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ABSTRACT

There are two categories of representations: figurative and non-figurative. Within the category of figurative representations, there are two groups: visuals and graphic symbols. Graphic symbols include pictorial symbols, abstract symbols, and arbitrary symbols. Symbols can be used for identification, overview, supplying instructions, position, size, representation, and media. As there are so many uses for symbols, every situation and every context requires the consistent use and explanation of the symbols used. The variety of symbols used in schematic pictures makes it hard for users to understand the communication. ELLEMTEL, a Swedish research and development company, has created a set of defined symbols to be used as image elements. This allows a standard set of symbols to be used in various schematic diagrams which makes it an easier and cost effective method for readers to understand the message. (Contains 11 references.) (JLB)

Using Digital Image Elements to Produce Schematic Pictures

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Rune Pettersson

Background

ELLEMTEL is an internationally well-known Swedish R&D company working in the field of telecommunications. More than one thousand people have access to a computer network. Most people use SUN workstations, and some have Macintosh computers.

In any organisation devoted to R&D, people produce documents such as memos, instructions, reports, and even books. Some documents are intended for internal use only, some for wider use. In both cases it is important that the readers (receivers) understand the content of the written messages. However, this is not always the case. Some people complain that documents are hard to understand.

Representations

For Wileman (1993) all kinds of representations of an object are symbols. He argues that there are three major ways to represent objects—as pictorial symbols, as graphic symbols, and as verbal symbols—ranging from concrete to abstract representations. Pictorial symbols include two subgroups; photographs, and illustrations/drawings. Graphic symbols include three subgroups: image-related graphics, concept-related graphics, and arbitrary graphics. Verbal symbols include two subgroups: verbal descriptions, and nouns or labels.

Pictorial symbols

Photographs
Illustrations/drawings

Graphic symbols

Image-related graphics
Concept-related graphics
Arbitrary graphics

Verbal symbols

Verbal descriptions
Nouns or labels

According to Wileman (1993) symbols range from concrete to abstract representations, from photographs to nouns or labels.

There seems to be no major difference in "abstractness" between abstract arbitrary graphic symbols and verbal symbols. Thus, I prefer to talk about two categories of representations: figurative representations and non-figurative representations (Pettersson, 1993 a).

In my view, figurative representations include two groups: *visuals* and *graphic symbols*. Visuals include four subgroups: three-dimensional images, photographs, drawings, and schematic pictures. Graphic symbols include three subgroups: pictorial symbols, abstract symbols, and arbitrary symbols.

Non-figurative representations include verbal symbols, and other non-figurative representations or rather non-visual representations. Verbal symbols (or verbo-visual symbols) include three visual subgroups: verbal descriptions, nouns or labels, and letters/characters. "Non-visual representations" include audial representations like sounds and signals, as well as representations based on smell and taste. These "non-visual" representations are not further discussed here.

Figurative representations

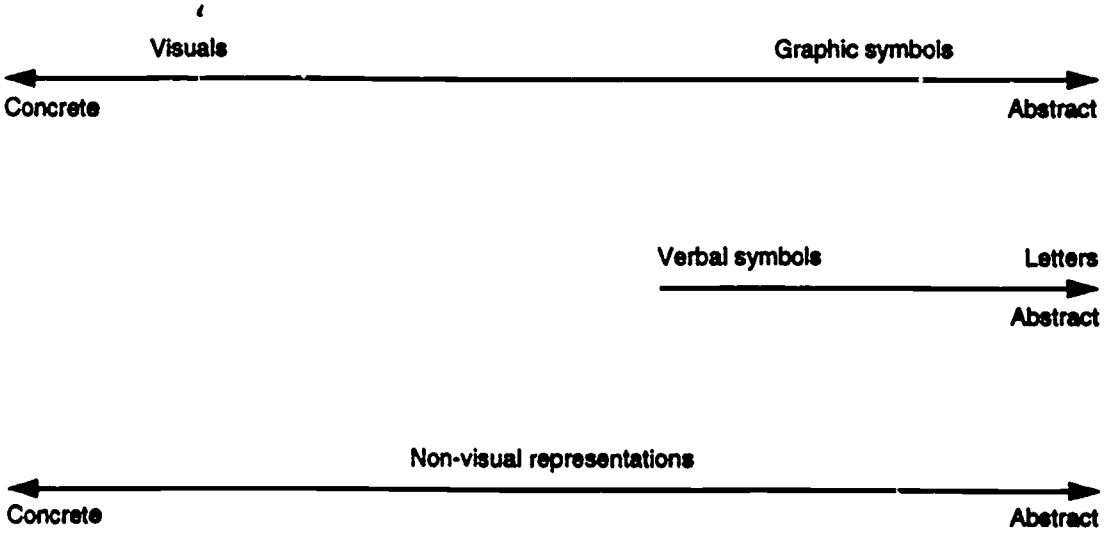
Visuals
- Three-dimensional images
- Photographs
- Drawings
- Schematic pictures

