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Published in the Proceedings of the Human Factors Society Meeting, Los Angeles, CA, October 1980

IMAGES, IMAGES, IMAGES

A. Marcus

July 1980

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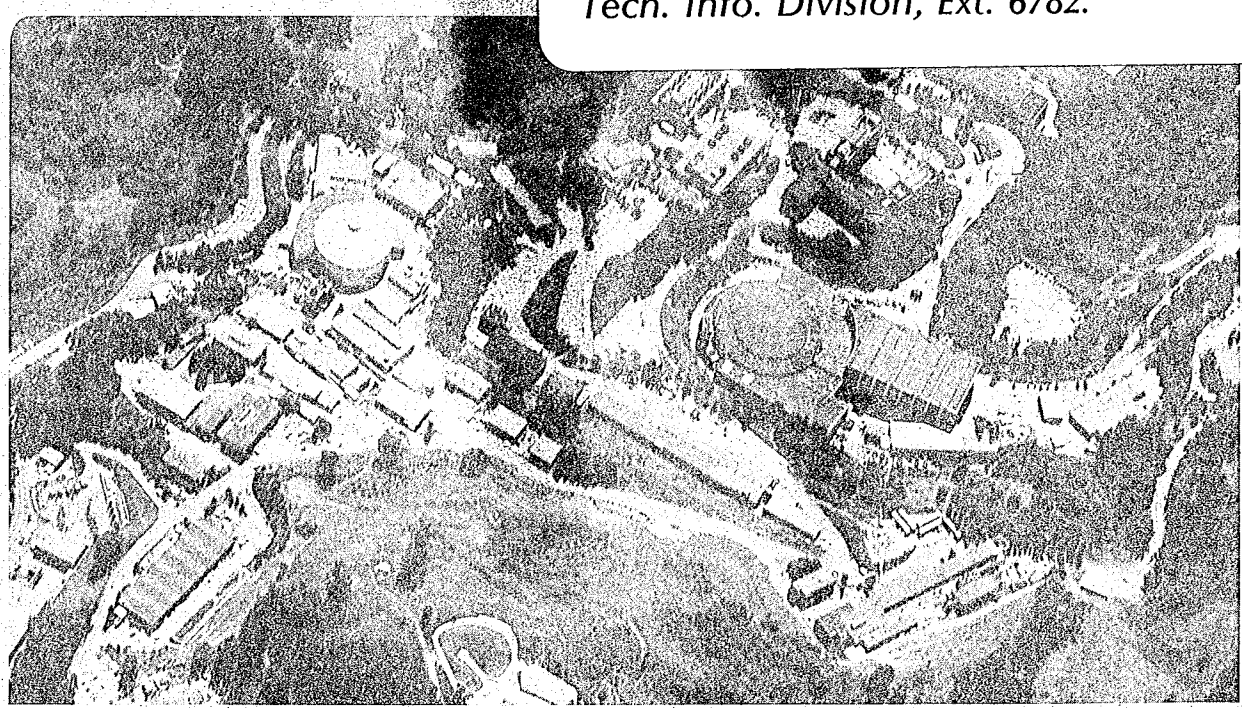

Prepared for the U.S. Department of Energy under Contract DE-AC03-76SF00098

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This research was supported by the Applied Mathematics Sciences Research Program of Office of Energy Research, U.S. Department of Energy under contract W-7405-ENG-48.

IMAGES, IMAGES, IMAGES
(Lecture Presentation and Discussion)

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ABSTRACT

The role of images of information (charts, diagrams, maps, and symbols) for effective presentation of facts and concepts is expanding dramatically because of advances in computer graphics technology, increasingly hetero-lingual, hetero-cultural world target populations of information providers, the urgent need to convey more efficiently vast amounts of information, the broadening population of (non-expert) computer users, the decrease of available time for reading texts and for decision making, and the general level of literacy. A coalition of visual performance experts, human engineering specialists, computer scientists, and graphic designers/artists is required to resolve human factors aspects of images of information. The need for, nature of, and benefits of interdisciplinary effort are discussed. The results of an interdisciplinary collaboration are demonstrated in a product for visualizing complex information about global energy interdependence. An invited panel will respond to the presentation.

