

Bedolina Petroglyph at Valcamonica, Northern Italy 2500 B.C.

INFOGRAPHICS SEMINAR HANDOUT

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INTRODUCTION

Information graphics reveal the hidden, explain the complex and illuminate the obscure. Constructing visual representation of information is not mere translation of what can be read to what can be seen. It entails filtering the information, establishing relationships, discerning patterns and representing them in a manner that enables a consumer of that information construct meaningful knowledge.

In the attention scarce world of today, information graphics (or infographics) have taken the media and communications industries by storm. From simple instructions on how to assemble your table, to explaining how a conjoined set of twins were surgically separated, to understanding what went wrong in the Challenger Shuttle disaster - designers, educators, journalists, and communicators in general have embraced infographics to help audience understand their intent in a swifter and smarter way.

In this seminar we will see what an infographic is, how it evolved, and what it takes to create one.

WHAT IS AN INFOGRAPHIC?

Infographics are traditionally viewed as visual elements such as charts, maps, or diagrams that aid comprehension of a given text-based content. Thus, a newspaper infographic on a breaking news accident is expected to faithfully record, using visuals, what has been explained in the accompanying text.

However, as we shall see in this seminar, visual representation of information can be more than just the manner in which we are able to record what has been discovered by other means. I hope to establish that they have the potential to become the process by which we can discern new meaning and discover new knowledge.

A classic example of an infographic that not merely illustrates the content but interprets it in a manner that was not possible otherwise, was produced by Dr. John Snow to identify the cause of cholera epidemic in Central London. By plotting (fig.1) the two available sets of data about number of deaths and their corresponding locations, Snow was able to pinpoint the notorious contaminated pump well.

In designing infographics, applying a graphic style to the information is not nearly as important as giving a graphic form to the actual content, with a clear understanding of how that content is perceived and processed by an audience. For example, the Periodic Table chart designed by Henry Hubbard is a visual representation of known chemical elements. Since the last edition of the Hubbard chart, 16 new elements have been discovered. These discoveries have confirmed the genius of the Periodic Table as a template that not only summarizes information succinctly, but also provides a system for predicting future outcomes¹.

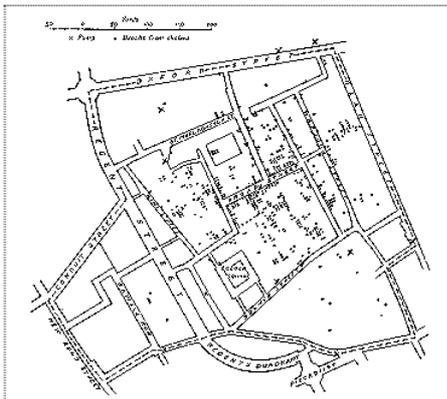


fig.1. Location of deaths from cholera in Central London by Dr. John Snow, 1854.

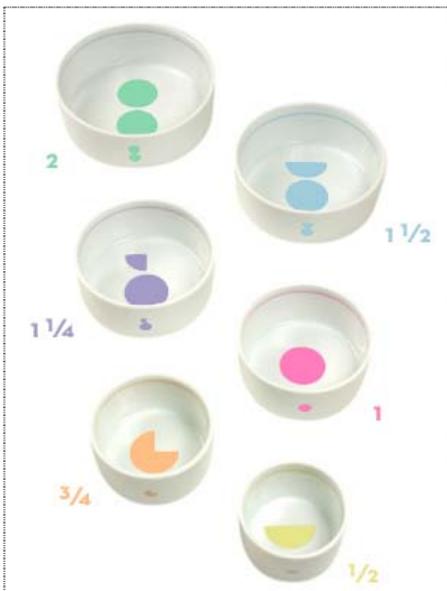


fig.2. mesû measuring bowls by Studio Panepinto, 2005.

1. For a scathing criticism of the indiscriminate appropriation of scientific imagery, read *Wonders Revealed: Design and Faux Science* by Helfand and Drenttel.



fig.3. Light Switches.



fig.4. Electric Plugs.



fig.5. Traffic Light.



fig.6. One Rupee Currency.



fig.7. Lift Floor Indicator.

Also in this seminar, we will see how infographics have wide ranging applications beyond news dissemination, in several other domains such as, scientific visualization, product design, education, information technology, business communication and entertainment. The ceramic measuring bowls (fig.2) from the design studio Panepinto is a fine example of product that displays unambiguous information in a vivid manner.

EXERCISE 1

Let's look at some common everyday artifacts around us. Think about the nature of the information they contain and how they get communicated to the user.



The clock for example is probably the most well-known information graphic in the world. Three hands revolving on the clock face at differing speeds reveal information about seconds, minutes, hours and days. It is a clever depiction of four measures using one scale.

Take a look at the 5 artifacts on the left. What information do they possess? Where is the information embedded? Why is the information important? How do they communicate them to us?

VISUAL THINKING AND REPRESENTATION

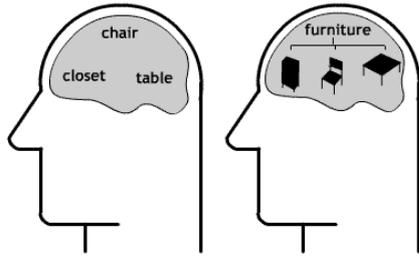


fig.8. We think in terms of categories. A diagrammatic representation by Alberto Cairo.