Graphic symbols
- Pictorial symbols
- Abstract symbols
- Arbitrary symbols

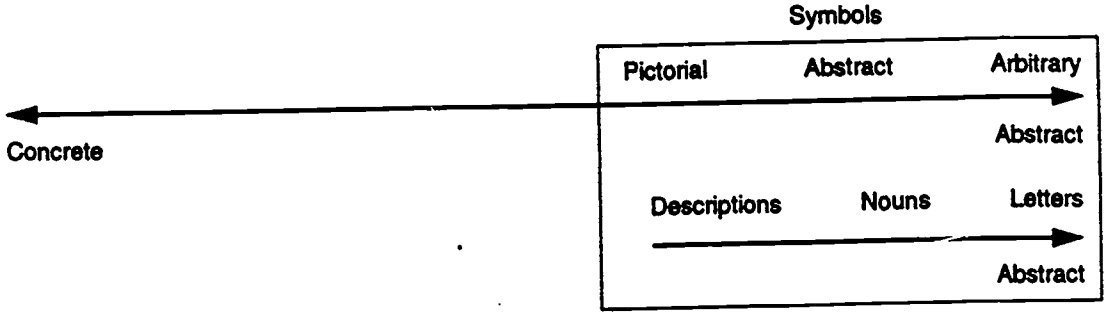
Non-figurative representations

Verbal symbols
- Verbal descriptions
- Nouns or labels
- Letters/characters

Non-visual representations
- (Sounds...)



According to Pettersson (1993 a) representations range from concrete to abstract ones.



Symbols can be figurative (upper field) as well as non-figurative (lower field). All symbols are more abstract than concrete.

Symbols

There are figurative as well as non-figurative symbols (Pettersson, 1993 a). Graphic symbols include pictorial symbols, abstract symbols, and arbitrary symbols. Verbal symbols include verbal descriptions, nouns or labels, and letters/characters.

Pictorial symbols, or *representational symbols*, are "image-related" graphic symbols. They are simplified pictures, and resemble the objects they represent. Pictorial symbols can be characterized as silhouettes or profiles with no surface detail. A traffic sign with a silhouette of a locomotive, to denote a railroad crossing, is a good example of a pictorial symbol.

In the design process, some pictorial symbols can be successively simplified into figurative and *abstract* graphic symbols. They still look like the objects they represent but have less detail than pictorial symbols. In athletic contests, like the olympic games, abstract graphic symbols are often used to denote the different kinds of events. Good abstract graphic symbols are intuitive. We should be able to understand their meaning.

Some figurative symbols are *arbitrary* graphic symbols. They are formed by the designer's creative imagination. Usually, arbitrary graphic symbols have no resemblance at all with the objects or the ideas that they represent. Many are based on basic geometric shapes. Many signposts and traffic signs are good examples of arbitrary symbols. They are unambiguous by convention; we agree and decide on their meaning. Just as new words have to be learned when we begin to study a new topic, we have to learn arbitrary graphic symbols.

Many non-figurative *verbal symbols*, written characters, and letters of various alphabets, have evolved from simplified pictures. Verbal symbols are used in written languages and in many branches of science. In many areas, verbal symbols have gained universal acceptance.

Taking up only a very small amount of space, a graphic or a verbal symbol can convey a message containing a large amount of information. But it is not possible to make anything but *simple statements* by using symbols for objects, actions and events. Eco (1976) suggests that the verbal equivalent of an iconic sign is not a word but a phrase, or indeed a whole story. Of course, this is also the case with a large number of the Chinese kanji-characters, designating different words or sometimes whole phrases.

