VISUAL THOUGHT AND DATA VISUALISATION

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"Of all the senses, whether we are acting or idle, it is sight we most prefer. The reason for this is that it is through sight that we acquire the greatest knowledge and discover the widest differences".
Aristotle, Metaphysics

Abstract

While underlining the importance of the visual approach in the artefact’s design a hypothesis is made that computer graphics can be a method that allows to pass from abstract architectural and urban data graphic representation to figurative one. The "vision" of a three components matrices and the dynamic computer schema can be seen as a possible interface toward the architectural schema.

Outline of a visual approach to design

Architectural schema can be compared to the "smooth cut" used by Descartes in the Dioptric, which act outside resemblance by allusion. Through "spots, lines and markings, the object is revealed", it "excites our thought processes to conceive in the same way as figures and words make us do", by giving us " a sufficient number of clues and the means to form the idea of the thing"? "It presents the object by its outside look or its envelope".
For Merleau-Ponty sight [Merleau-Ponty 64] acts dually, going from "the thought of seeing to sight in action". There is sight - "I reflect, there is no other way to think of it than as a thought", and "there is sight which takes place as honorary or established thought, impressed into the body, which can only exist by exercising it".
The visual approach relys on this double understanding of sight, as "the thought of sight and sight in action", which fully corresponds to the activity of the designer acting in the design space. It is through heuristic visual modelling and simulation, shuttling between the two extremes of abstract and figurative representation, that *vision in action* is achieved. Thanks to this vision, an increasingly figurative architectural schema emerges through the superposition of different representation modes, in successive graphic layers of different levels of abstraction.
All these representations are codified and use symbols known in the professional field, or they are explained by legends. At this stage, the notion of scale is quickly operational. It begins to act as soon as topological relations indicate a proportional manner in its nodes, areas and relation constraints.

To see data

Architectural and urban data: programmatic, statutory, normative, analytical, ... are often presented in the form of a double entry matrices. Placing data in the matrices is an operation which has to be done after answering the following questions:

	A	B	C	D
1	W	Y	P	G
2	K	12	65	43
3	M	28	90	75

Fig. 1 - Double entry matrice

- With what goal in mind should data be placed in abscises and how should the data be organised?
- What information does one want to obtain in questioning the matrices?

Most of the computer programs for the treatment of double entry matrices, *spread sheet programs*, are universal tools designed independently of the treated subject or activity. Those design activities that concern us are those where the visual part is preponderant, and which are aimed at the creation of artefacts. For these activities, the passage from matrices to graphic representation is of great operational importance. In our research, after a survey done in the architectural offices on architectural program reading, we have learned that in the majority of cases, to the great regret of the designers, the proposed graphic representations are given in abstract form. These abstract graphics are systematically transformed by the architects into more figurative ones, in which nodes are proportional in size to the area matrices. This finding allows us to put forward a first hypotheses:

1. The desing activity aimed at the creation of spatial objects, artefacts, is linked to the visual heuristic approach by graphic spatial composition. This design activity is done through a media interface that allows a progressive movement from abstract representations toward more and more figurative ones.

Types of graphics

Taking the three graphic categories defined by J. Bertin [Bertin 67]: diagrams, networks and maps, and analysing the contribution that is expected from the existing, or to be developed computer tools, it appears that these tools barely cover the first diagram graphic category. Spread sheets only allow graphic representations in the form of diagrams. Network representations can only be made with the help of specialised computer programs according to established methods in a particular and precise field of activity, For example: a graphic representation of a process evolving in time under specified constraints of the type "Pert". For the last graphic category, - maps - geographic computer programs allow for questioning and visualisation through a selection of criteria and the superposition of various representations of selected data.