Human factors specialists have traditionally been concerned with issues of visiblity and legibility of text materials in considering how information is conveyed. (Shurtleff, 1980) In 1965 Chapanis strongly advocated broadening the investigation of human factors specialists to include the semantics as well as the visibility of words. (Chapanis, 1965). After 15 years there is once again a need to broaden the focus of the profession to include the non-verbal, meta-linguistic aspects of communication, to the 'semantics' of images, especially charts, diagrams, maps, and symbol combinations used for conveying information.

The need for refocusing attention on these 'images of information' arises from several factors. These include advances in computer graphics technology (Marcus, 1980; Bolt, 1979), increasingly hetero-lingual, hetero-cultural world target populations of information providers, the urgent need to convey more efficiently vast amounts of information, particularly through emerging mass audience teletext and viewdata systems (Neehan, 1979), the broadening population of (non-expert) computer users (Schneiderman, 1979), the decreasing time available for reading texts and for decision making (Blake, 1979), and general concern about literacy levels. A coalition of visual performance experts, human engineering specialists, computer scientists, and graphic designers/artists is needed to resolve human factors aspects of information packages in the form of images, viz., charts, diagrams, maps, and symbol combinations.

Of particular importance is the need for greater sensitivity to factors that arise in the context of the graphic design of information (Poggenpohl, 1980): to the partially intuitive, partially rational optimization of complex factors leading to a creative syntheses of points, lines, planes, of color and texture, of words and images, into an effective visible language. Schneiderman (1979) has alluded to the difficulty in visualy designing images of information. In his summary of human factors considerations, he lists over 50 basic principles, many of which are conflicting. For any set of these principles, there is some ambiguity from the graphic designer's point of view as to how the verbally stated principle is to be related to a particular visual form. It is for this reason that human factors specialists should be aware of graphic design and its own concern for the effective use of symbols, typography, color, composition, and sequencing. Among exemplary questions that graphic designers ask and which human factors specialists can help answer are the following ones about effective visual communication:

How complex can/should an effective image of information be? How can this complexity be appropriately measured?

What problems/possibilities does the use of color create, especially in multi-cultural situations?

What is the appropriate conceptual/perceptual resolution for significant visual elements?

To what extent are images and symbols universal in their denotation and connotation?

What relation exists between image making (diagramming, chart making, and map making) and modes of human problem solving?

What is the proper role of images vs. words in a visual-verbal interface?

What are the special attributes of images vs. words? For example, can images more efficiently present global or over-all information in a particular context?

Can new ways of looking at problems be better synthesized through visual means such as computer graphics displays? For example, can images allow better description of multi-dimensional phenomena than alphanumeric displays?

How can image manipulation in time (i.e., movement) be effectively utilized?

What would effectiv user-oriented 'image editing' or 'image processing' software be like, as opposed to text editing or word processing.

In proposing these and other questions concerning new directions for research in the 'Image of Information Age', an inter-relationship must be formed among graphic designers/artist, experimental psychologists, computer scientists, and human factors specialists. To help make concrete the context in which this interdisciplinary effort could exist, an example of communication of complex information through images is discussed below. This will be presented directly to the audience as an audio-visual presentation.

An Example of Imaging Information

To help clarify the context in which human factors specialists can assist in the analysis and synthesis of images of information, it is useful to consider an exemplary display of information through images as opposed to texts. 'Visualizing Global Interdependencies' is such an example (No Author, 1980). It is an essentially non-verbal sequence of charts, diagrams, maps, and pictographic/ideographic symbols appearing as a multi-media slide presentation (see Figure). The author co-ordinated the research and development of this presentation as a multi-disciplinary, international reseach project at the East-West Center, Honolulu, a federally funded center for technical and cultural interchange betweeen the United States and the countries of Asia and the Pacific.

The East-West Center invited five visual communicators from the USA, Japan, India, and Iran to investigate new ways to communicate essential information to a multi-cultural audience of policy makers. Together with graphic designers, the team studied the subject of global interdependence, particularly energy interdependence, and reviewed existing international means for conveying information.