Meaning

Pettersson (1986, 1987, 1993 a) concluded that *perceived image content is different from intended image content.* Even simple pictures can cause many different associations, and a given set of basic picture elements and symbols can be combined to form completely different images. Moriarty and Sayre (1993) studied intended and perceived advertising meanings. They also found a high level of *disagreement between intended and perceived messages.* More than half of the responses were different from those intended by the creators.

Several different signs and symbols can be used to convey the same information—the same meaning. In an exercise, subjects were asked to vote for candidates on a ballot. The ballot looked like this.

Ballot

President		
(vote for one)	Ken Adams	____
	Diana Bates	____
	Leo Davis	____
Vice president		
(vote for one)	John Bell	____
	Jim Cannon	____
	Nancy Carr	____
	Carol Dennis	____

Several different signs were used to convey the same meaning, namely a selected candidate.

/, ✓, ✕, ✱, •, ok, —

Even more signs could be used to convey the same meaning, "this is my candidate". It is actually also possible to cross over the names of the people that are not selected. The meaning of a symbol is seldom easy to guess. Pettersson (1989), as well as Griffin and Gibbs (1992), found that graphic symbols were interpreted in many different ways. Sometimes only a few persons will understand the intended meaning of a symbol. Thus the sender will always have to supply an explanation for the symbols used in a report, on a map or in any other document. This can be a chart or a list of symbols and their meanings.

Use of symbols

Image perception is very rapid, virtually "instantaneous" (Pettersson, 1989). Reading and comprehending the equivalent message in words takes much more time. So graphic symbols permit *rapid reading.* This is important in numerous situations, in traffic, industry, and aviation, for example.

A good symbol is designed so that it can be used in many different situations. For example, the McDonald's M is designed to work in every conceivable size from a height of a few millimetres in a brochure to more than six feet in outdoor signs.

At the end of his book on writing for science and technology, Kirkman (1992) noted the possibility of using symbols (page 155):

> Perhaps, since use of words causes so much difficulty in international communication, we should abandon words wherever possible, and use icons instead.

Symbols (icons), may well become more and more common in communication. Kirkman commented (page 156):

> I have no doubt that we shall gradually have to include more and more icons in our presentations of information, especially in our onscreen presentations.

We can use symbols for many different reasons (Pettersson, 1989).

Identification. Graphical symbols can be used effectively in manuals and on screens to help readers with quick recognition and identification of information.

Overview. Symbols can be used for creating an overview and providing a holistic perspective. This property is utilized in maps and informative signs as well as in catalogues and project reports.

Supplying instructions. Symbols can be used for supplying instructions and information about appropriate behavior in different situations. Numerous examples can be found in catalogues and timetables. Various traffic signs also belong to this category.

Position. Symbols can be used for illustrating the spatial and geographic position of different objects or services. One example is the floor plan of an exhibition hall with symbols designating the location of telephones, lavatories, information booths and refreshment sites. Another example is maps with numerous cartographic symbols for objects and conditions.

Size. Symbols can be used for illustrating size relationships and to supply numerical and statistical information. Some diagrams and many symbols in maps are examples of this category.

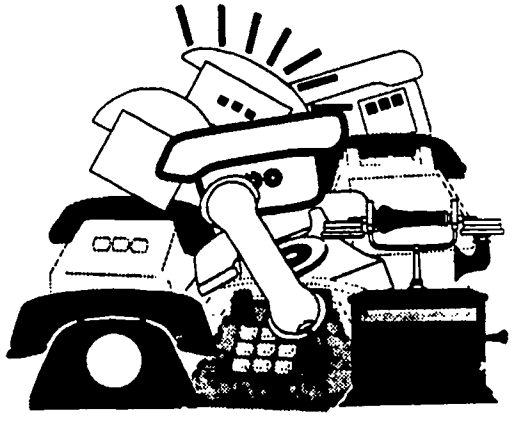
Representation. Symbols can be used to represent an organization, service or product. Trademarks and logos are utilized in marketing, advertising, and public relations. As a rule, promotion of the representation begins with text (e.g. a company or product name), followed by text + a symbol. Ultimately the symbol alone suffices. Examples: McDonald's yellow M and Shell's scallop.