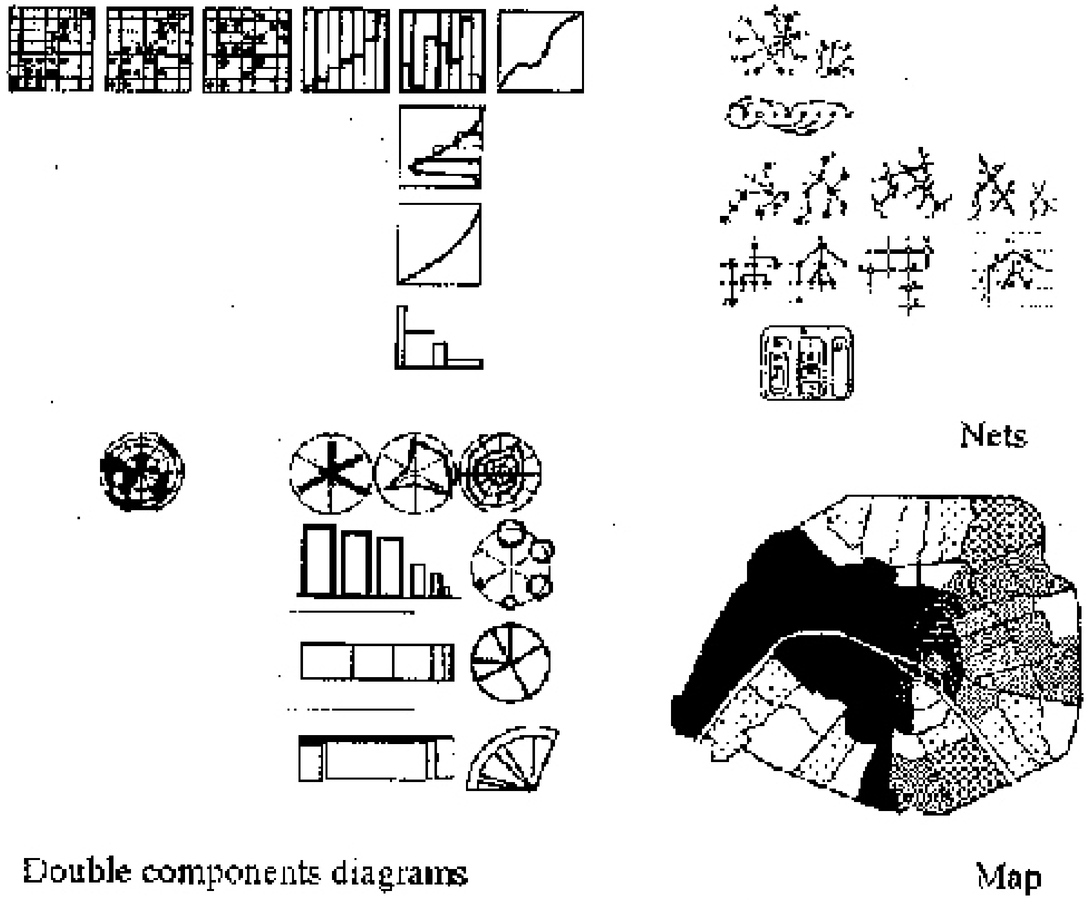

Fig. 2 - Bertin's graphical categories

If we act within the logic of architectural design, all qualitative and quantitative data, whatever their modes of representation, are progressively transformed into figurative graphics: sketches, technical schema and drawings; plan, section, elevation, perspective, etc. To reach that point, the transformation of the different modes of representation undergo an evolution through hybrid dynamic schema media. These schema pass progressively into the figurative domain by successive additions, transformations and superpositions of different modes of représentation under the visual heuristic graphic approach. To achieve this, the designer has both know how and a procedure: the architectural schema.
Hybrid dynamic computer schema unify several kinds of representation:

- spatial topological and flow relations are codified network graphics where figurative representation is still elementary. These elementary graphics intervene at the level of these components and their relationships: "patatoide", line types and spatial composition;
- virtual axis directions: geographic orientation, cardinal points and composition stemming from the placement of the site elements and their introduction into the flow- in urban or compositional contexts.

Seing the matrices

In the architectural design domain we have experimented with a computer program prototype called "Vision". "Vision" is a prototype computer program that has two modules: the first, "Graphique", implement dynamic graphics from a two components matrices, and "See", allows a visual arrangement to be made of a three components matrices. (Porada Mikhael and Dimitri, authors). Its "Graphic" module permitted a dynamic transfer between two symmetrical entry matrices - space/activity allowing for their graphic topological representation.
The space/activity fields are visualised through:

- proportional nodes, with sizes that correspond to the matrices area;
- liaisons, whose importance are defined by the size of the line as stated in the matrices;

- colour"which shows the appurtenance of space/activity to a pre-defined group of common activities.

