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GRAPHIC MATRIX FOR SPECIFIC DATA VISUALIZATION PROJECTS

PROPOSAL OF GRAPHIC RESOURCES AND VISUAL ELEMENTS THAT FOR THEIR FUNCTION COULD BE CONSIDERED AS THE PRIMARY ELEMENTS OF A MATRIX

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ABSTRACT

For a PhD research, we are investigating the recognition and systemization of common categories of graphical elements to build a Graphic Program (GP) that is used in Planimetric Projects (PP) construction and could also benefit computational visualization techniques.

This study is being developed from an in-depth analysis of current PP examples –like Tokyo, London and Paris underground maps– and aims to obtain methodological and graphical results. The aim of this research is to identify and implement a possible order and relational rules of graphic planimetric elements. This analysis will help to improve the clarity of urban transport project diagrams and avoid incoherencies, in other words, make better visual communication.

Overall, the results will show the importance of having a GP as a model for the creation of a new one and the existence of visual and conceptual hierarchies into Planimetric Language (PL).

KEYWORDS

Graphic Program, Transnational Language, Cross-disciplinary Project, Design Information, Schematic Language

1. INTRODUCTION

The use of visual languages to improve communication is not a new concept. It goes back to very ancient cultures. Many authors like Philip Meggs (1942-2000), Donis A. Dondis (Dondis, 1997: 20) or Adrian Frutiger (1928-) have studied the origins of visual language in communication. Dondis has explained that the key issue in the communication is to analyze the visual alphabets[1], and their meaning in a language context. Moreover, Frutiger, in his book *Signos, Símbolos, Marcas y Señales* (Frutiger, 1997), also makes a meticulous morphologic analysis of graphic elements and their relations in the construction of visual languages.

In the 70's, Jacques Bertin (1918-) called "graphic syntax" at the rules of behavior of visual codes and graphic resources. And in the 90's Leland Wilkinson made an analysis of statistics graphics elements and developed a possible grammar of graphics. As the written language has rules to be able to write properly, it may be assumed that visual language also has. Every graphic construction (image), explains Dr. Justo Villafane, has three operations that are involved in its construction process: (1) a selection of reality that is the subject of the construction itself, (2) some graphic elements and (3) a **syntax that orders them and builds a graphical model of the reality**. It could be argued that graphic syntax determines: the rules of behavior between visual elements, helps to define visual language's basic elements, and also helps to understand the relations between individual elements of a visual system.

In other words, there are general guidelines (rules) for graphics project constructions, that can be learned, understood and studied, and that can be used to create visually clear messages (Dondis, 1997: 35). The **knowledge of these codes, elements and relations**, as we have mentioned above, **is one of the main objectives of this research**.

Despite the existence of these (and more) known authors that have analyzed the semiotic and morphological problematic of visual language, none of them has developed a specific analysis on the Planimetric Language.

2. THE PLANIMETRIC LANGUAGE: AN IMPORTANT TYPOLOGY

Before the project research description, it is important to define briefly what a Planimetry Project is, and why it is important to make an in depth analysis on it.

Planimetric Projects (PP) are informative and directional sign systems - Graphic-Informative Projects (GIP)— that represent possible society movements into a determinate geographical space. PP synthesize in a small area, a complex amount of information. PP were created in the 30´s by Henry Beck (1903-1974) and they used a synthetic, effective and universal graphical language called **Planimetric Language (PL). PL** helps to communicate useful information to a wide and varied audience.

Social mobility involves groups of people from different geographic and socio-cultural characteristics, moving/traveling from one point to another for very different reasons. This social dynamics implies the idea of "flow spaces", in other words this means that traveling through certain places is sporadic. This causes "new" situations, like morphological and organizational ignorance of these new places (Costa, 1990: 10). The need to create new languages comes as a consequence of this new ignorance.

GIP— especially ones related to Planimetry and space movement— not only have local interactions but also an extended use factor. For example, graphic-informative projects' codes could be used to resolve interdisciplinary communicative situations. That is why we consider GIP important graphic pieces (key codes) for the social integration of our present transnational collective; in other words the reality in which we are immersed and still do not know too well.