Representation (literally, to *present again*) provides the basis for all communication. We can convey ideas about things that are not materially in our presence only by calling forth an appropriate mental representation. These mental representations are stored in categories and are characterized by a degree of abstraction. Recent studies have revealed that we categorize even before we identify things.

For example when we look at a chair, a closet, and a table, we process them as a broader class of objects (“furniture”) rather than as individual instances of the class (fig.8). Furthermore, the mental imagery associated with each of the furniture is likely to have the essential characters of the class (“chairness”) rather than literal characters of a specific instance (“recliner”).

Thus, we think in terms of categories, and relationships among categories. This capacity to generalize, to form associations, to detect relationships, and to seek comfort in organization is the cornerstone of our communication system. While words and sentences are part of the verbal communication system, images and graphical representations form the visual communication system.



fig.9. The Treachery of Images by Rene Magritte.

The visual-verbal dichotomy² is well illustrated in the example of Rene Magritte's *The Treachery of Images* (fig.9). When serving as representation of concrete, real-world objects, images make identification easy. When word and image collide, as in this case, the image dominates perception and it is impossible to read the caption (“this is not a pipe”) without first recognizing the pipe.

The representational style - a highly realistic rendering of the pipe - is a conscious choice of expression by the painter to underscore the contradiction between word and image. Pictorial representations cross social and linguistic boundaries with ease. However they are also dependant upon the culture in which their meaning is established. Magritte's painting can be recognized as a pipe by anyone, but only a Francophone will appreciate the full meaning of the work. Communication therefore is always affected by the context in which it occurs.

Infographics, because they use a combination of images, words, and numbers, operate in a hybrid system of both the verbal and the visual. Consequently they offer us the greatest opportunity to increase the effectiveness of our communication.



fig.10. Bizarro by Don Piraro *The Globe and Mail* 24.03.97.

2. For a more detailed discussion of the topic, read chapter 'Image and Representation' from the book *Designing Visual Interfaces* by Mullet and Sano.



fig.11. Abstraction from Typical to General.

EXERCISE 2

A given representation can be characterized by its degree of abstraction. The ease of interpretation varies with the level of abstraction of the representation.

As highly concrete, realistic representations are simplified, they become easier to interpret – up to a point, beyond which further abstraction begins to obscure its meaning. We get best results by eliminating non-characteristic details and exaggerating defining features.

Representations that successfully manage to communicate are easily visible, simple, immediate, cohesive and general in nature.

Create visual representations for the following things, processes, or phenomena.

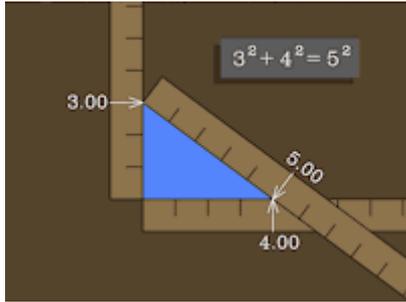


fig.12. Animated Proof of Pythagoras Theorem, *Project Mathematics*, California Institute of Technology.

1. Slow moving traffic
2. Flood Alert
3. Building unsafe to live
4. Women's Self Help Group
5. Delayed indefinitely
6. How to tie a tie?
7. Lunar eclipse
8. How to greet someone in India?
9. Using an ATM
10. Tsunami
11. Middle class
12. Purchasing Power
13. Voter apathy
14. Democracy
15. War against terrorism

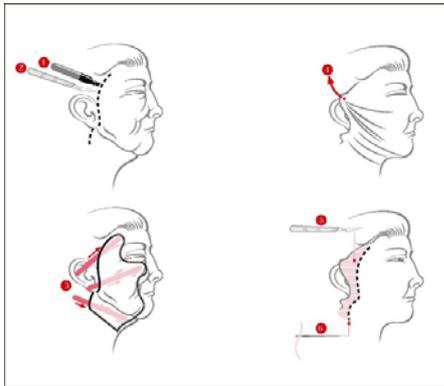


fig.13. How to do a facelift. *Wordless Diagrams*, Nigel Holmes.

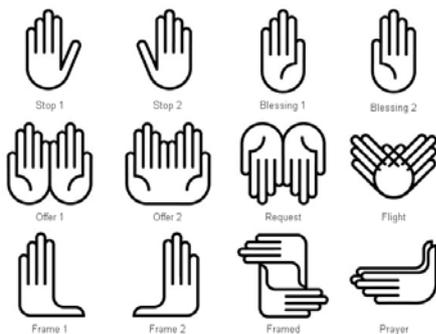


fig.14. Hand Symbols by Ravi Poovaiah Industrial Design Centre, Indian Institute of Technology, Bombay.

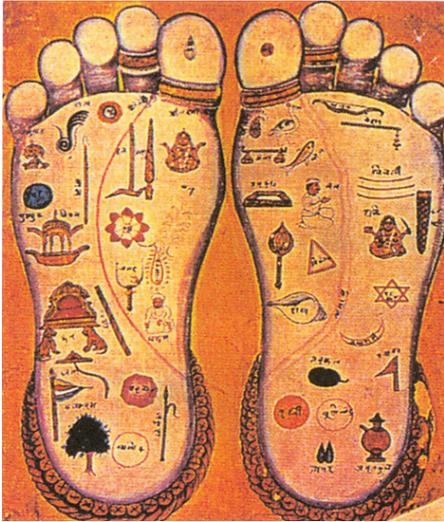


fig.15. Vishnu's Footprints as Constellation of His Earthly Symbols, Rajasthan, 18th century.