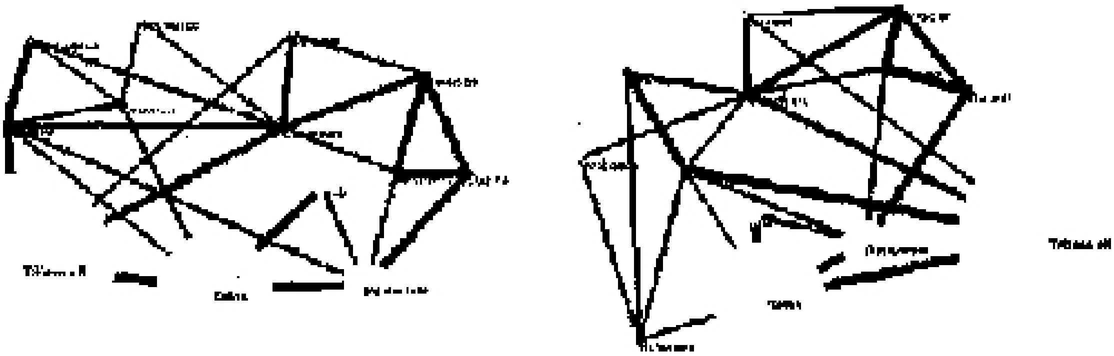

Fig. 3 - Computer dynamic schema examples

These experiments allowed us to observe that the arrangement of the initial graphics and a visual evaluation can serve as the basis for a preliminary spatial composition. It can also help the designer to verify the appropriateness of the graphics to the program data, and can reveal possible oversights and contradictions.
But, lets come back to our problem of data visualisation in architectural and urban design. On a practical level, we are confronted with great dimensions, and thus illegible matrices. In the case of the urban analyses of a street, it is easy to have matrices of one hundred by one hundred columns and lines. How does one "read" such matrices when no standard computer programs are capable of doing so ? To answer such a question, we experimented with the ’See" module of "Vision" which is based on Bertin’s methodology of matrices vision [Bertin 74]. This method allowed us to move from a two components matrices to a three components matrices and to use a visual approach to organise the matrices for further visual evaluation.

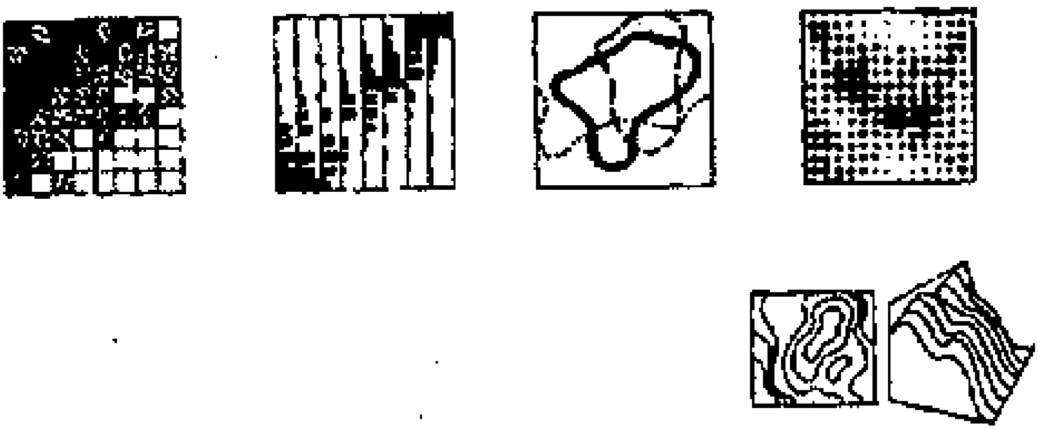

Fig. 4 - *Three components matrice*

Bertin’s proposition strangely did not get the anticipated audience it deserved, although, it has the merit of putting forth the fundamental question of ’how to see" a matrices. It is evident that at the time of its publication the computer tools where non existent, and presenting the information by the existing manual method of steel bars, perforated cards and cubes seemed at inoperative. With the passage of time, it showed that it is not only a question of tools but also of the comprehension of the method.

Toward computer architectural schema

In our current research approach, we start with the hypothesis that the first stage of the spatial composition begins with a "map" type graphic representation reduced to the following components:

- topographic, as a general representation support, which shows the "geography" of the site and the oriented virtual axis: cardinal points, compositionnal, contextual, directions;
- a relational dynamical graphics component stemming from synthetic reading matrices of the

architectural program, as well as from the "vision" of large analytical matrices.

The play between the different dynamic representation modes upon the general support which is produced at the graphic level, by superposition and assimilation - the movement from abstract to figurative visualisation - is regarded as a promising design interface. An interface which should facilitate the movement to a more figurative graphic representation, and thus herald the development of architectural schema through computers.

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