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[1] Dondis introduced the concept of Visual Alphabet in his book "*La sintaxis de la imagen*" to refer to the universal visual and graphics elements that make up the images, similar to the ability of reading and writing.

3. RESEARCH DEVELOPMENTS, THE CURRENT STATE: IDENTIFYING ITEMS AND CATEGORIES FOR A GRAPHIC IDENTITY PROGRAM PROJECT

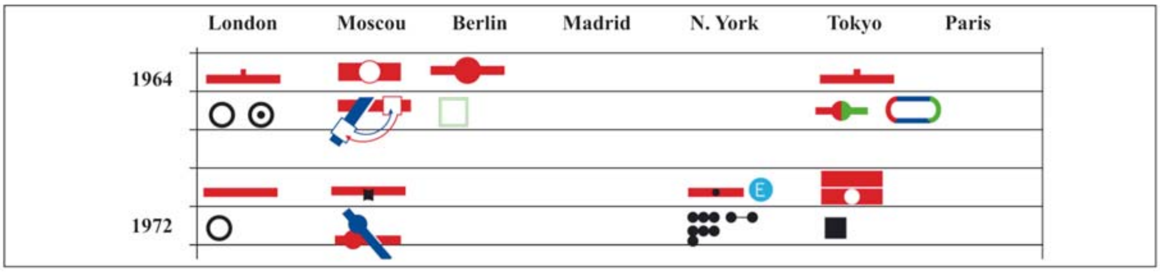
As explained at the beginning, this research project is part of a doctoral research thesis being carried out within the doctoral program entitled "*Research on Design*" based in the Department of Design and Image of the Faculty of Fine Arts at the University of Barcelona.

The development of this research project can be summarized in the following four stages:

1. Possible Conceptual Parameters. The first step of this research is to find out all the conceptual information categories that are involved in a PP, as well as a transport system context, and have to be representing graphically. Some of biggest categories are as follows:
1 - An identification graphic system
2 - Recognition of underground lines
3 - Basic public services: particular of each line, general of the urban system (e.g. bathrooms, exits, lifts)
4 - Complementary services: particular of each line, general of the urban system
5 - Stops denomination: name, number, map language reference
6 - Total/partial accessibility, disability
7 - System connections: interchange stops, time taken
8 - Directionality
9 – User orientation: relation between reality-topography-environment
10 – Additional information: frequency, timetable

2. Data Collection: The second step is based on an initial comparative graphical analysis of the underground designs of the main and oldest rail systems -London, Moscow, Berlin, Paris, Madrid, New York and Tokyo (Fig. 1). As initial results, we find common graphic elements that are used for all underground systems analyzed. We have compiled a detailed list of all these graphic elements, not in any particular order.

Figure 1. Small part of the initial comparative underground designs analysis. The whole analysis goes from the beginning of the XX century to the present (2007). These graphic constructions belong to the graphic representation of underground stops and connections used for each of the rail systems analyzed.



3. Data Organization/Elements: In this step, we have carried out a **categorization** of the above-described elements following functional criteria.

As a result of this practical and conceptual analysis we have developed **two main categories**: graphic elements and graphic resources. All elements were grouped according to their function into the specific context of an "urban transport project". In the first category, we have grouped those elements that are considered fundamental to a graphic project (Wilkinson, 1999; Costa, 1990). They are called **Universal Identity Forms (UIF)** of a PP, and there are five: the form, the color, the text, the composition, and the support visual elements (Table 1).

The second category is made up of those elements that give specific characteristics to a project: the **Resources and Uses of Visual Elements (RUVE)** (Table 2).

Tables 1-2. The figure on the left shows a proposal of possible Graphic Identity Elements of the Planimetric System. The figure on the right, a non-categorized proposal of Planimetric Graphic Resources and Uses.