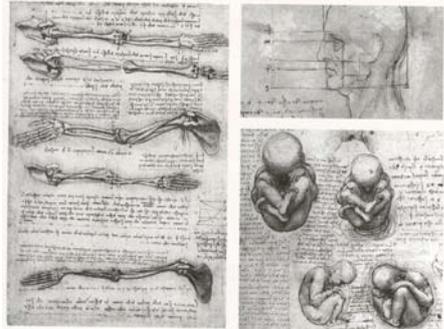


fig.16. Anatomical Studies by Leonardo Da Vinci, 15th century and 16th century.

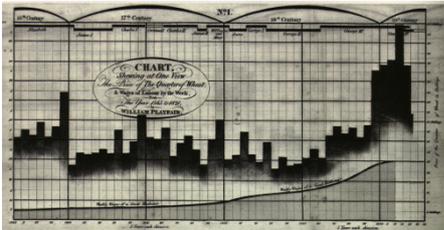


fig.17. Chart by Playfair, showing the price of the quarter of wheat and the wages of labor by the week, 1786.

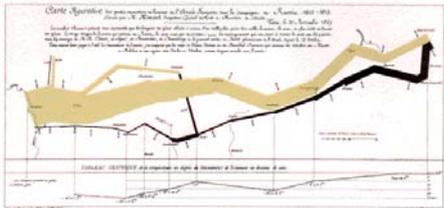


fig.18. Napoleon's Army's Russian Campaign by Charles Minard, 1861.

A BRIEF HISTORY OF INFOGRAPHICS

Images predate not only today's graphics-laden media but also written language itself. Petroglyphs³, which were the earliest forms of non-verbal communication created by prehistoric societies, are found in all continents except Antarctica. They evolved into more advanced pictograms such as the Sumerian cuneiform script and the Egyptian hieroglyphs, which in turn led to linguistic writing that we use today.

Throughout most of this history, image and text have remained inextricably mixed. From ancient holy books (fig.15) to Renaissance writing (fig.16), authors strived to integrate visuals and script into a coherent whole. However when technology intervened in the form of moveable type, visual expression became separated from written text because of the different production processes and the skills required to produce them.

With the advent of desktop publishing in the late eighties, and the emergence of the field of information design in the nineties, the infographic movement has regained its lost momentum. But before we get to its present state, let's look at 5 key examples from the past that have left a lasting influence on the way we think about and create infographics today.

1. William Playfair's The Commercial & Political Atlas: Scottish engineer and political economist William Playfair is credited with inventing the bar chart and the pie chart. With the help of charts, he was able to better communicate the data that was conventionally presented in tables.

In 1786, he published *The Commercial and Political Atlas*, which contained a series of 43 charts (fig.17) representing changes in data over time graphics and one bar chart. It has been described as the first major work to contain statistical graphs.

By abandoning a literal, metaphorical approach that likened data to piles of items, Playfair "broke free of analogies to the physical world and drew graphics as designs-in-themselves," Edward Tufte⁴ notes. In doing so, he furthered the quest for symbolically representing ideas than simply depicting them.

2. Charles Minard's Map of Napoleon's Army's Russian Campaign: French engineer Charles Joseph Minard in 1861 charted the ill-fated campaign by Napoleon's army during the Russian Campaign of 1812. This map (fig.18), along with several dozen others that he published during his lifetime, set the standard for excellence in graphically depicting statistical data such as flows of people and goods in space and time.

Edward Tufte⁴, who considers Minard's map as the best statistical graphic ever drawn, identifies six separate variables that are captured in the map. First, the line width continuously indicates the size of the army. Second and third, the line shows the latitude and longitude of the army as it moved. Fourth, the direction that the army was traveling, are distinguished by colors, tan for advance and black for retreat. Fifth, the location of the army with respect to certain dates.

3. Petroglyphs: The word comes from the Greek words petros meaning "stone" and glyphein meaning "to carve".

4. See Edward Tufte's *The Visual Display of Quantitative Information* (p.40).

Finally, the temperature along the path of retreat. Few, if any, maps before or since have been able to coherently and so compellingly weave so many variables into a captivating whole.

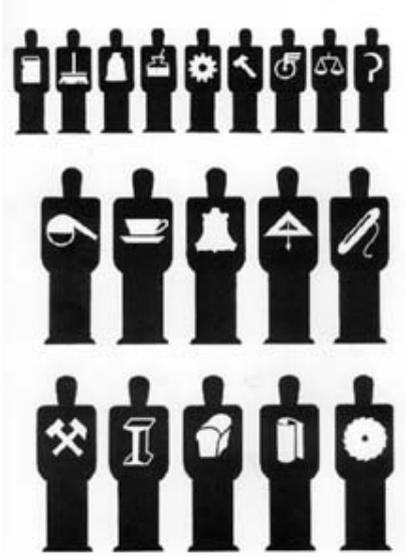


fig.19. Isotype system by Otto Neurath, 1920.