Media. Symbols are employed in different media. They are static and immutable in graphical media. They may be more changeable in computer-based media. When you select a brush in the menu for a Macintosh drawing program, the brush icon switches from positive to reverse video. This "acknowledgement", which tells you that the command has been received by the machine, makes communication more reliable.

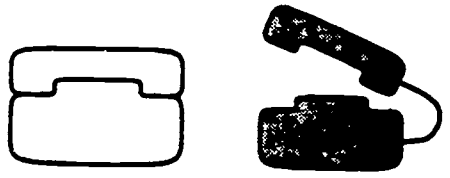
It can be concluded that every situation and every context demands the consistent utilization of symbols, an explanation of the symbols used, and learning the meaning of those symbols. Well-designed symbols can be used, and can work in different cultures in different parts of the world.

Schematic pictures

At ELLEMTEL most people create their own schematic pictures in their documents. There are many ways to create even a very simple schematic picture. Thus the quality of the pictures ranges from "very good" to "very poor". Several people have designed their own graphic symbols, which they use in various combinations in their pictures. In a sample of documents, no less than 29 different "telephone pictures" were used. Some of the telephone pictures were well-drawn schematic pictures, some were pictorial symbols, and some were abstract symbols.



Telephones 1. Some examples of existing representations of telephones.



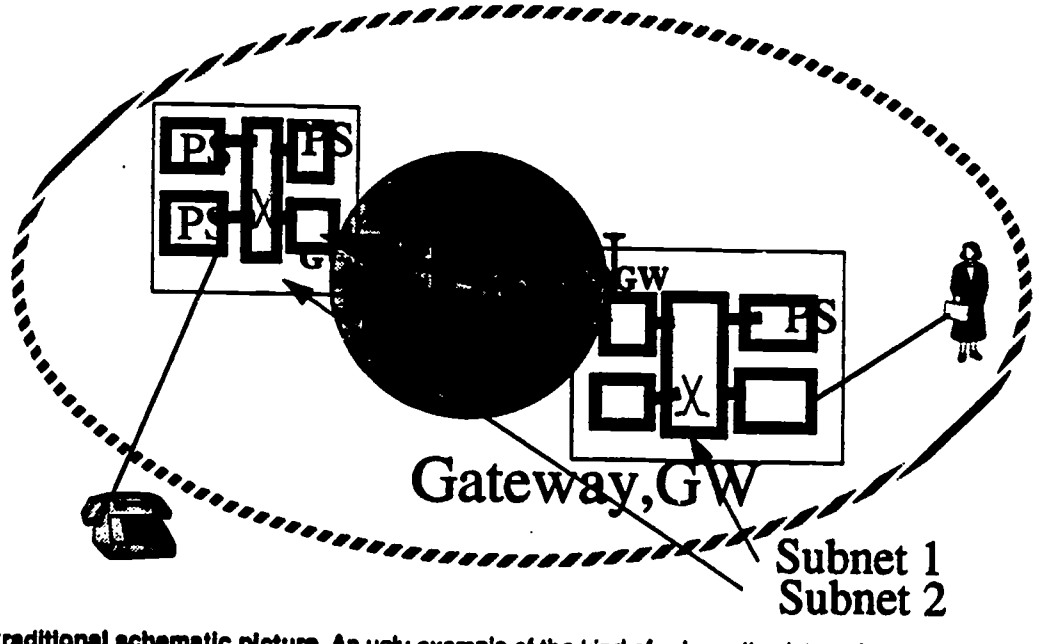
Telephones 2. The resulting graphic abstract symbols for telephones, passive (left), and active (right) to be used in schematic pictures.

This variety of symbols and image elements used in schematic pictures makes it hard for readers to understand the messages. Usually, the variety is not aesthetically pleasing. It does not aid comprehension, rather it introduces a lot of confusion. Technical documentation must be easy to comprehend. It is therefore vitally important to be consistent and use the same symbols in different schematic pictures.