Universal Identity Forms (UIF)
Form
Colour
Text
Composition
Support Elements

Resources and Uses of Visual Elements (RUVE) of Planimetric Systems	
Text-Name Topograpy Place	Specific / General Pictography
Line Typology	Textual Infotmation for Services
Form Typology	Chromatic Uses
Intersection Forms	Line Functions
Geometric / Amorphous Form	Non Scalar Information
Tridimentionality: resource for make evidence	System Directionality

4. Data Relations: Up to this stage, we were analyzing and working with elements. In the next step, we are going to construct relations from the combination of both elements: UIF and RUVE. If we follow the GP concepts explained by Costa, as initial results of the combination of these two categories of elements, we obtain three possible complex categories of relations of a PP:

1 - **Projects Identity References** (PIR)
2 - **Formal Aspects of Use** (FAU)
3 - **Conceptual Aspects of Relations** (CAR)

3.1 Graphic Program (GP)

Without forgetting the essential contributions of the Swiss designer Karl Gerstner[2] (1930-) in his book "Designing programs", we also will use the PP definition of Costa whereby he explains that a GP is a formula that can solve a non-defined problem as well as a complex problem or a different set of interrelated problems. The development of Graphic Programs has made it possible to create a matrix that can be applied for the resolution of the same type of design problems (Costa, 1990: 153). In Costa words, creating a GP is to create a **model of multiple possibilities** for further achievements that is characterized by a number of variations, and the ability to obtain multiple solutions from the same initial structure. Every GP is structured with:

- Simple elements (the body structure)
- A structural pattern, (the invisible architecture behind a message)
- Laws of structure (precise rules that determine the combination of elements)

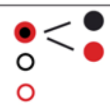
Taking into account this definition of GP and the initial results of our graphical analysis, we can suggest that this research project can be consider the basis of what could be a **Planimetry Graphic Program (PGP)**. **Projects Identity References** (PIR) could be considered as the minimum elements that make up a graphic system, like the bodies of the structure. The **Formal Aspects of Use** (FAU) could be as patterns that help build the structure, and the **Conceptual Aspects of Relations** (CAR) could work as the laws that govern these graphic structure patterns.

3.2 Planimetric Graphic Alphabet (PGA)

It has been demonstrated that a PP is structured by a GP, so the language of a PP it is also a GP. It can be concluded that, as a PL, every language is a GP itself (Table 3).

Table 3. This table shows the elements and relations that construct a graphic program. Although a Text Alphabet and a Planimetric Graphic Alphabet has different intern structures (3rd column), both can be consider as Graphic Programs, because they have similar functions: order and categorized elements for make a better communication.

[2] Karl Gerstner defined the concept of Program as a grid: "A grid is a formal in advance program for some unknown elements". (Gerstner, 1979)

	Elements (● ●)	Relations (● ○ ◉ ○)	Intern Structures
Graphic Program (GP) *definition*	1.a. constant factors 1.b. variable factors	1. Simple elements 2. A structural pattern 3. Laws of structure	
Graphic (abc) Model *graphic program 1*	1. Universal Identity Forms of the Planimetric System (UIF) 2. Visual Resources and Uses of the Planimetry System Elements (VRUE)	1. Projects Identity References (PIR) 2. Formal Aspects of Use (FAU) 3. Conceptual Aspects of Relations (CAR)	
Textual Alphabet (TA) *graphic program 2*	1. vowels 2. consonants	1. syntactic rules 2. grammatic rules 3. semantic rules	

In a complex level of analysis, this research project is based on the theory that a PL could define its own alphabet using hierarchical and conceptual categories of a Textual Alphabet (TA). In other words, the PL has been *metaphorically* called as a Planimetric Graphic Alphabet (PGA). It is important to state clearly that the aim of this project is not to make a direct relation between a TA and a Graphic Alphabet (GA). We are trying to define and systematize rules and combination elements of a PP, that is why we are interested in the parameters that TAs use to order their elements.

As our project is still in process, the following explanation is an approach to an **initial potential conceptual way of analogy between a TA and a GA**. Based on the definition of Aristide Quillet (1880-1955) and Eduardo Valenti Fiol of vowels and consonants as elements that structure alphabets, we aim to demonstrate our initial hypothesis: the existence of a PGA that can help in systematical constructions –like visualization software- of Graphic-Informative Projects (GIP).