3. Otto Neurath's Isotype: Otto Neurath an Austrian sociologist and political economist conceived a visual communication system called ISOTYPE (International System Of Typographic Picture Education) in Vienna in the late 1920's. Using a standardized system of symbols, he believed he would be able to convert profound research statistics into ideas, ideas into a picture narrative, and a drama of social interpretation (fig.19).

Meant to represent quantitative information as easily interpretable icons, Isotype served to visualize social and economic relations especially to ease reception of complex matters for the uneducated receiver. Isotype was developed from a specific socialist concept of adult education beyond reading, one that was generally accessible independent of individual educational backgrounds.

In this picture language, elements or pictograms were reduced to the smallest possible detail of what they represented (e.g. starting with the outline of a "man" and if necessary, with additional attributes to identify the man as "worker", "coal worker", "unemployed" etc). In the pictures, perspective was abandoned, details banned and any use of colors standardized. They were then arranged into fact pictures according to a set of rules concerning serialization and consistency in use.

Although Isotype failed due to the difficulties related to the sheer enormity and complexity of iconic representation, it had profound impact on graphic design and iconography. The influence continues to be felt today in such things as road signs, universal symbols and software user interfaces.

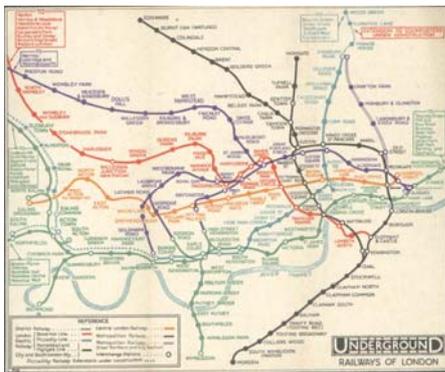


fig.20. London Underground Map, 1932.

4. Henry Beck's Map of London Underground: The London underground rail system was getting complex in the 1930's and the map designers were having a hard time fitting all the stations into the standard issue card folder (fig.20). Un-intimidated by cartographic convention, an out-of-work engineering draughtsman called Henry Beck plotted the underground as if he was sketching an electrical circuit board.

He used only vertical, horizontal, or 45 degrees angled colored lines; located the stations according to available space; and evened out the distances between stations. The resulting "map" although geographically inaccurate, provided a coherent overview of a complex system (fig.21). The map was an instant success and for Londoners it became the organizing image of their city. "The map organized London, rather than London organizing the map", remarks Tufte.



fig.21. Redesigned Map by Henry Beck, 1933.

(There was an interesting and unwitting fallout from Beck's map. The map telescoped scale, and brought the suburbs closer to central London. Suddenly, Watford was no further from Paddington than Liverpool Street. The map lubricated the exodus of London's inner-city dwellers as nearly half a million people were enticed out to the suburbs, where they

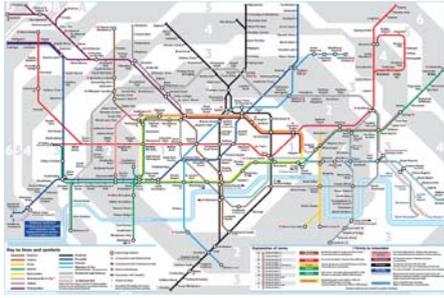


fig.22. London Underground Today.

found themselves captive customers of their local tube station).

Beck's map is by far the most successful infographic as it continues to accommodate the ever expanding rail network (fig.22) and inspires design of countless other route maps world-wide. This success is due to 2 design strategies that the map employs.

First, the map places importance on function over precise geography. A commuter is interested in how to go from one station to another. All he needs to know are: which line to take, where to change lines, and what are the preceding stations. The map fulfills this need by simple lines (which ensure an uncluttered layout), color (which differentiates the lines), clear typography (which makes text easy to read), and symbols (which differentiate stations from interchanges).

Second, the map capitalizes on the fact that the system operates underground and therefore the commuters need not be burdened with the confusing topography above ground. The only surface feature to survive was the River Thames. The map makes complex information simple by eliminating all extraneous details.



fig.23. Weather Map by George Rorick, *USA Today*, 1982.

5. George Rorick's Weather Maps: At a time when graphics in Newspapers were considered time consuming and distracting, George Rorick⁵, pioneered the use of graphics as an important component of news communication. He envisioned *USA Today* as a visual Newspaper – "Visuals that help people understand the news. And color, of all things!"

However, he is best known for the weather graphics, which revolutionized the way we read weather information and is probably the most imitated news infographic (fig.23). Using a combination of color, maps, tables, symbols, and annotation, Rorick transformed a hitherto dull and often hard to understand information into something very interesting and accessible.

Rorick's greater legacy though was his efforts in gaining a widespread acceptance for visual journalism in a profession dominated by text, establishing a business case for infographics, and formalizing a production process within the newsroom setup that churn out consistent quality infographics on a continuous basis under tight deadlines.

5. The vision of George Rorick (<http://www.poynterextra.org/George/index.htm>).

INFOGRAPHIC DESIGN: A FRAMEWORK

There are 3 major challenges in designing a successful infographic.

