour Design".

As an example, look at the Ski Touring Map Serie «S». This 1:50 000 map has been produced by Swisstopo in cooperation with the Swiss Ski Federation in order to have better user knowledge. This close collaboration brought specific Ski Tour information:

- Map is light and easy to handle (possibly with gloves).
- Tours and mountain refuges can be seen quickly. Information is clear and legible, even in case of danger (storm, fog, cold, etc.).
- Because most ski hikers have a good map reading knowledge, topographical and geographical information is also present on the map (for slope gradient, orientation, etc.).
- The map has specific extra information: index of tours with a short description and degree of difficulty, information on rescue services and avalanches, lists with important phone numbers (rescue, weather, avalanche hazard bulletin).

*Ski Tour Map Serie«S»: Passo del Bernina, reproduced with the permission of swisstopo (BA057224)* ( Swisstopo)

## 1.2.3. Summary

Because a map becomes meaningful only in relation to the previous knowledge the user brings to it, the knowledge of users should always be taken into account when you design the map. So, if you want to be successful with map communication, take the time to well interpret the user's requirements.

# 1.3. Summary

Throughout this lesson, we saw how to build up step by step a map in a correct way, in order that the resulting map will be well designed and accurate to the map user.

## 1.4. Recommended Reading

- **Deutsche Gesellschaft für Kartographie**, 2000. *Ausbildungsleitfaden Kartograph / Kartographin.*

# 1.5. Glossary

**imposition:**

Imposition means the correct assembly of pages for a layout with, for example, 4,8,16 or 32 pages.

# 1.6. Bibliography

- **Deutsche Gesellschaft für Kartographie**, 2000. *Ausbildungsleitfaden Kartograph / Kartographin.*
- **Grindelwald Tourismus**. touristic information map.
- **Klett-Perthes**, 1993. *Alexander Schulatlas.*
- **Michel, F. ,Mignon, P.**, 1998. *Mein Super Atlas*. München: arsEdition.
- **Monmonier, M.**, 1996. *Eins zu einer Million*. Birkhäuser Verlag.
- **Monmonier, M.**, 1996. *How to lie with maps*. second edition.
- **Slocum, T. A.**, 1999. *Thematic Cartography and Visualization*. Prentice Hall Upper Saddle River New Jersey .
- **Spiess, E.**, 1993. *Schweizer Weltatlas*. Konferenz der kantonalen Erziehungsdirektoren (EDK).
- **Swisstopo**. Landeskarte, 1:25000.
- **Swisstopo**. *Swisstopo* [online]. Bundesamt für Landestopographie. Available from: http://www.swisstopo.admin.ch/ [Accessed 2016-05-10].