The Research Fellows on the team were the following: Dr. Shyam S. Agrawal, an audio-visual specialist from the Central Electronics Engineering Research Insitute, Pilani, India; Dr. Mei-Ling Hsu, Professor of Geography at the University of Minnesota; Co-Ordinator Aaron Marcus, a graphic designer, formerly Assistant Professor at Princeton University and now at Lawrence Berkeley Laboratory, Berkeley; Yukio Ota, art director of the Advanced Social Planning Institute in Tokyo, Japan; and Dr. Ebrahim Rashidpour, Head of the Educational Technology Center at the University of Tehran, Iran. The Graphic Designers for the team were Jerry Kuyper, Assistant Professor, Graphic Design Department, University of Hawaii, Honolulu, and Susan Marcus, Principal Designer, Meta-Graphics, Berkeley.

The team developed a pictographic/ideographic symbol system for conveying facts and concepts and used it to convey the contents of approximately 100 items of information. In the development process, their experimental studies of more than 500 symbols and 200 composite images were reduced to a set of approximately 70 symbols in a sequence of approximately 80 images. The symbols, their composition and timing, were organized into a single-screen slide presentation that depends primarily on images, not words, for communication.

For reasons of readability and impact, all images (except a color photograph of the earth) appear in black-and-white, with the images as white symbols against a black backgrouund. The symbols utilize some elements of international transportation symbols (AIGA, 1974) as well as proposals for international non-verbal symbol languages (Bliss, 1965; Ota, 1973). Basic principles of chartmaking have been utilized

(Schmid, 1979) but they have been adapted for use in a slide medium with greater attention to over-all visual coherency. Basic factors such as legibility of text and multi-cultural comprehension of symbols were tested informally by the team members in determining a final set of images.

Extensive human factors testing of this product would undoubtedly yield valuable insight into the appropriate format of visual narration. The value of this prototype synthesis of information through images has been indicated by the ability of 'Visualizing Global Interdependencies' to communicate to a wide range of audiences (approximately three dozen showings) in the USA, Japan, and India, and by its ability to stimulate discussion about the form as well as the content of the display.

Summary

The discussion of 'Visualizing Global Interdependencies' in the context of human factors research is intended to awaken the interest of the human factors community iin the over-all semantic role of charts, diagrams, maps, and symbols, and to demonstrate the potential areas for analysis and research. The development of higher-level approaches to the study of communicating complex information through images will require an interdisciplinary exchange between the scientific human factors perspective and the discipline of graphic design. An exchange of approaches to understanding and using the semantics of images should be mutualy beneficial. Within the human factors commmunity it can enlarge and deepen the scope of inquiry into human communication.

ACKNOWLEDGEMENT

This work was supported by the Applied Mathematical Sciences Research Program of the Office of Energy Research, Department of Energy under Contract W-7405-ENG-48.

REFERENCES

(AIGA) American Institute of Graphic Arts. Symbol Signs. U.S. Department of Transportation, Washington, D.C., DOT-OS-40192, November 1974.

Blake, George B., 'Ideas for Action', Harvard Business Review, March-April 1979, 6-8ff.

Bliss, C. K. Semantography (Blissymbolics). Semantography (Blissymbolics) Publications, Sydney, Australia, 1965.

Bolt, Richard A., 'Spatial Data Management,' Office of Cybernetics Technology, Defense Advanced Research Projects Agency, Washington, D.C., Contract No. MDA-903-77-C-0037, 1979.

Chapanis, A., 'Words, Words, Words,' Human Factors, Vol. 7, 1965, 1-17.

Marcus, Aaron, 'Computer-Assisted Chart Making from the Graphic Designer's Perspective, Computer Graphics, Proceedings of Siggraph 80, Vol. 14, 1980 (in press).

Neehan, Michael et al, Newsletter, Special issue on teletext/viewdata, Insitute for the Future, Palo Alto, Summer 1979.

(No Author), 'New Ways to View World Problems,' Icographic, (Pergamon Press, England), No. 14/15, 1979, 23-30.

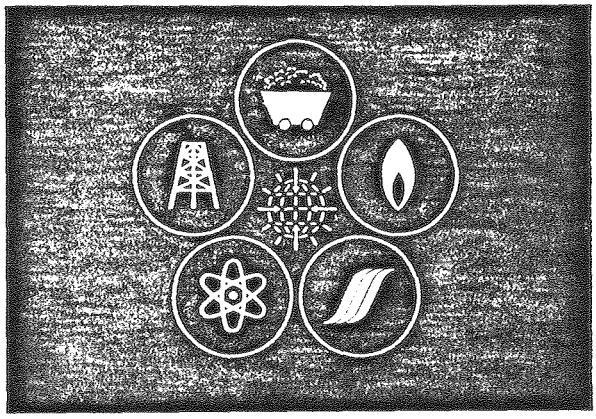
Ota, Yukio, 'LoCoS: An Experimental Pictorial Language,' Icographic, (Prgamon Press, England), No. 6, 1973, 15-19.