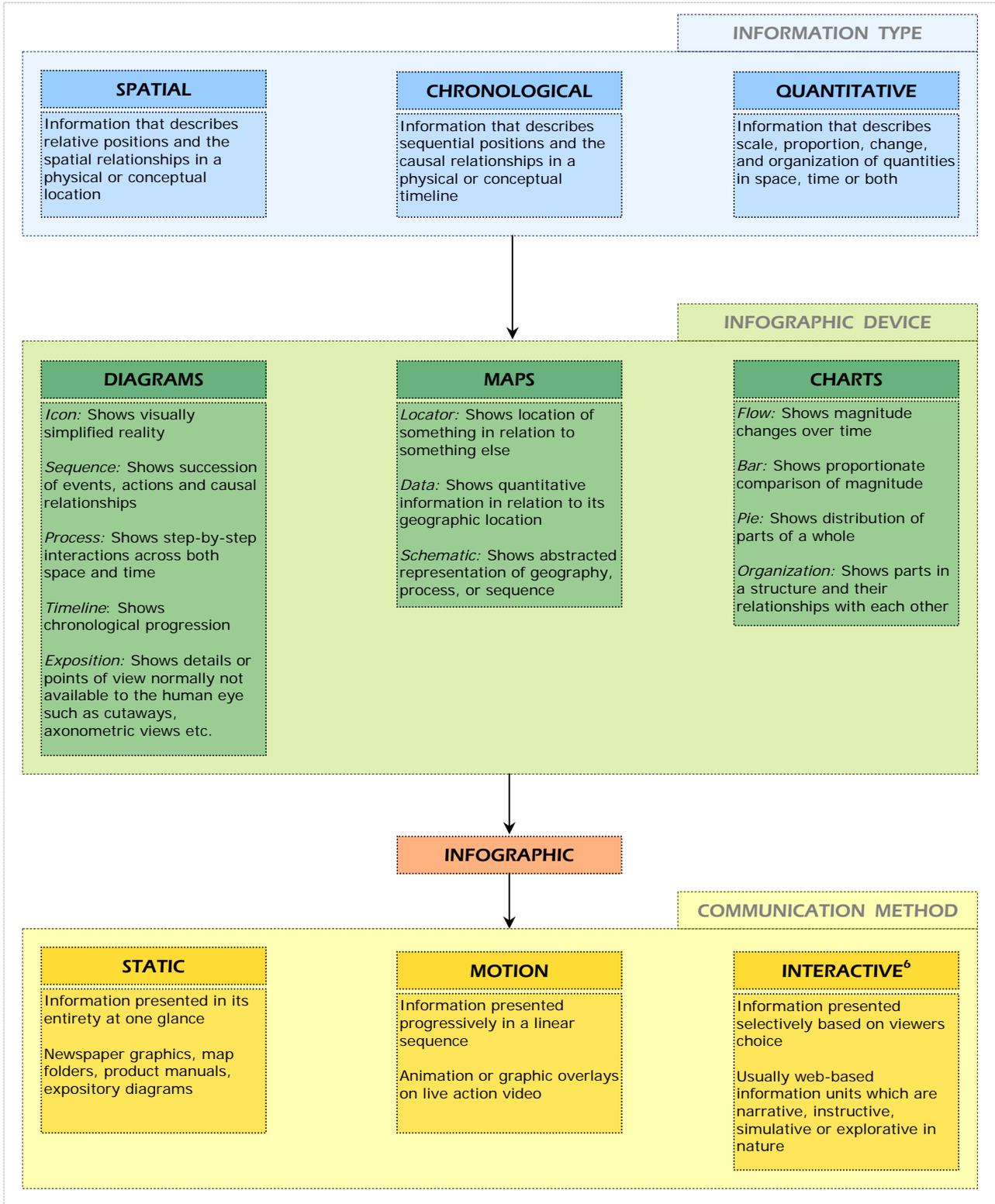
1. To clearly understand what type of information it is trying to communicate – whether spatial, chronological, quantitative or, as is usually the case, a combination of all three.
2. To conceive a suitable representation for that information as a cohesive whole – a whole that is more than the sum of its constituent parts such as, charts, diagrams, maps, timelines etc.

3. To choose an appropriate medium for presentation – static (paper or computer screen), motion (animation or video), or interactive (increasingly web or other electronic device-based, but could be something as simple as a paper-based pregnancy wheel).

6. Read *Interactive Visual Explainers - A Simple Classification* for an elaboration of the types of Interactives (<http://www.elearningpost.com/features/archives/002102.asp>).

Despite the difficulty in creating a design framework, it would be useful to have one, in order to understand the overall picture of the infographic design process. The following diagram depicts one such a framework:

Infographic Design Framework



INFOGRAPHIC DESIGN: NINE STRATEGIES

In the last section, we understood where and how an infographic fits into the overall scheme of the information design process. In this section, let's glean some design strategies by analyzing some successful infographics.