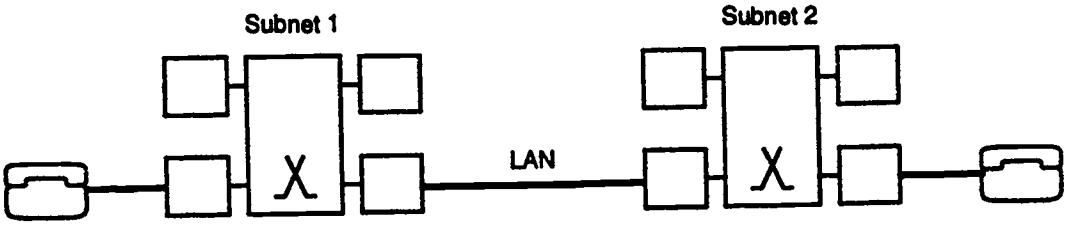
Those who work with information cannot content themselves with a message being produced and transmitted, as in radio and TV; nor with a message being produced, transmitted and received by an audience. The act of communicating is not complete until our message has been both received *and* understood by the audience. In other words, *our messages must always be comprehensible, otherwise they will have no effect.* Pettersson (1993 b) provides several guidelines on how to make documents more comprehensible.

An image database

At ELLEMTEL, a "terminology council" is responsible for the development of the new terminology that is needed. Since symbols can be regarded as "iconic or figurative representations of concepts", a set of carefully defined symbols has been created as image elements. These symbols are stored in digital form and can easily be accessed from all workstations in the network. We have also written "guidelines" to make it easier for people to create their own schematic pictures.



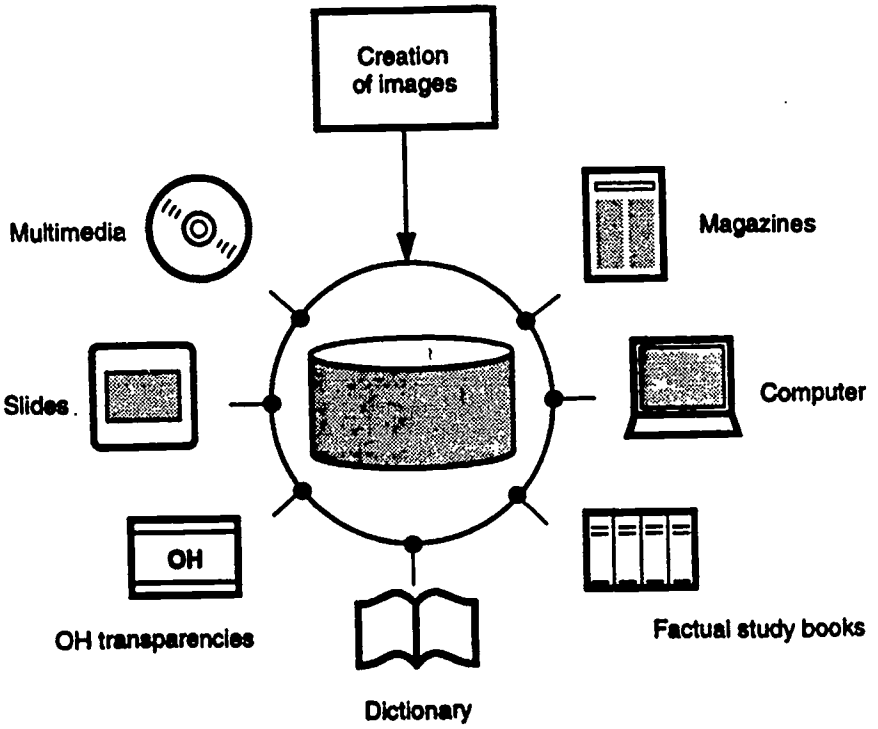
A traditional schematic picture. An ugly example of the kind of schematic picture that can be found in internal technical documentation. This kind of picture is costly to produce, and it violates most of our guidelines for the design of schematic pictures.



Using image elements and approved graphic symbols makes production as well as reading much more effective. This schematic picture conveys the same content as the previous illustration.

The new images can be stored in a database and used in different documents, such as memos, instructions, reports, magazines, and even books. Images can also be used in other media, such as computers, OH transparencies, slides, and multimedia. Since the formats are different, images must be adopted to each medium (Pettersson, 1993 a).

It can be concluded that using standard image elements and standard symbols in schematic pictures is very cost-effective. Using standard image elements and standard symbols also makes it far easier for all readers to understand the intended messages. The readability of schematic pictures is increased.



An image database makes it possible to use the same images in several different media.

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