The relations among the actors and the architectural project in the design process: a rugby match

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In the vast panorama of Computer Assisted Design in Architecture, we are currently researching new IT support tools.
The present article shows how the design process has been conceived, and how it is carried out over time by the different design teams, as well as the computerized representation of the architectural project.
After briefly outlining the contextualization of the problems and a necessary description of our scientific position, we go on to illustrate the complexity of the data involved in the problem by means of an allegory.

***Keywords**: Collaborative Architectural Design; Design Process; Knowledge Engineering; Distributed Knowledge Bases; Polymorphic Object.*

The scientific context

The present paper addresses on-going research on Collaborative Design.

The proposed model, the resulting system and its implementation refer mainly to architectural and building design in the modes and forms in which it is carried on in advanced design offices.

The model, which may actually be used effectively also in other environments, simultaneously simulates:

- structure of the networked architectural design process (operators, activities, phases and resources);
- required knowledge (distributed and functional to the operators and the process phases).

The article focuses on the first aspect of the model: the relationship that exists among the various 'actors' involved (according to the STEP-ISO definition, Wix, 1997) during the various stages of its development (McKinney and Fischer, 1998) and the design process.

Only this aspect of Collaborative Design touches on a number of different problems on which a number of different research teams are working: database structure, homogeneity of the Knowledge Bases and their construction (Galle, 1995), the representation of the IT datum (Carrara et al., 1994; Papamichael et al., 1996; Rosenmann and Gero, 1996; Eastman et al., 1997; Kim, et al., 1997; Gero and Reffat, 2000; Kalay, 2001).

Our scientific approach focusing on support for decision-making and the relationship between 'private' design space (involving the decisions of the individual design team) and the 'shared' design space (involving the decisions of all the design teams) were defined in a previous article (Carrara and Fioravanti, 2002).

The model for representing the building (defined in: Carrara and Fioravanti, 2001), is represented by a structured set of Knowledge Bases, Inference Engines and Databases. It is provided with an effective IT representation of the individual building components which allows: the management of conflicts; the modification of data structure and interface according to the actors interacting with it and the design phase; the definition of a 'dominus' for every IT object (i.e. the decision-maker, according to the specific design phase).

2. Design process models: a historical excursus

The scenario in which the research is situated is that of the preliminary and detailed design phases in architecture.

There are several ways of conceiving of the relations among the various actors in the design process, the process itself and the data involved. In the following several examples are given in the form of a football match using metaphors of different conception.

Indeed also here, just as we have designer, project and process, three elements may be identified: the players, a football, rules. Also here we have an objective, consisting of scoring goals, and it too is not just an objective - a point in the field - but a set of points in the "state space of solutions" which are all equivalent. Likewise, in architecture, we do not speak of a single exact solution but a field of approximate solutions.

The era of the "rule of art".

As a first approximation we can think of the project, the football, as the only one in the game that that is played and is passed among the various actors, and this has an equivalent in the model of the design process which is a serial process, and in the representation of the project (the corresponding IT datum) which is unique (Fig. 1).

There is only one project to which all actors have access one at a time, which is broadly shared in its meanings attributed to it by the various actors, and simple in its representation, so that it is easy to communicate and interpret. The process is neither monotonic nor undirectional and, in the absence of suitable solutions, the project often has to be reapproached.

This is represented in figure 1 as step 1 with the ball being passed back. Further examination is needed, often performed by other actors, which leads to an amended project, before moving forward again towards the global solution. Nevertheless, these iterative processes of project redefinition were not so frequent as they are nowadays.

One typical example is what happened in the Renaissance or in the period in which the quality was related to the 'rule of art'. This type of process requires a homogeneous cultural environment, homogeneity of intentions of a stable group of actors, in a stable society, and a well defined role hierarchy. In such a situation we have elementary graphics and numerical data. If this is related back

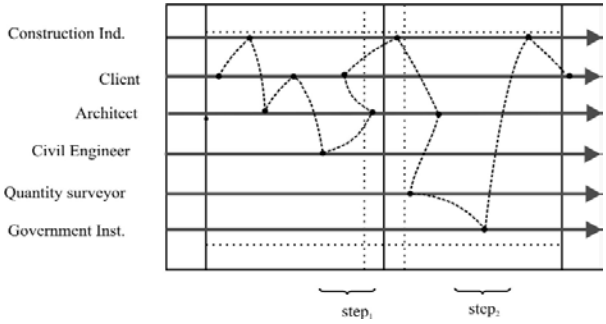

Figure 1. The project is single, actors have "fixed" roles, the process is serial.

to the IT resources were possess, the Uniqueness of datum could be associated with the hierarchical databases.