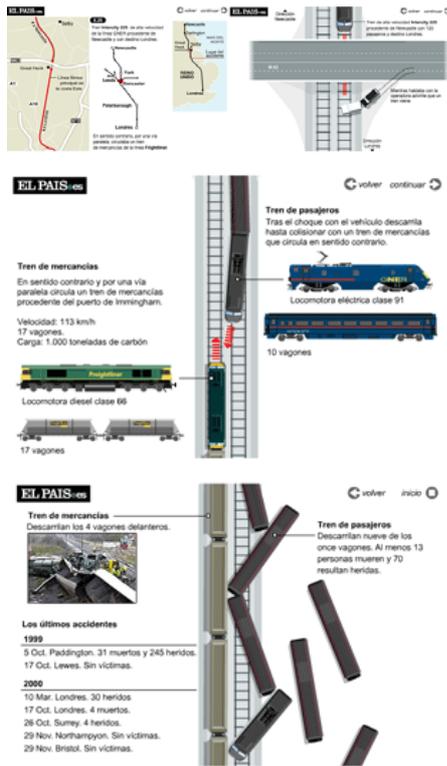


fig.24. Anatomy of an accident, *El Pais*.

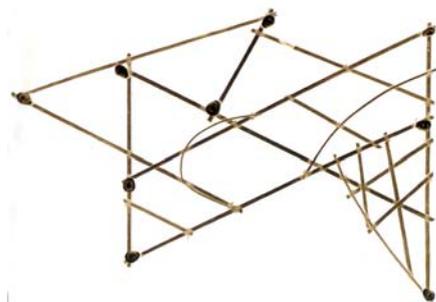


fig.25. Shell Map, Marshall Islands.

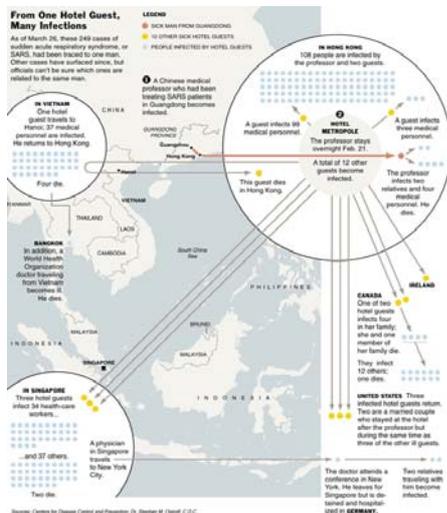


fig.26. How SARS spread, *The New York Times*.

1. ORGANIZE: Organizing the available information and coming up with a plan for presenting it is the first and probably the most difficult stage in designing any infographic. The train accident infographic (fig.24) explains the collision of two trains triggered by an automobile veering off a nearby highway.

The key to reconstructing an event like this is to establish the role of geography, the cause, the chronological sequence, and the facts of the objects involved. All of these pieces of information have to be organized effectively with right amount of detail and emphasis to make sure the viewer experiences the incident as an authentic whole.

2. MAKE VISIBLE: It is the essential quality for an infographic. The fishermen of Marshall Islands have for centuries used maps (fig.25) made using shells tied together by bamboo sticks, to visually represent the distance between the various islands, their locations with respect to each other, and the direction of currents.

3. ESTABLISH CONTEXT: Going back to the train accident example, establishing context begins with locating the geography of the accident site so that the viewer get the bearings on the topography of the event. The designers have chosen the top view because the key components are the highway and the tracks below. Notice the view is closer when the first collision happens and gets wider during the second collision. Through this the difference in scale of collision is established. The viewer is able to experience the fact that a small vehicle has triggered a catastrophic collision.

4. SIMPLIFY: Representations that are simple and direct are easier to interpret. We get easily distracted by extraneous properties of representation. The NYT graphics on the spread of the SARS virus (fig.26) exemplifies the principle of simplicity – most notably in its visual treatment of the map and use of colors.

The graphic talks about a spread from country to country. Hence a coarse representation is good enough to convey that message. Colors are used to indicate the primary, secondary and tertiary spreaders of the virus and it is critical piece of information. Hence you see only 3 colors in the entire graphic.

5. ADD REDUNDANCY: Redundancy is a concept which has emerged from the information theory to communication. Redundancy is the opposite of information. Something that is redundant adds little, if any, information to a message. Yet much of the information we deal with in everyday life contains a good deal of redundancy.

The English language, for example, can be mostly understood if you remove the vowels. Cnsdr ths sntnc, fr xmpl. One of the purposes of adding redundancy to a stream of information is to make it easier for us to digest

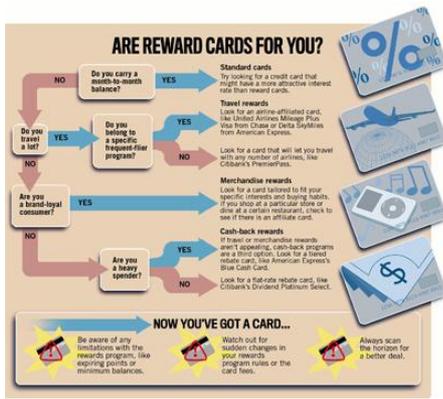


fig.27. Decision Diagram. Are Reward Cards for you?

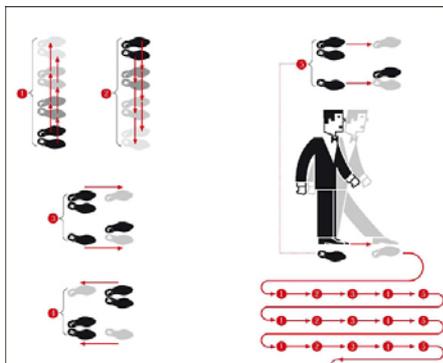


fig.28. How to dance the electric slide. Wordless Diagrams, Nigel Holmes.