3.1.1 Proposal of Graphic Vowels (GV)

In this stage, we are going to give a logical and conceptual order to the graphic elements (elements and resources) that have been defined in ***3. Data Organization/Elements*.** The five elements -the **UIF**- were ordered from a general to a specific function. The first element of this series is the one that has the most general function, while the last of them has the more specific one. Once we have ordered this five items, we can find a metaphorically parallelism between this first series of elements and the elements that Costa defined as ***constant factors*** of a GP, which function as the **fundamental elements of a graphic project**. The elements of a TA that have the same function are the vowels ("direct" emissions of the voice) because they are present in every coherent text construction of a language. They can also be considered as the structure of a word. As it is shown in the table, we have used this order criterion to assign to a vowel name to each of the five UIF.

3.1.2 Proposal of Graphic Consonants (GC)

Finally, we have ordered and categorized the resources - the **RUVE**. In order to make a functional categorization, we have defined specific sub-categories in the initial 12 resources. Once we have developed an order list of resources and uses, we find an analogy between the RUVE and the ones that Costa defines as ***variable factors*** of a GP. Variable factors are those elements that give **specific characteristics to each typology of a graphic system**. The function of variable factors, according to Costa, is to combine and articulate a complex visual system. In a TA, the consonants have this function, which leads to a possible relation between the function of the RUVE and the consonants of a TA.

Each of these resources and uses is given the 'name' of a textual (Spanish) consonant. This 'name' is used to make a logical order of the RUVE, which means that we are not trying to create GC for written texts. The alphabet metaphor is used to **make an order criterion** (Table 4).

Table 4. Order and categorized list of graphic elements and graphic resources-uses of a Planimetric System with a proposal of textual (Spanish) alphabet names.

Resources and Uses of Visual Elements (RUVE) of Planimetric Systems as a proposal of consonants

B	text-name topograpy place	Line Typology
C	continue line	Line Typology
Ç	discontinue line	Line Typology
D	form	Form Typology
F	form	Form Typology
G	form	Form Typology
H	form	Form Typology
J	form	Form Typology
K	intersection forms	
L	geometric forms	

L·L	amorphous forms	
M	tridimentionality: resource for make evidence	
N	specific pictography of transport systems	Pictographic Uses
Ñ	specific pictography of service information	Pictographic Uses
P	textual info for services	Chromatic Uses
Q	identity colour line	Chromatic Uses
R	colour as a topic: service	Chromatic Uses
S	colour as a topic: function	Chromatic Uses
T	straight line connection	Line Functions
V	angular line connection	Line Functions

W	turn line connection	Line Functions
X	topographic line	Line Functions
Y	non scalar information	
Z	system directionality	

Universal Identity Forms (UIF) as a proposal of vowels	
A	Form
E	Colour
I	Text
O	Composition
U	Support Elements

To summarize the described analysis, the main objective of this project has been to find a hierarchical organization that demonstrates –through the parallelism between the text-graphic alphabets governed by the functionality of their signs - ways of structuring and systematizing projectual design process of PL. In other words, the development of a graphic projectual is not arbitrary creation or intuition. This highlights the validity and relevance of a proposal of a systemic graphic projectual development and its functional value.

4. PARTIAL CONCLUSIONS

As the PL is a visual language typology, it has its own codes and signs that determine the structure and behavior of its elements. One of the first results of this research is the membership of these graphic codes and signs with a GP that has been called "Planimetric Graphic Alphabet" (PGA). It is crucial to explain and show the importance of the PGA structure from an existing and functional program, such as the TA. We are analyzing in-depth the order and hierarchical classification of TA signs. We believe that once we learn TA signs' behavior, we will be able to organize and systematize PGA signs. The definition of a possible program of GV and GC would help to reinforce and demonstrate the initial hypothesis of this investigation: the necessity of having a graphic program –the TA- as a model for the creation of a new graphic program – the PGA.

The **forthcoming phases** of this research will be focused on the **final definition** of GA signs, and on the creation of a **Planimetric Grammar (PG) and Syntax (PS).** If we are able to define universal rules of combination of Planimetric elements –a Graphic Structure-, these rules could be used to systematize the construction of graphics. These universal rules or parameters can be used, for example, to develop visualization methods and benefit computational visualization techniques with specialized data visualization software.

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