The Positivist era.

n other periods this metaphor did not fit reality. The advent of industrialization brought with it the specialization of roles, which is always present in each era, but that as the project complexity increases or the number of actors involved grows, it becomes increasingly clear. This led to each actor working on "his own" reproduction of the project, a "specialistic" representation that is a function of his needs as the design process takes place in parallel. Otherwise with a large number of actors the process would take a very long time to complete.

If we were to relate this situation to the allegory we would need a second metaphor: it is as though the players were playing with *more than one football*. The overall information exchanged is greater, but the data exchanged between two actors are the bare minimum; misunderstandings arise among different heterogeneous teams; in data exchange keen attention is paid to the interfaces, which have the task of translating the data from one representation to another on a one-to-one basis; there is a fragmentation of knowledge typical of the cultural scientific environment, actors have a pyramidal hierarchy, for instance the organization of the work on the Eiffel Tower.

This approach was born during the Enlightenment and became established in the Nineteenth Century with Positivism. From the point of view of IT representation, this approach corresponds to: a large quantity of "passive" data exchanged; some difficulty in managing and controlling data change; one or more Relational Databases.

The era of Relativity.

In more recent times, with growing complexity, we are forced to give up also this second metaphor, the single football or large numbers of footballs are replaced by a kind of probabilistic cloud, as the actors are working on partial representations of the project, with the possibility of different interactions depending on their role, but in any case they affect the development of the project even when they appear to be less present in the decisions; even when the players are playing without a ball, they nevertheless influence the choices made (Fig. 2).

In this case the design process is comparatively undefined, sometimes serial and parallel, account must be taken of a multitude of actors who are not always present and of the links between teams that are difficult to detect and code. This is the phase of building design and its process that has just concluded. We have heterogeneous data, representations of often incompatible models; the hierarchical structure of the actors is quasi horizontal. The data require frequent updating of their classification and properties: the most compatible database is the Object Oriented type. Period of Relativity in Physics and the Human Sciences.

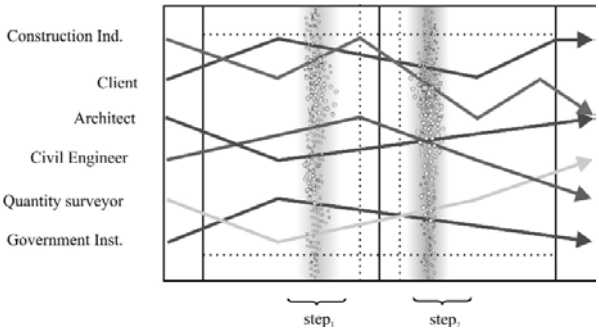

Figure 2. The project is a "probabilistic cloud", actors may exchange roles, the process is parallel.

The contemporary era.

Today we are witnessing a further development of the design process: it is simultaneously serial and parallel, the actors often change their roles and the project is constantly developing and at the same time in each stage of the design it is already finished. The data thus possess default values, as though they were at the "rule of art" era, values computed as though they were at the age of the hegemony of calculation, 'situated' values as though they were at the age of the late 20th century, we could define them as creative values, as it were, deriving from the new procedures and technologies produced by the unceasing process of innovation, optimization and technological transfer among all the sectors. The oval is unique, plural, probabilistic, creative.

In this case the group of actors is cohesive, fully behind the undertaking, dishomogeneous as regards culture, there is a frequent aggregation and breaking up of groups of actors linked to the individual project.

A suitable representation of this environment is provided by Knowledge Bases, with which an IT datum must be associated, or rather a polymorphic and plurisemantic IT object: the object is both unique and plural.

As though our metaphor football, although unique, was perceived as different by the various players, just as the atom may be defined by means of corpuscular theory and undulatory theory at the same time. An IT datum thus has many instances at the same time, not just multiple parent-objects. All the actors manipulate the unique plural object with different decision-making and control capacity, which varies also according to the design phase in which they are operating (Carrara and Fioravanti, 2002).

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