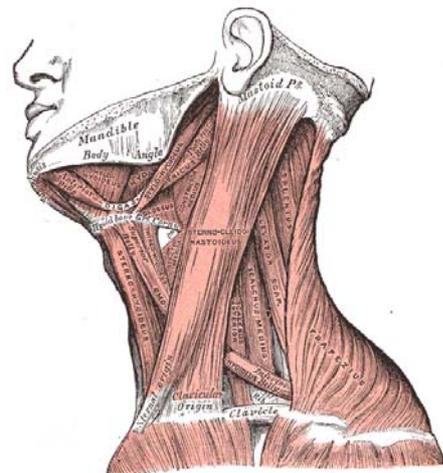


fig.29. Gray's Anatomy. Words well integrated with the image.

information. Although the sentence without vowels can be read, it is harder to read. On a noisy transmission channel, the redundancy enables the reader to correct errors that may have been introduced into the stream of information. Noise is any factor in the process that works against the predictability of the outcome of the communication process. For example, traffic lights communicate through color. They also use position to reinforce the message.

While adding redundancy offsets noise, too much redundancy is inefficient. Using repetition, reiteration and restatement, we run the risk of burdening or boring the audience. So, maintaining an optimal balance between predictability and uncertainty is the key to success in communication.

6. SHOW CAUSE AND EFFECT: When we try to comprehend something, we are looking for information to understand the underlying mechanisms. Reasoning is about examining causality.

Earlier we saw an example which shows cause and effect in of Dr. John Snow's medical detective work in which he identified the cause of Cholera epidemic in London. Similarly the decision diagram (fig.27), lucidly shows the cause and effect by taking the viewer through a decision diagram about whether a particular is suitable for them or not.

7. COMPARE AND CONTRAST: Together with what is the cause, and what is the effect, the third important question that needs to be answered is, compared to what?

In the NYT graphic on the spread of SARS, comparison comes across through the use color-coding, which differentiates primary, secondary and tertiary infections. Dots are used to indicate the number of infected people. This helps us to make a quick visual comparison of the volumes infected people across different countries.

8. CREATE MULTIPLE DIMENSIONS: We saw earlier the graphic by Minard in which he manages to portray six dimensions - the size of the army, latitude, longitude, direction the army is moving, temperature, and date. On a single sheet of paper with no text, he eloquently captures Napoleon's failed march to take Russia.

The NYT SARS graphic too is multi-dimensional. The graphic informs us about space (map of South East Asia), volume (numbers of infected), and movement of infected people (arrows to indicate the direction of spread).

9. INTEGRATE: It is importance to tell a "coherent story". This means avoiding references for figures and examples, which are physically removed from the flow of the text. Also information for comparison should be put side by side. That is, within the eye span, not stacked in time on subsequent pages.

This very document tries to present a coherent story by placing visual and references within the eye span and not at the end as an appendix.

EXERCISE 3

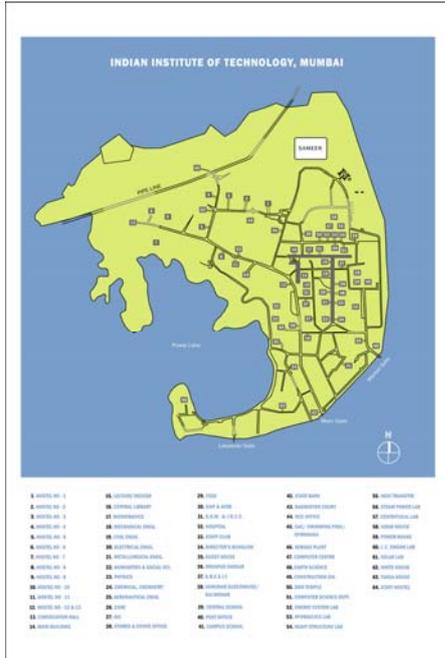


fig.30. IIT Bombay Campus Map.

1. Design an infographic for the given information (refer to additional handouts).

2. Map making and map reading fulfills one of our deepest desires – understanding the world around us and our place in it. They intrigue us, perhaps none more than those that ignore mapping conventions. For example, the campus map (fig.30) might give an unsuspecting reader an impression that IITB is situated an enchanting island. But does it fulfill our informational needs?

Assuming a particular user profile (parent, international guest, prospective student, festival or conference participant etc.), design your campus map. You will identify the information needs specific to that user group, choose a suitable communication strategy, and apply the appropriate graphic devices.

3. Both IIT Bombay and NID Ahmedabad have significant and defining roles in the history of higher education in India. They also have a long and achievements studded history that is ripe for narration.

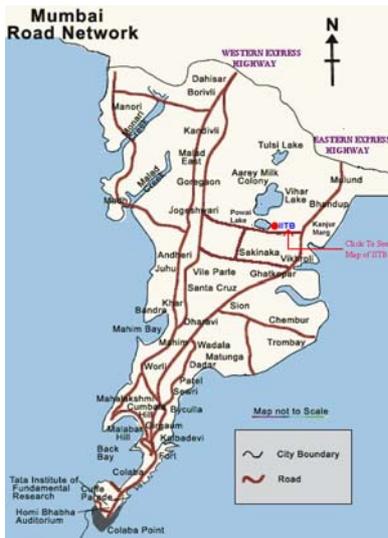


fig.31. IIT Bombay Locator Map.