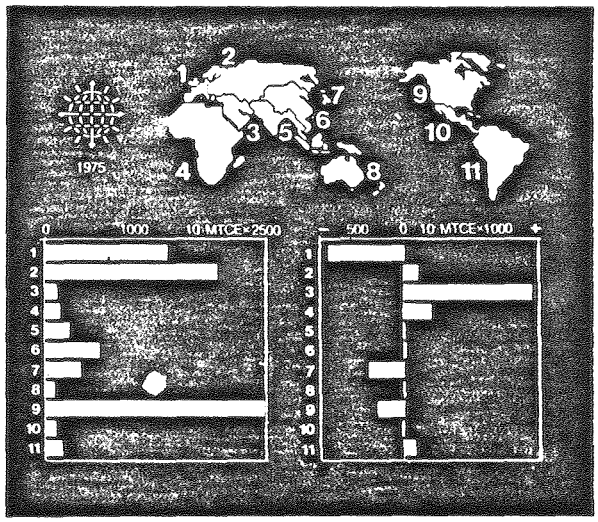
Schmid, Calvin F. and Stanton E. Schmid. Handbook of Graphic Presentation. John Wiley and Sons, New York, 1979.

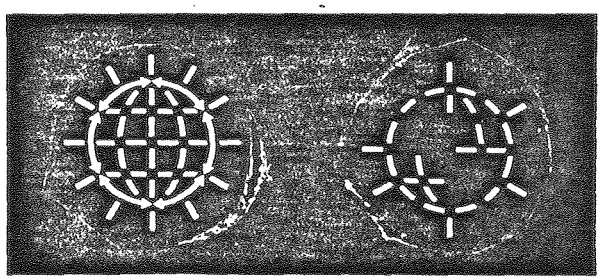
Schneiderman, Ben, 'Human Factors Experiments in Designing Interactive Systems,' Computer, 12:12, December 1979, 9-19.

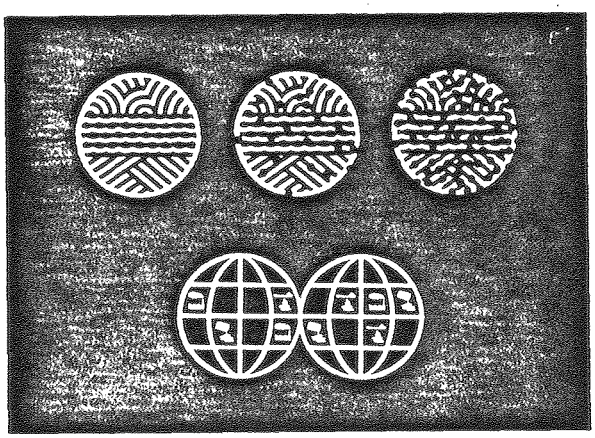
ILLUSTRATIONS

The accompanying exemplary images show frames from 'Visualizing Global Interdependencies,' a non-verbal visual narrative of charts, diarams, maps, and symbols. The copyrighted images appear courtesy of the East-West Center, Honolulu.









DISCUSSION PARTICIPANTS

A special panel has been convened to respond to the lecture and audio-visual presentation. The presentation will be made in two versions: the first using only charts, diagrams, maps, and symbols; the second adding an English language narration. Following the presentation the panel members will respond to the issues raised and the impact upon their respective fields of expertise. One panelist will be a human factors specialist with background in human interaction with computer graphics displays. The second will be an experimental psychologist with a background in visual information processing, pattern recognition, and reading processes. The third will be a psychologist with background in human factors.

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This report was done with support from the United States Energy Research and Development Administration. Any conclusions or opinions expressed in this report represent solely those of the author(s) and not necessarily those of The Regents of the University of California, the Lawrence Berkeley Laboratory or the United States Energy Research and Development Administration.

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