Sadly however, such stories, if ever they are told, are depicted in a visually uninteresting and informationally tedious manner. Using timeline as a central organizing principle of information, create an interesting, interactive visual narrative of the history of your institute.

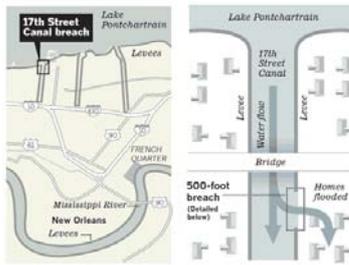
(Incidentally, Charles and Ray Eames, on whose vision NID was founded, were also the pioneers to exploit the information-carrying capacity of timelines. Their IBM pavilion at the New York' World's Fair and "The World of Franklin and Jefferson" exhibition that toured during the American Revolution bicentennial year are brilliant examples of timeline-based information design).



fig.32. NID Ahmedabad Milestones.

Patching the levee

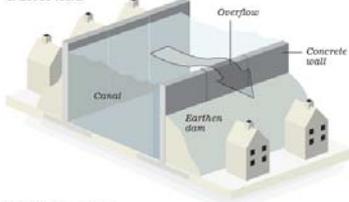
The Army Corps of Engineers failed Wednesday to repair a two-block-long levee breach that flooded nearby New Orleans neighborhoods. Today engineers will try to install a pile-driven steel wall to fill the gap. The work, if successful, could take days.



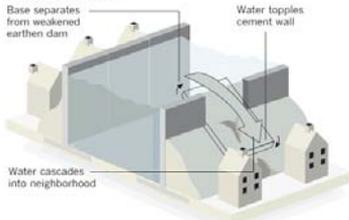
How the levee failed

Rising water flows over the top of the levee wall and undermines an adjacent earthen dam.

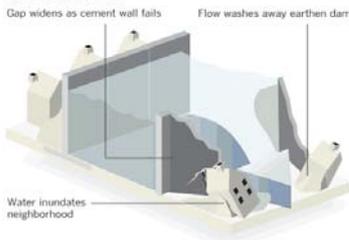
1. Levee leaks



2. Levee cantilevers



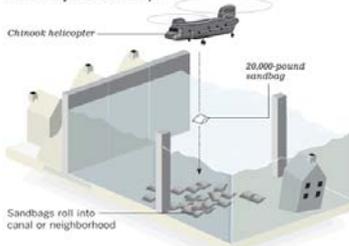
3. Levee deteriorates



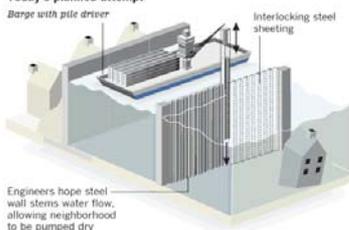
Blocking the breach

Super-sized sandbags dropped by military helicopters fail to close the gap.

Wednesday's failed attempt



Today's planned attempt



Source: Army Corps of Engineers. Graphics reporting by BRADY MACDONALD
RAOUL HARGA for *Los Angeles Times*

fig.33. Patching the levee in New Orleans, L.A. Times.

BOOKS

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WEBSITES

1. Alberto Cairo – A lot of useful resources from one of the leading practitioners (<http://www.albertocairo.com/>)
2. Design of Signage – Theory, Application and Resources (<http://www.designofsignage.com/>)
3. Gallery of Data Visualization – Examples of good and bad infographics (<http://www.math.yorku.ca/SCS/Gallery/noframes.html>)
4. InfoDesign – A well maintained collections of annotated links related to infographics (http://www.informationdesign.org/archives/cat_information_graphics.php)
5. Interactive Narratives – A database of links to interactive narratives from the web (<http://www.interactivenarratives.org/>)
6. John Grimwade – Online portfolio of one of the leading infographic designers (<http://www.johngrimwade.com/>)
7. Nixlog – An exhaustive collection of infographics available online (<http://www.nixlog.com/infographics/>)
8. New York Times – Arguably the best online interactive features in the business (<http://www.nytimes.com/pages/multimedia/index.html>)
9. Society of News Designers – News design resources and awards gallery (<http://www.snd.org/>)
10. Xplane – The visual thinking weblog (<http://www.xplane.com/xblog/>)

ABOUT THIS DOCUMENT

I prepared this document as a handout to my October 2005 seminars on Infographic Design to the Visual Communications students at the National Institute of Design, Ahmedabad, and the Industrial Design Centre, Indian Institute of Technology, Bombay.

Images in the document may be too small, but a discerning reader should be able to find better quality images from the references. Some sections may appear brief and abrupt as I have not put in all the examples and discussions that I use in the seminar.

This however could change in the next version of the document. I intend to capture some interesting digressions, discussions and exercises that emerged during the seminar. Additionally, I invite you to tell me what more I can add or how better I can improve this document. Send your feedback to venkatra@gmail.com.

VENKATESH RAJAMANICKAM
OCTOBER 2005
SINGAPORE

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